BOOK OF ABSTRACTS

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Acharya, P. N., University of Tromsø, Tromsø, Norway, ole.n.aarbakke@uit.no
Nørbin, F., University of Tromsø, Tromsø, Norway

PHYLOGENETIC RELATIONSHIPS BETWEEN TWO KNOWN AND ONE RECENTLY DISCOVERED POPULATION OF PSEUDOCALANUS MOUTONI
Copepods of the genus Pseudocalanus are very abundant and present in all marine environments throughout the northern hemisphere where they constitute an important link between primary production and higher trophic levels. Due to their cryptic nature and co-occurrence with one or several sibling species, species level identification of Pseudocalanus species is time consuming and difficult. Consequently, knowledge of species specific differences in habitat, life history and environmental preferences within this genus is scarce. Through barcoding Pseudocalanus moultoni (Frost 1989), which is considered native to Puget Sound and the Gulf of Maine, was recently found in samples collected in Svarthard and North Norwegian fjords. Through sequencing of mitochondrial genes in individuals of P. moultoni from the Gulf of Maine, Puget Sound and the newly discovered East Atlantic populations, we present phylogenetic relationships between the three and suggest the origin of the Norwegian and Svarthard populations.

Abuzenine, A. A., Texas State University, San Marcos, USA, aa1290@txstate.edu
Nowlin, W. H., Texas State University, San Marcos, USA, wnowlin@txstate.edu
Smith, A., Texas State University, San Marcos, USA
Bonner, T. H., Texas State University, San Marcos, USA, tbunner@txstate.edu

ORGANIC MATTER SOURCES SUPPORTING COMMUNITIES OF AN ARID RIVERINE SYSTEM: THE LOWER RIO GRANDE DRAINAGE
Determining sources of organic matter (OM) to aquatic communities has been a central focus of aquatic ecology. In riverine ecosystems, spatial resource subsidies can occur among habitats within a river and between riverine and terrestrial ecosystems. This study examines OM sources in an arid river ecosystem, the Rio Grande/Rio Bravo del Norte (Texas). Fish, periphyton, and invertebrates were collected from 6 main stem and 6 tributary sites and analyzed for stable isotopes of nitrogen (N) and carbon (C). We utilized Bayesian mixing models (SIAR) to determine the percent contribution of C sources to consumers in food webs. Results show that C sources in mainstem and tributary sites may be driven by higher turbidity in the central focus of aquatic ecology. In riverine ecosystems, spatial resource subsidies can occur among habitats within a river and between riverine and terrestrial ecosystems.
systems. Coral reefs are particularly vulnerable to disturbances and may undergo phase shifts to algae-dominated states following significant loss of coral. Reefs on Moorea, French Polynesia have experienced repeated disturbances over the past three decades including multiple cyclones, Acanthaster outbreaks, and bleaching events. They have recovered from these disturbances with coral cover returning to pre-disturbance levels over decadal time scales. The most recent series of disturbances, an Acanthaster outbreak (2007-2009) followed by a cyclone (2010), together resulted in loss of most coral cover on large portions of the outer reefs while having little impact on lagoon reefs. The dramatic loss of coral on outer reefs was followed by large increases in herbivorous fish and only a modest increase in algae, suggesting the rapid population response of herbivores prevented a phase shift to an algae-dominated state. This response was facilitated by the presence of lagoon reef nursery habitat for herbivorous fishes, underscoring the importance of habitat diversity for reef resilience.

Adams, A. T., University of Michigan - Cooperative Institute for Limnology and Ecosystems Research, Ann Arbor, USA, adamack@umich.edu
Clouse, M. A., Old Dominion University - Earth and Atmospheric Sciences, Norfolk, USA, melissacrouse@hotmail.com
Ludsin, S. A., Ohio State University - Aquatic Ecology Laboratory, Columbus, USA, ludsin.1@osu.edu
Mason, D. M., NOAA - Great Lakes Environmental Research Laboratory, Ann Arbor, USA, doran.mason@noaa.gov
Brandt, S. B., Oregon State University - Oregon Sea Grant Program, Corvallis, USA
Zhang, H., University of Michigan - Cooperative Institute for Limnology and Ecosystems Research, Ann Arbor, USA, zhanghy@umich.edu

EFFECTS OF HYPOXIA ON FISH DIETS IN THE NORTHERN GULF OF MEXICO

Extensive hypoxic areas form each summer in the northern Gulf of Mexico. To assess hypoxia’s impact on trophic interactions in the northern Gulf, we sampled fish inside and outside of hypoxic areas during late-July and early August in 2006, 2007, and 2008. Fish were collected using bottom and midwater trawls with CTD casts being made before each trawl to determine temperature, DO, salinity, and depth. 5,100 fish diets from 73 species were examined. Non-metric multidimensional scaling analysis was conducted on individuals with non-empty stomachs and species with n > 15 individuals with non-empty stomach, and was used to identify general patterns in diets in relation to biotic and abiotic factors, including hypoxia. Diets of individuals within a species were generally more similar within than among species. Within species, individual diet differences were primarily influenced by fish size and then by DO. Additional work will be done to determine whether the effects of DO increase or decrease individual consumption rates, and will attempt to resolve the mechanism for these effects.

Adams, H. E., Montana State University, Bozeman, USA, hea@montana.edu
Priscu, J. C., Montana State University, Bozeman, USA, jpriscu@montana.edu

BACTERIAL ACTIVITY IN METHANE-RICH, ICY HABITATS

Thermokarst lakes near Barrow, Alaska were sampled during late season ice cover (April) to assess their role of geogenic methane on microbial metabolism. Ten sites in nine lakes were selected which varied in physical and chemical characteristics. Dissolved methane in the liquid water column varied by four orders of magnitude (0.02 to 1682 µM). Dissolved organic carbon (DOC) also varied in concentration among the lakes but DOC fluorescence excitation-emission matrices indicated that the carbon is of similar quality. Rates of methane oxidation were not dependent on methane concentration, suggesting that dissolved methane was at saturation levels. C:N molar ratios of DOC to TDN ranged from 6.9 to 14.8; the highest ratios occurred in the lakes with the highest methane concentrations. Q10 values for leucine uptake between 1 and 25 °C ranged from 1.5 to 1.9, less than those reported in the summer for other lakes on the North Slope of Alaska. Our results indicate that geogenic methane in the Barrow lakes can be rapidly oxidized beneath the ice season cover by bacteria that are adapted to cold temperatures.

Adeniyi, A. A., University of Windsor, Windsor, Canada, adeniyi@uwindsor.ca
Bailey, S. A., Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, Canada, Sarah.Bailey@DFO-mpo.gc.ca
Maclsaac, H. J., University of Windsor, Windsor, Canada, hughm@uwindsor.ca

DOMESTIC VESSELS AS A POTENTIAL PATHWAY OF NONINDIGENOUS SPECIES IN THE GREAT LAKES – ST. LAWRENCE RIVER

Transoceanic ballast water is recognized globally as a dominant dispersal vector for nonindigenous species (NIS) while domestic ballast is generally considered to be lower risk. The Great Lakes receives approximately equal amounts of foreign and domestic (St. Lawrence River-SLR) ballast. The SLR could donate NIS to the Great Lakes if native SLR taxa are NIS to Great Lakes ports, or if NIS established at SLR ports are not in the Great Lakes. Because all discharged transoceanic ballast must be managed by ballast water exchange while domestic discharges are unmanaged, the relative importance of SLR ballast as a dispersal vector may have increased. We assess the invasion risk of SLR ballast to the Great Lakes by examining invertebrate community similarity between source and recipient ports. We conducted biological surveys at 16 SLR ports and sampled ballast water of over 25 transits originating from these ports. Sample analysis is underway; to date, 1 NIS (Microsetella norvegica) found in samples has not been reported from the Great Lakes. Species level identifications will inform future risk assessments that elucidate potential vs. effective propagule pressure.

Adjou, M., Center for Macroecology, Evolution and Climate, University of Copenha
gen, Copenhagen, Denmark, Madouj@bio.ku.dk
Bendtsen, J., VitusLab, Symion Science Park, Copenhagen, Denmark, jb@vituslab.dk
Richardson, K., Center for Macroecology, Evolution and Climate, University of Copenhagen, Copenhagen, Denmark, KARl@science.ku.dk

MODELLING THE INFLUENCE FROM OCEAN TRANSPORT, MIXING AND GRAZING PRESSURE ON PHYTOPLANKTON DIVERSITY

We have developed a simple model for analyzing the potential impact of transport by ocean currents and turbulent mixing, nutrient input into the euphotic zone and grazing pressure on phytoplankton diversity. Phytoplankton species are defined by their growth kinetics within 5 functional groups; cyanobacteria, cocolithophorids, diatoms, green algae and dinoflagellates. Mortality is determined from selective grazing pressure. The model sensitivity was analyzed in relation to changes in nutrient input and physical transports of biomasses and related to realistic values of new production and ocean currents, respectively. We show that phytoplankton diversity is sensitive to selective grazing. Model solutions imply that low nutrient inputs (oligo-trophic conditions) are associated with relatively low diversity, and, correspondingly, relatively high nutrient inputs (mesotrophic – eutrophic conditions) are characterized by a relatively high diversity. The results of the model are in general accordance with observed patterns of global phytoplankton diversity. In a sensitivity study, we show that contributions of phytoplankton biomasses from relatively small physical transports by ocean currents or turbulent mixing increase diversity in the model significantly. These model results suggest a significant influence from ocean transports and mixing on phytoplankton diversity implying a higher diversity in dynamic areas.

Adu, T., Department Of Chemistry, University of Otago, Dunedin, New Zealand, tadu@chemistry.otago.ac.nz
Frew, R. D., Department Of Chemistry, University of Otago, Dunedin, New Zealand, rfrew@chemistry.otago.ac.nz
Hunter, K. A., Department of Chemistry, University of Otago, Dunedin, New Zealand, khunter@chemistry.otago.ac.nz

INFLUENCE OF BIOACTIVE TRACE METALS ON CADMIUM/PHOSPHATE RATIO AND PRIMARY PRODUCTIVITY IN WATER MASSES AROUND SUBTROPICAL FRONT, SOUTHEAST NEW ZEALAND

Primary productivity within the ocean plays a key role in determining atmospheric CO2 levels and hence climate conditions. Proper understanding of the relationship between Cd and PO4 in the modern ocean is imperative for reconstruction of past oceanic phosphate concentrations using the Cd Paleo–nutrient proxy. This article focus on a field based explanation for the seasonal variation in Cd/PO4 ratio and estimates the partitioning of Cd between surface seawater and particulate matter in water masses around the Subtropical Front, Southeast of NZ. Current measurements have shown that dissolved Zn is very low in these waters (< 0.15 nmol kg-1 and hence, may limit productivity). We believe the drawdown in dissolved Cd observed in summer is as a result of seasonal input of dissolved Fe that triggers productivity especially for microplanktons which may have over the years adapted to the use of Cd in place of Zn.

Afonso Souza, C., The University of Texas at Austin, Port Aransas, USA, souzaj@utexas.edu
Wayne Gardner, S., The University of Texas at Austin, Port Aransas, USA
Tamar Pease, K., University of Texas at Brownsvill, Brownsville, USA
activity was monitored in controlled sediment slurries containing casein and tannic acid - an enzyme inhibitor - in sediment samples from Aransas Bay, TX. Casein additions increased NH₄⁺ concentration from 19 ± 0.3 µM to 120±, a final concentration of 4.3 fold; M to 737 ± 150 µM and 150 µM higher than that of control samples and 2.9 fold higher than that of samples with casein and tannic added together. The lower NH₄⁺ concentration in samples with tannic acid showed that the inhibition of aminopeptidase caused a reduction in NH₄⁺ production rates. Linear relationships showed that NH₄⁺ concentration was directly proportional to aminopeptidase activity in controls (r = 0.80, P < 0.01) and controls (r = 0.97, P < 0.01) over the first 72 hours. The results provide insights about the mechanisms of enzyme hydrolysis to nitrogen fluxes in estuarine sediments.

AGUADO-GIMÉNEZ, F., IMIDA, SAN PEDRO DEL PINATAR, Spain, felipe. aguado@car.es
PIEDECAUSA, M. A., IMIDA, SAN PEDRO DEL PINATAR, Spain, susi.piedecausa@gmail.com

SPANNER, E., Recanati Institute of Maritime Studies. University of Haifa, HAIFA, Israel, spanner@research.haifa.ac.il
ANGEL, D. L., Recanati Institute of Maritime Studies. University of Haifa, HAIFA, Israel, adriano@research.haifa.ac.il

MARINE CAGE AQUACULTURE AND ARTIFICIAL REEFs: EXPERIENCES IN ISRAEL, AND SPAIN

It has been amply shown that marine net cage fish farms alter the benthic habitat beneath them, strongly reducing the natural biological diversity. One strategy to counter this impact involves an increase in structural habitat complexity in the vicinity of the cage farms to enhance the reuse and exploitation of farm derived wastes. This mitigation measure (deploying artificial reefs) has been tested in the Red Sea (Israel) and in the Mediterranean sea (Spain) by deploying artificial structures on the seafloor and monitoring the communities that developed therein. In both locations there was not a clear improvement of sediment quality around the artificial reefs, even one year after their deployment. However, the reefs lead to a remarkable aggregation of natural macrobenthic organisms and ichthyofauna. The benthos in the artificial structures retained fish farm derived wastes, albeit at low efficiency but contributed toward increased habitat complexity, biodiversity and trophic interactions among the biota. Application of artificial reef technology to marine fishnet cage aquaculture could provide additional beneficial outlets, such as recreational (diving) and commercial (fish and invertebrate nurseries) purposes.

Agular C., University of Wisconsin Milwaukee Center for Great Lakes Studies, Milwaukee, USA, agular@uw.edu
Cuhel, R. L., University of Wisconsin Milwaukee Center for Great Lakes Studies, Milwaukee, USA, rculhel@uw.edu

ALTERNATING YEARS OF UNICELLULAR CYANOBACTERIA DOMINANCE BETWEEN EPISODIC CLIMATE EVENTS IN LAKE MICHIGAN

The invasive quagga mussel (QM) has had a profound influence on Lake Michigan’s biogeochemistry, exemplified by severely damped seasonal cycling of silicate indicating a basin-wide reduction of diatom production. Concurrently unicellular cyanobacteria became dominant in deep chlorophyll maximum zones (DCM) both numerically and as chlorophyll biomass. Phytoplankton communities in Lake Michigan shifted from diatom and large cell dominated to small cell picocyanobacteria dominated phytoplankton. QM were first observed in 2002 and have taken advantage of bathymetry-induced circulation to scour larger phytoplankton from the water column, establishing communities reaching 40,000 m³/m³ or higher. In the DCM, Synechococcus reached populations of 210,000 cells/ml. DCM chlorophyll a remained similar (3-4 µg/l) but late summer species composition changed dramatically to mostly <2µm cells. After the June 2008 Midwest floods, river discharge to Lake Michigan was 30X normal for nearly a month. The depth of 1% PAR shifted upwards by 10m, providing less radiance to the DCM. Chlorophyll a concentrations increased several-fold in surface waters during a rare resurgence of diatom biomass. Synechococcus populations in the DCM were only 25% of the previous years.

Agular C., University of Wisconsin Milwaukee Center for Great Lakes Studies, Milwaukee, USA, agular@uw.edu
Cuhel, R. L., University of Wisconsin Milwaukee Center for Great Lakes Studies, Milwaukee, USA, rculhel@uw.edu

SCIENTIST-TEACHERS AND TEACHER-SCIENTISTS: TRANSMITTING THE THRILL OF DISCOVERY THROUGH HANDS-ON HYPOTHESIS-TESTING EXPERIENTIAL RESEARCH: A COSEE SUPPLEMENT

Our hands-on, hypothesis-testing programs bring scientists and educators together on Lake Michigan. Teacher Aquanauts begin a week of immersion activity with discussion about physical, chemical, geological, optical, and biological processes in freshwater systems followed by a research-based half-day cruise on Lake Michigan. The educators themselves use the equipment required for sampling to test their hypotheses. Laboratory sample processing the next day is sufficient to test the biological and chemical concepts, with ensuing discussion of regional and national standards addressed. A more detailed full-day cruise on the third day expands to sampling a local shipwreck habitat or offshore depth gradients, including directed use of Remotely Operated Vehicle slurp gun collections. Laboratory analysis of the new samples is accompanied by benchtop demonstration activities related to the hypotheses and suitable for classroom use. On the last day, summaries, evaluations, and resource availability discussions are lively. The scientists are side-by-side with the Teacher Aquanauts 8-10 hours a day for the whole week. Recently, lab-to-classroom telepresence has been a school-year enhancement, and ship-to-classroom telepresence will occur soon. Independent formal evaluations have been positive.

Agusti, S., Instituto Mediterráneo de Estudios Avanzados (IMEDEA), CSIC-UIB, Esporles, Spain, sagusti@imedea.uib-csic.es
Regaudie-de-Gioux, A.
Arrieta, J. M., IMEDEA(UIB-CSIC), Esporles, Spain, txetxu@imedea.uib-csic.es
Duarte, C. M., Instituto Mediterráneo de Estudios Avanzados (IMEDEA), CSIC-UIB, Esporles, Spain, carloduarte@imedea.uib-csic.es

EFFECTS OF UV RADIATION ON THE NET METABOLISM OF PELAGIC COMMUNITIES

Changes in the ocean as a consequence of climate warming will occur under a scenario of multiple stresses for organisms, since present global change is including increased intensity of other vectors. Surface pelagic communities in the ocean are exposed now and will be exposed to increased ultraviolet radiation levels for decades, since the recovery of the ozone layer, expected to occur around 2050, is now under revision. A scenario of increased ocean's stratification due to increased warming may imply an overexposure to UVR of pelagic communities. However, we still lack much information on the effects of UVR for the oceanic ecosystems. For example, incubations for the measurement of plankton community metabolism are usually performed using glass winker bottles that may eliminate the UVB and UVA bands of the solar radiation, and, since natural communities are exposed to the full spectra of solar radiation, we could not evaluate properly the effect of UVR on the net metabolism of pelagic communities.

Ahmadia, N., Texas A&M University - Corpus Christi, Corpus Christi, USA, Gabriella.Ahmadia@tamucc.edu

RESPONSE OF CRYPTOBENTHIC FISH COMMUNITY STRUCTURE TO A DECLINE IN REEF HABITAT QUALITY IN THE WAKATOBI MARINE NATIONAL PARK, INDONESIA

Cryptobenthic fishes occur in high densities on coral reefs, though due to their small size and cryptic nature they are often overlooked when quantifying reef biodiversity. This study examines their distribution on shallow reefs in a region within the Coral Triangle and assesses their response to habitat degradation. Cryptic fishes were observed on intact microhabitat types (hard coral, rubble/sand, soft coral) within healthy and degraded reefs. Traditional metrics showed few differences between healthy and degraded reefs. Cryptic fishes were observed on intact microhabitat types (hard coral, rubble/sand, soft coral) within healthy and degraded reefs. Traditional metrics showed few differences between healthy and degraded reefs, though further investigations revealed differences occurred in community composition. Additional analyses of individual species demonstrated that reef degradation can have positive or negative effects on populations depending on type and strength of habitat associations. In summary, larger spatial scale factors associated with the decline of reefs are altering habitat use of cryptic fishes on a much smaller microhabitat scale and will likely have repercussions on overall coral reef dynamics.

Ahmed, S., Optical Remote Sensing Laboratory, City College, New York, USA, ahmed@ccny.cuny.edu
Tonizzo, A., Optical Remote Sensing Laboratory, City College, New York, USA, tonizzo@ccny.cuny.edu
Ibrahim, A., Optical Remote Sensing Laboratory, City College, New York, USA, ibrahim@ccny.cuny.edu
Gilerson, A., Optical Remote Sensing Laboratory, City College, New York, USA, Gilerson@ccny.cuny.edu
Gross, B., Optical Remote Sensing Laboratory, City College, New York, USA, Gross@ccny.cuny.edu
Moshary, F., Optical Remote Sensing Laboratory, City College, New York, USA, moshary@gc.cuny.edu

ALGAL FLUORESCENCE: ANALYSIS OF ITS IMPACT AND POTENTIAL FOR RETRIEVAL FROM FIELD MEASUREMENTS AND SIMULATIONS OF THE UNDERWATER POLARIZED LIGHT FIELD

The impact of the unpolarized nature of sunlight induced Chlorophyll a fluorescence on the underwater hyperspectral polarized underwater light field, and the potential for its retrieval was examined by us in several cruise campaigns in primarily eutrophic waters with Chlorophyll a concentrations of up to approximately 57 µg/L. The measurements, in the Chesapeake/Virginia area and New York Harbor/Hudson River areas were carried out using our recently developed multivariate, hyperspectral Stokes Vector polarimeter, complemented by comprehensive hyperspectral measurements of IOPs, obtained using a WETLabs AC – s. The measured degree of polarization (DOP) of the total underwater radiance, containing both the unpolarized fluorescence and partially polarized elastic particulate scattering, which shows a dip of DOP in the 650-700 nm fluorescence spectral region, is then compared with adding – doubling polarized radiative transfer simulations of elastic scattering reflectance using measured IOPs as input, and which therefore do not include fluorescence in the total radiance. Analyses of the comparisons permit separation of the impact of fluorescence component on total radiance, and potential for estimating its magnitude.

Alexandra S. Marcano Rivas, A. M., Institute for Tropical Ecosystem Studies, University of Puerto Rico, San Juan, Puerto Rico, alexsteephy@gmail.com

Jorge R. Ortiz Zayas, J. O., Institute for Tropical Ecosystem Studies, University of Puerto Rico, San Juan, Puerto Rico, jorgeortz_ties@yahoo.com

THE QUALITY OF DISSOLVED ORGANIC CARBON ALONG A TROPICAL URBAN GRADIENT

Dissolved organic carbon (DOC) is considered the most important source of energy of river ecosystems, including tropical rivers. We hypothesized that the quality or the biodegradability of the organic matter that is imported to the river is determined by its source either natural or of anthropogenic origin. This research investigates the quantity and quality of DOC along an altitudinal and land use gradients in a tropical setting. We predict that rivers located in the upper forested regions of the watersheds will have more labile DOC, which diminish through the altitudinal gradient. Because headwater sections are closer to the source of production of organic matter, presumably forest litterfall, the DOC present in the water will be more labile. The study sites of the investigation are located in Northeastern Puerto Rico: Río Mameyes, Río Canovanas, and Río Piedras watersheds. Each watershed differs in terms of land use and human influences. We conducted synoptic samplings in each watershed and analyzed samples for TOC, DOC, SUVA, and BODs. A land use analysis was done to determine the potential sources of the organic matter. The data collected suggest that BODs and DOC increase downstream in all three watersheds. In the SUVA analysis, the sampled rivers did not show a significant difference through the longitudinal gradient. The land use analysis showed that the sources of organic matter differ in every watershed, depending in the level of urbanization.

Alexandrindis, K., Center for Marine and Environmental Studies (CMES), University of the Virgin Islands, St. Thomas, VI, USA, kalexan@uvi.edu

DeFreitas, D., Australian National Centre for Ocean Resources & Security, University of Wollongong, QLD, Australia

PERCEPTIONS AND FALLACIES IN SPATIAL PLANNING & DECISION-MAKING: INTEGRATING ENVIRONMENTAL, SOCIAL AND ECONOMIC REALITIES TO MARINE ECOSYSTEM-BASED MANAGEMENT

This paper will address how the multiplicity of perceptions, different ranges of attitudes, expectations, and aspirations from diverse community and stakeholder groups, as well as key fallacies, misconceptions and paradoxes that found their way decision making (and decision-makers) are critically affecting our ability to address marine and spatial planning challenges. They also prevent us from generating opportunities for a new and integrated ecosystem-based approach to addressing the complexity of interactions across spatial, social, and temporal scales. We will use a case study in the Great Barrier Reef in Australia’s North Queensland’s coast to look at community and stakeholder (fisher’s) perceptions towards marine conservation zones and planning efficiency in general. We will demonstrate how perceptions of adequate consultation are as likely to affect community and stakeholder adoption of marine spatial planning protected zones, than other important conservation or environmental factors, across a range of spatially explicit zones. We will finally provide a set of inferences and recommendations for directions and challenges in promoting a decision-theoretic, ecosystem-based, coupled systems approach to marine and spatial planning/decision-making.

Allen, Ph.D., R. J., NOAA Gulf Coast Services Center, Stennis Space Center, USA, becky.allen@noaa.gov

Carollo, Ph.D., C., Florida Institute of Oceanography, St Petersburg, USA, cristina.carollo@myfwc.com

Sutter, F. C., NOAA, National Marine Fisheries Service, St Petersburg, USA, buck.sutter@noaa.gov

ECOSYSTEM ASSESSMENT ACTIVITIES IN THE GULF OF MEXICO: INTEGRATING SCIENCE WITH MANAGEMENT NEEDS

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act called on the Secretary of Commerce to complete a study assessing the state of science to integrate ecosystem considerations into fisheries management. In response, the National Oceanic and Atmospheric Administration (NOAA) devised a strategy to support this mandate and the NOAA vision to ‘protect, restore, and manage the use of coastal, ocean, and Great Lakes resources through an ecosystem approach to management’ which initiated the implementation of regional Integrated Ecosystem Assessments (IEA). NOAA defines an IEA as ‘A synthesis and quantitative analysis of information … in relation to specified ecosystem management objectives.’ In parallel with the NOAA efforts, the Gulf of Mexico (GOM) Alliance Ecosystem Integration and Assessment Team has begun assessing data needs and gaps and will be developing recommendations to fill these gaps. NOAA staff and the Alliance team are working together to further implement an IEA in the GOM. This presentation will discuss how researchers will begin assessing the overall health of the GOM and how resource managers will utilize the outcomes to identify regional priorities for conservation.

Allen, A. E., I. Craig Venter Institute, San Diego, USA, aaallen@jcvii.org

Badger, J. H., I. Craig Venter Institute, San Diego, USA, jbadger@jcvii.org

Brussaard, C. P., Royal Netherlands Institute for Sea Research, Texel, Netherlands, corina.brussaard@nioz.nl

Hopkinson, B., University of Georgia, Athens, USA, bhopkin@uga.edu

Frischer, M. E., Skidaway Institute of Oceanography, Savannah, USA, Marc. Frischer@sko.usg.edu

Verity, P. G., Skidaway Institute of Oceanography, Savannah, USA

COMPARATIVE GENOMICS OF PHEOCONFYOSIS GLOBOSEA TRANSCRIPT PROFILES DURING VIRAL INFECTION, COLONY FORMATION, AND OTHER DEFINED CONDITIONS

Although I did not work on Phaeocystis with Peter during my time with him as a PhD student, his passion for Phaeocystis research was infectious. Peter’s enthusiasm and interest in Phaeocystis was something that I never forgot and many years after leaving his lab it was the major motivating factor behind initiation of Phaeocystis genome and transcript sequencing projects. The chlorophyll-c containing haptothyal algal genus Phaeocystis, found world-wide from the Arctic to the Antarctic, is a major player in the ecology and biogeochocsm of pelagic environments. In concert with an ongoing whole genome sequencing project, we have performed a variety of transcript sequencing (i.e., global gene expression) experiments under various conditions. Conditions include colony formation, viral infection, CO2 enrichment and limitation, and nitrogen limitation. Results from infecting P. globosa with a nucleocytoplasmic large DNA virus (NCLDV) indicate significant up regulation (compared to control) of light harvesting proteins in the early stages of infection as well other dramatic shifts in patterns of global gene expression. Transcript profiles have been comparatively analyzed between conditions and in relation to other phytoplankton and bacteria.

Allen, J. T., National Oceanography Centre, Southampton, United Kingdom, jta@noc.soton.ac.uk

Martin, A. P., National Oceanography Centre, Southampton, United Kingdom, apm1@noc.soton.ac.uk

BAROCLINIC INSTABILITY: THE PHYSICAL TRANSPORT ROUTE THROUGH STRATIFICATION

Baroclinic instability is the open ocean mechanism through which available potential energy is released. It can be broken down into quasi-geostrophic flow along sloping density surfaces at the mesoscale, ageostrophic filamentary flow at the sub-mesoscale, and turbulent diapycnal mixing transforming water masses and re-stratifying the water column. All these components and thus baroclinic instability as a whole can be viewed as a mechanism responsible for transporting biogeochemical material vertically through the oceanic stratification. High resolution modelling studies have indicated that dynamic small scale flows associated with oceanic fronts and eddies are a dominant component of this mechanism for the observed patchiness of marine algae (phytoplankton) blooms. High resolution observations have shown that sub-
mesoscale flows (~5-20 km scale) may provide both the fertilisation mechanism for nutrient depleted surface waters and a subduction mechanism for the rapid export of phytoplankton biomass to the deep ocean. We present multidisciplinary analyses of the data from examples of these studies in which we have the first direct observations of the sub-mesoscale transport of phytoplankton and nutrients. These data confirm this transport is constrained by the requirement to conserve angular momentum, expressed in a stratified water column as the conservation of potential vorticity.

Aller, R. C., Stony Brook University/School of Marine and Atmospheric Sciences, Stony Brook, NY, USA, aller@notes.cc.sunysb.edu

Chistoserdov, A. Y., University of Louisiana at Lafayette/Department of Biology, Lafayette, LA, USA, acy6160@louisiana.edu

Kemp, P. E., University of Hawaii/C-MORE, School of Ocean and Earth Science, Honolulu, HI, USA, paul.kemp@hawaii.edu

HIGH BACTERIAL PHYLOGENETIC DIVERSITY AND FUNCTIONAL REDUNDANCY ALLOW FLUIDIZED MUDS TO OPERATE AS EFFICIENT BIOGEOCHEMICAL REACTORS

Fluidized and reworked muds dominated by microbes characterize energetic coastlines downdrift of tropical rivers like the Amazon. These sedimentary systems are temporally rather than spatially structured, with repeated cycling of redox conditions and inshore mangrove-rooted deposits. High bacterial phylogenetic diversity revealed through pyrotag sequencing, facilitates differential responses to perturbations thereby reducing temporal variability in ecosystem biogeochemical functions with parallel processing of available substrates and physiological redundancy. The result is optimized metabolic efficiency which promotes continual oxidation of virtually all refractory and labile organic material of terrestrial or marine origin.

Aller, J. Y., Stony Brook University/School of Marine and Atmospheric Sciences, Stony Brook, NY, USA, raller@notes.cc.sunysb.edu

BIOMICN STRUCTURE AND REDOX REACTION COUPLING IN SEDIMENTARY DEPOSITS

How do the spatial and temporal properties of biogenic sedimentary structures relate to biogeochemical functioning of the soft seabed, the adaptations of benthic communities, and the preserved properties of deposits? The developments of specific wavelength LEDs, planar sensors, digital imaging, molecular biological techniques, and numerical models provide unprecedented opportunities to quantitatively address such questions. Imaging optical sensors are now available to reveal high resolution, time dependent 2 and 3-D patterns of selected biogeochemically important solutes including O2, pH, pCO2, H2S, and Fe2+, and exoenzyme activities. These measurements can be combined with traditional radiographic and visual imaging to provide a basis for mechanistic transport – reaction models. One example, developed here, is the relation between time-dependent redox reaction geometry and S cycling in bioturbated deposits. Isotopic patterns of reduced S in particular are highly sensitive to coupling between oxic and anoxic zones having scalings typical of biogenic microenvironments.

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Allison, M. D., Woods Hole Oceanographic Institution, Woods Hole, USA, malison@whoi.edu

Chandler, C. L., Woods Hole Oceanographic Institution, Woods Hole, USA, cchandler@whoi.edu

Groman, R. C., Woods Hole Oceanographic Institution, Woods Hole, USA, rgoogle@whoi.edu

Wiebe, P. H., Woods Hole Oceanographic Institution, Woods Hole, USA, pweibe@whoi.edu

Gieg, S. R., Woods Hole Oceanographic Institution, Woods Hole, USA, srgieg@whoi.edu

Glover, D. M., Woods Hole Oceanographic Institution, Woods Hole, USA, dglover@whoi.edu

MANAGEMENT OF PLANKTON DISTRIBUTION AND ABUNDANCE DATA

Plankton distribution, abundance, and rate process data have been collected systematically since the Challenger Expedition, but unfortunately these and many other kinds of data have been lost. This fact highlights the importance of managing the ecological, biogeochemical and physical data we have in hand now or will be collecting in the future and making them easily discoverable, accessible, and re-usable. To facilitate this, in 2006 the US National Science Foundation funded the Biological and Chemical Oceanography Data Management Office (BCO-DMO) to serve the data management requirements of investigators funded by the NSF's Biological and Chemical Oceanography Sections. BCO-DMO staff members collaborate closely with investigators ensuring that data are documented, stored, disseminated, and protected long after the research is completed. Highlighting global plankton distribution data and the availability of concurrent environmental data, we describe the capabilities of the BCO-DMO data management system including geospatial and temporal data discovery and access systems; recent enhancements to data search tools; data export and download utilities; and strategic use of controlled vocabularies to facilitate data integration and improve interoperability.

Allison Faver, A. M., The Institute for Broadening Participation, Damariscotta, USA, aflaver@ibparticipation.org

Ashanti Johnson, , The Institute for Broadening Participation, Damariscotta, USA, apyttle@ibparticipation.org

Sandra Thomas, , The Institute for Broadening Participation, Damariscotta, USA, sthomas@ibparticipation.org

Susie Valaitis, , The Institute for Broadening Participation, Damariscotta, USA, svalaitis@ibparticipation.org

Liv Dietrick, , The Institute for Broadening Participation, Damariscotta, USA, ldetrick@ibparticipation.org

Dana Saywell, , The Institute for Broadening Participation, Damariscotta, USA, dsaywell@ibparticipation.org

PATHWAYS TO OCEAN SCIENCES: BUILDING PARTNERSHIPS TO SUPPORT DIVERSITY IN THE OCEAN SCIENCES REU COMMUNITY

In agreement with the US Commission on Ocean Policy's stance that, beyond the matter of equity, "human diversity has the power to enrich and invigorate the ocean community with a range of perspectives critical to the overall capabilities of the ocean workforce" (2004), the Pathways to Ocean Science initiative seeks to make careers in ocean sciences more accessible and attainable for underrepresented students. The initiative focuses on fostering interaction among REU programs to promote the sharing and adoption of successful recruitment strategies; outreach to potential participants about Ocean Sciences REU opportunities; helping REU participants identify further STEM resources such as graduate school funding, mentoring opportunities, and professional skills development; the creation of an Ocean Sciences web portal; and the development of virtual communications and social media to support virtual community. The Institute for Broadening Participation (IBP), project implementer, has been supporting diversity by fostering an ongoing exchange of ideas and resources between students, faculty and administrators since 2002. IBP's extensive web portal, www.pathwaystoscience.org, helps individuals access the many resources that support successful careers in the STEM fields.

Almodovar Acevedo, L., University of Puerto Rico, Mayaguez Campus, Mayaguez, Puerto Rico, lalalita_2006@yahoo.com

Romero, A., University of Puerto Rico, Mayaguez, Puerto Rico, abnerd_18@hotmail.com

Detres, Y., University of Puerto Rico, Mayaguez Campus, Mayaguez, Puerto Rico, yasmin.detres@upr.edu

DETERMINATION OF SOIL CHARACTERISTICS IN NATURAL UNDISTURBED SALT FLATS IN SOUTHERN PUERTO RICO
Anthropogenic activities such as agriculture result in increased sediment and nutrient input into coastal areas. Vegetation buffers are helpful in preventing damage to coral reefs due to their capacity to filter nutrients, sediments and other contaminants generated by agricultural activities. The implementation of these mitigation strategies by conservation agencies require information regarding the adequate salt flats plant species, their associated plant attributes and soil characteristics. This work reports data obtained from the analysis of soil samples associated to dominant salt flat vegetation species in four undisturbed salt flat areas in southern Puerto Rico. Sediment cores were collected from areas with homogenous plant species growth. Samples were prepared and further analyzed for pH, conductivity, primary nutrients (nitrate, phosphorus, potassium) and micronutrients (calcium - magnesium) using a HACH SIW-1 Soil and Irrigation Water Kit. Values for pH and conductivity ranged from 8.36 to 9.04 and 8.96 to 18.11 mS/cm, respectively. The variability observed in nutrient values will be presented. Findings of this project will be used to supplement existing USDA – NRCS conservation programs.

Alonso, A., University of the Basque Country, Leioa, Spain, aitor.alonso@ehu.es
Orive, E., University of the Basque Country, Leioa, Spain, emma.orive@ehu.es
Laza-Martinez, A., University of the Basque Country, Leioa, Spain, aitor.laza@ehu.es
Seoane, S., University of the Basque Country, Leioa, Spain, sergio.seoane@ehu.es
PICOPLANKTON DETECTION IN ESTUARINE WATERS

Picoplankton is a major component of the phytoplankton in many marine areas, especially in those of oligotrophic character, where this size fraction dominates most if not all the year. The contribution of the picoplankton to total phytoplankton is, however, highly variable in estuarine waters, where its relative importance changes at small spatial and temporal scales. To gain insight into the abundance and taxonomic composition of these small organisms, optical (flow cytometry, epifluorescence microscopy), chemical (pigment analysis of cultured isolates) and molecular (Fluorescent In S itu Hybridization, FISH) methods have been applied to samples taken during three years in the marine extreme of the Nervion River estuary (Bay of Biscay, Northern Spain). FISH analysis revealed that the prasinophycean Micromonas was the dominant taxa among chlorophytes, which were, in turn, the dominant group among eukaryotes. Percentage contribution of the different algal groups to total picoplankton both prokaroytes and eukaryotes is discussed as assessed by the different methods used.

Alonso, C., Instituto de Investigaciones Biologicas Clemente Stable, Montevideo, Uruguay, calonso@iibce.edu.uy
Piccini, C., Instituto de Investigaciones Biologicas Clemente Stable, Montevideo, Uruguay
MICROBIAL ECOL OGY OF COASTAL TRANSITIONAL ENVIRONMENTS IN URUGUAY

Coastal environments are of key significance to human populations due to the disproportionate amount of ecosystem services they provide. Often, these systems are characterized by strong physicochemical gradients and anthropogenic stress, establishing a unique scenario to analyze the dynamics of microbial communities at very different environmental settings, in a relatively small area. Understanding how microbial communities react to sharp habitat alterations is fundamental for modelling the response of aquatic ecosystems under global change challenges. In this talk, results will be presented on different aspects of microbial ecology in coastal transitional systems of Uruguay, focusing on changes in bacterial diversity and activity along environmental gradients. We aim to summarize 5 years of work giving as examples the characterization of unusual massive losses of bacterial diversity in a coastal lagoon, the analysis of changes in metabolic processes of betaproteobacterial populations going through a natural boundary, an eco-ecological study of an invasive cyanobacterial species, and the differences in the degree of coupling between bacteria and grazers along the Rio de la Plata-Atlantic Ocean transition

Altieri, K. E., Princeton University, Princeton, USA, kaltieri@princeton.edu
Hastings, M. G., Brown University, Providence, USA, meredith_hastings@brown.edu
Peters, A., Bermuda Institute of Ocean Sciences, Hamilton, Bermuda, andrew.peters@bios.edu
Sigan, D. M., Princeton University, Princeton, USA, sigman@princeton.edu
THE CHEMICAL COMPOSITION OF ORGANIC NITROGEN IN MARINE RAINWATER AND AEROSOLS

Organic N appears to be a ubiquitous and significant component of marine atmospheric deposition, (i.e., 20-80% of total N). The sources (anthropogenic vs. ter-restrial vs. marine), composition (reduced or oxidized N), potential connections to inorganic N, and spatio-temporal variability of organic N are largely unknown. Rainwater and aerosol samples were collected on or near the island of Bermuda which is located in the western North Atlantic and experiences both anthropogenically and marine influenced air masses. Samples were analyzed by positive-ion ultra-high resolution electrospray ionization Fourier-transform ion cyclotron resonance mass spectrometry to chemically characterize the organic N. We found –800 N containing compounds in 8 compound classes. The CHON compounds dominate in number, have reduced N functionality, and are amino acid like, which suggests they would be bioavailable. No organosulfates or nitroxy-organosulfates were detected in the marine samples, both of which are known secondary anthropogenic compounds. Other areas of investigation include the influence of air mass origin on the sources of organic N and the potential inter-relationships of inorganic and organic N using nitrogen and oxygen isotopic ratios of nitrate.

Amacher, J. A., Arizona State University, Tempe, USA, jaamacher@asu.edu
Neuer, S., Arizona State University, Tempe, USA, susanne.neuer@asu.edu
Baysinger, C. W., Arizona State University, Tempe, USA, cbaysing@asu.edu
Lomas, M. W., Bermuda Institute of Ocean Sciences, St. George, Bermuda, michael. lomas@bios.edu
MOLECULAR TIME-SERIES OF PHYTOPLANKTON EXPORT FROM THE UPPER WATER COLUMN AT THE BERMUDA ATLANTIC TIME-SERIES STUDY (BATS)

The importance of small phytoplankton cells for downward particle flux has been postulated in numerous studies, but there are hardly any direct observations because cells contained in particle trap material are difficult to identify with traditional methods. Denaturing gradient gel electrophoresis (DGGE) and clone libraries of small subunit ribosomal RNA genes allow us to determine the relative contributions of different eukaryotic and cyanobacterial taxa to particle flux and to monitor changes over time. We present results from a two year molecular time series at the Bermuda Atlantic Time-series Study (BATS). Our results indicate that both small eukaryotes and cyanobacteria contribute to downward flux. We will focus on the 2009 and 2010 winter bloom period; these years were quite different hydrographically, with higher storm activity and the passing of a cyclonic eddy in 2010. These differences are reflected in our results so far indicating changes in the sinking patterns and a higher diversity of eukaryotes in the traps in 2010 compared with 2009. Clone library data will enable us to compare the community contribution to the particle flux in both years.

Amann, T., Institute for Biogeochemistry and Marine Chemistry, KlimaCampus, University of Hamburg, Hamburg, Germany, thorben.amann@zimaw.de
Weiss, A., Institute for Biogeochemistry and Marine Chemistry, KlimaCampus, University of Hamburg, Hamburg, Germany, andreas.weiss@zimaw.de
Hartmann, J., Institute for Biogeochemistry and Marine Chemistry, KlimaCampus, University of Hamburg, Hamburg, Germany, jens.hartmann@zimaw.de
DECADAL TRENDS OF BIOGEOCHEMICAL MATTER LAND-OCEAN FLUXES THROUGH A TIDAL ESTUARY CONSIDERING UPSTREAM CATCHMENT CHANGES (ELBE, GERMANY)

In the tidal Elbe estuary the improvement of water quality in the upper catchment area leads to a change of organic carbon processing in the oxygen minimum zone (OMZ) during the summer months. The decline of labile DOC concentrations and rising oxygen concentrations increased the significance of POC mineralization in this zone. Between 1985-1989 only 8.3% of POC entering the OMZ was mineralized during transition. After 1997 this value rose to more than 50%. Restoration of the water quality not only shifted the internal organic carbon processing from DOC to POC, but also revealed that the OMZ buffers the downstream transfer of oxygen. After 1995 oxygen saturation in the OMZ stayed constant at 72% while increasing upstream to 110%. The time series analysis also revealed that overall POC values of the OMZ decreased by more than 50% of the values in 1985. Results have implications for the assessment of global or regional land-ocean biogeochemical matter fluxes through estuaries, as studies - in general - omit the tidal freshwater part in their analysis.

Amirbahman, A., University of Maine, Orono, USA, ariamaine.ork@gmail.com
Lake, B. A., University of Maine, Orono, USA, bjorn.lake@umit.maine.edu
SEASONAL PHOSPHORUS DYNAMICS IN THE SURFICIAL SEDIMENT OF SHALLOW TEMPERATE LAKES: A COMBINED DET AND 31P-NMR STUDY

Lake sediments are a source of phosphorus (P) to the water column when lake hypolimnion becomes anoxic. To understand and quantify hypolimnetic P release, we studied several lakes across the trophic gradient in Maine, USA, by diffusive
equilibrium in thin film (DET) and 31P-NMR. The DET showed that during oxic periods, solubilization processes deeper in sediment supply the oxycline near the sediment-water interface (SWI) with a large reservoir of inorganic P. These processes are controlled by Fe(III) reducing bacteria, organic P mineralization, and P desorption from sediment. In eutrophic lakes, P solubilization occurs closer to SWI and the zones of P mobilization are larger due to increased sedimentation. Once hypolimnion becomes sufficiently anoxic, accumulated P at SWI releases into water column with a large initial efflux that steadily declines as P accumulates in the hypolimnion. 31P-NMR provided evidence that part of this sedimentary efflux is a result of decomposition of organic P, but compared to the dissolution of Fe hydroxides, this is minor. Combined, these techniques allow us to understand and quantify the dynamics of lake sedimentary P release.

Amundsen, T., Norwegian University of Science and Technology, Trondheim, Norway, trond.amundsen@bio.ntnu.no

Dupont, S., University of Gothenburg, SLC-Kristinberg, Fiskebäckskil, Sweden, sam.dupont@marecol.gu.se

Jutfelt, F., University of Gothenburg, Göteborg, Sweden, fredrik.jutfelt@zoool.gu.se

Forsgren, E., Norwegian Institute for Nature Research, Trondheim, Norway, elisabet.forsgren@nin.no

OCEAN ACIDIFICATION INCREASES ACTIVITY IN FISH LARVAE

According to IPCC predictions, oceanic pH may by 2100 have been reduced by 0.4 units compared to pre-industrial levels (a doubling in oceanic CO2). Ocean acidification can have dramatic effects on calcifying organisms. Little is known about consequences for fishes, the commercially most important group of marine organisms, but early life stages may potentially be highly vulnerable. We tested the effect of simulated ocean acidification on fertilization, embryogenesis and newly hatched larvae of the marine goby Gobiusculus flavescens. This was done by letting 28 pairs of fish spawn, rear their eggs, and hatch their larvae in individual aquaria with reduced (7.6) or control (8.1) pH water. Reduced pH resulted in a higher proportion of developmental malformations, increased respiration of newly hatched larvae, and a strong increase in larval phototactic response. Further studies are required to evaluate fitness consequences of increased respiration and activity, and to reveal if similar responses to low pH are common among fishes. As newly hatched fish larvae are subject to very high mortalities, effects on respiration and activity could have profound consequences for recruitment.

Anantharayan, K., University of Michigan, Ann Arbor, USA, akrarthik@umich.edu

Beeier, J. A., Woodhole Oceanographic Institution, Woods Hole, USA, jbeeier@whoi.edu

Toner, B. M., University of Minnesota, Twin Cities, USA, brandy.toner@gmail.com

Sylvan, J. B., University of Southern California, Los Angeles, USA, jsylvan@usc.edu

Edwards, K. J., University of Southern California, Los Angeles, USA, kje@usc.edu

Dick, G. J., University of Michigan, Ann Arbor, USA, gdick@umich.edu

MICROBIAL COMMUNITY STRUCTURE OF HYDROTHERMAL PLUMES

Biogeochemical processes in deep-sea hydrothermal plumes mediate the fate of hydrothermal inputs into the deep ocean. Although past studies have shown enhanced biochemical activity in hydrothermal plumes, little is known about the microorganisms inhabiting hydrothermal plumes. Here we describe recent work characterizing the microbiology of hydrothermal plumes along the Eastern Lau Spreading Center (ELSC). The ELSC has unique geological and geochemical characteristics that provide novel opportunities to study the co-evolution of hydrothermal plume geochemistry with geobiology. 80 microbial samples were collected along a gradient of geochemistry and are currently being analyzed by Automated rRNA intergenic spacer analysis (ARISA), clone libraries and high-throughput pyrosequencing of 16S rRNA genes. Integration of this data with geochemical and mineralogical analysis will provide insights into the evolution of the geobiology of hydrothermal plumes. Comparison of this data with ~2.5 million RNA genes from our studies from Guaymas Basin will also provide a window into differences in microbial community structure between diverse hydrothermal vent sites. Overall, our results will seek to highlight the microorganisms present in hydrothermal plumes and determine their roles in plume biogeochemistry.

Anas, M., University of Regina, Regina, Canada, anaslnf07@yahoo.com

Scott, K., Ministry of Environment, Saskatchewan, Regina, Canada, Ken.Scott@gov.sk.ca

Wissel, B., University of Regina, Regina, Canada, Bjorn.Wissel@uregina.ca

IMPORTANCE OF SPATIAL EFFECTS ON ENVIRONMENT: ZOOPLANKTON RELATIONSHIPS IN PRISTINE BOREAL LAKES THREATENED BY ACIDIFICATION

Increasing SO2 emissions from tar-sand operations in Alberta in combination with future climate change are expected to impact zooplankton communities in downwind boreal lakes of western Canada. Present relationships between zooplankton and environmental parameters can be used to predict the vulnerability of these systems to future threats. To evaluate pre-impact conditions, 26 pristine lakes in north-west Saskatchewan were surveyed for environmental parameters and zooplankton from 2007 to 2009. Three distinct clusters of lakes were identified based on zooplankton compositions, and this distinction was partly explained by environmental parameters including TP, PN, conductivity and %-wetland in the catchment. Yet, a large fraction of this variability in species composition explained by environmental factors was confounded by spatial parameters. Such environmental-spatial interactions were also detected for individual key species (i.e., Daphnia pulex, Leptodora minutus and A. leptopus), as the relationships between environmental parameters and zooplankton abundances varied among regions. We anticipate that due to increased industrialization and climate change, environmental controls of zooplankton in this area will shift to pH and temperature-regime, while spatial controls will be more strongly associated with emission point-sources.

Anderson, C., University of California, Santa Cruz, Santa Cruz, USA, cleander@ucsc.edu

Kudela, R., University of California, Santa Cruz, Santa Cruz, USA, kudela@ucsc.edu

Benitez-Nelson, C., University of South Carolina, Columbia, USA, cbnelson@geol.sc.edu

Lane, J., University of California, Santa Cruz, Santa Cruz, USA, jglane@gmail.com

Hayashi, K., University of California, Santa Cruz, Santa Cruz, USA, khayashi@ucsc.edu

Sekula-Wood, E., University of South Carolina, Columbia, USA, esekula@geol.sc.edu

Burrel, C., University of South Carolina, Columbia, USA, cburrell@geol.sc.edu

Siegel, D., University of California, Santa Barbara, Santa Barbara, USA, daveg@sei.ucsb.edu

Goodman, J., University of California, Santa Barbara, Santa Barbara, USA, goodman@lifesci.ucsb.edu

Brzezinski, M., University of California, Santa Barbara, Santa Barbara, USA, brzezinski@lifesci.ucsb.edu

IS THERE A LINK BETWEEN THE 2009-2010 CENTRAL PACIFIC ENSO EVENT AND PROLONGED HARMFUL ALGAL BLOOMS IN CENTRAL CALIFORNIA?

Warm SST anomalies appeared in central California in June 2009 following the spring transition to El Niño conditions in the equatorial Pacific. As the El Niño reached peak strength in Fall 2009, large toxic diatom blooms (Pseudo-nitzschia spp.) occurred in the Santa Barbara Channel (SBC) and Monterey Bay (MB) regions in conjunction with cool (rather than warm) surface temperature excursions from either advection or local upwelling pulses and lasted until late December. These rare fall blooms were predicted by regional HAB models and are consistent with the observed association between toxic diatom blooms and upwelling signatures but are perhaps inconsistent with assumed El Niño effects in California. With the La Niña transition in May 2010, cold SST anomalies coincided with protracted toxic Pseudo-nitzschia blooms in the SBC and MB from June to September, punctuated by nearshore dinoflagellate blooms of Lingulodinium and Promonterium. Shellfish toxins reached very high levels (70 ppm) along with a dramatic rise in marine mammal strandings. It is hypothesized that strengthened upwelling associated with La Niña conditions fueled this prolonged Pseudo-nitzschia response on the California coast.

Anderson, D. M., Woods Hole Oceanographic Institution, Woods Hole, USA, danderson@whoi.edu

McGillcuddy, Jr., D. J., Woods Hole Oceanographic Institution, Woods Hole, USA, dmcgillcuddy@whoi.edu

Keafer, B. A., Woods Hole Oceanographic Institution, Woods Hole, USA, bkeafer@whoi.edu

He, R., North Carolina State University, Raleigh, USA, rhe@ncsu.edu

Townsend, D. W., University of Maine, Orono, USA, davidt@maine.edu

BLOOM DYNAMICS OF THE RED TIDE DINOFLAGELLATE ALEXANDRIUM FUNDYENSE IN THE GULF OF MAINES: A SYNTHESIS AND PROGRESS TOWARDS A FORECASTING CAPABILITY*

Blooms of the toxic dinoflagellate Alexandrium fundyense, commonly called “red tides” have been a serious problem in the Gulf of Maine since 1972. The blooms are associated with appearance of potent neurotoxins in shellfish and some fish species, leading to paralytic shellfish poisoning (PSP) in human consumers – a potentially fatal poisoning syndrome. This talk will summarize more than a decade of large-scale field and modeling activities in the nearshore waters of the region, leading to a conceptual model of bloom dynamics that is consistent with cruise observations and with pat-
Barrier zones between toxic and anoxic water masses, also termed redoxlines, host highly active bacterial communities that mediate important biochemical transformations (e.g., within N and S cycle). However, little is known to date on the prokaryotic communities that graze upon them, despite their acknowledged importance as top-down regulators. In the present study, we characterized and compared prokaryotic communities in the redoxlines of two Baltic Sea deep basins, and determined their grazing impact on the physico-chemical gradients. Our results show 1) changes in the prokaryotic community composition throughout the oxygen gradient, with a clear abundance peak at the oxic/anoxic interface; 2) the appearance of novel, hitherto uncultivated lineages; 3) high grazing rates in interface and suboxic zones, accounting for the removal of up to 50–80% of bacterial standing stocks per day; but low rates in anoxic/sulphidic waters; and 4) ciliates and not heterotrophic nanoflagellates appear to be the main bacterivores. These results demonstrate the potential importance of prokaryots as top-down regulators in suboxic and interface zones, and highlight the constraints of deeper anoxic/ sulphidic waters for prokaryotic communities.

Anderson, A. J., Bermuda Institute of Ocean Sciences, St George’s, Bermuda, andreas.anderson@bios.edu
de Putron, S., Bermuda Institute of Ocean Sciences, St George’s, Bermuda, samantha.deputron@bios.edu
Bates, N. R., Bermuda Institute of Ocean Sciences, St George’s, Bermuda, nick.bates@bios.edu
Collins, A., Bermuda Institute of Ocean Sciences, St George’s, Bermuda, andrew.collins@bios.edu
Garley, R., Bermuda Institute of Ocean Sciences, St George’s, Bermuda, rebecca.garley@bios.edu
Noyes, T., Bermuda Institute of Ocean Sciences, St George’s, Bermuda, tim.noyes@bios.edu
Dexter, E., Portland State University, Portland, OR, USA, edexter@psu.edu

BERMUDA OCEAN ACIDIFICATION AND CORAL REEF INVESTIGATION: TEMPORAL AND SPATIAL VARIATIONS IN SEAWATER CARBONATE CHEMISTRY AND CALCIFICATION

Rising CO2 and decreasing pH in surface seawater owing to human activities could have detrimental consequences to corals and other reef species. It is likely that rates of calcification will decrease and dissolution of CaCO3 sediments and structures will increase in response to these changes. The objective of Bermuda ocean acidification and coral reef investigation is to characterize calcification and CaCO3 production at different scales including individual coral colonies, local reef communities, and regional coral reef ecosystems exposed to different seawater carbonate saturation state (Ω) and pH over time and space in the natural environment. Here we present data on variations in seawater carbonate chemistry, calcification rates of individual colonies of Diploria labyrinthiformis and Porites astreoides, and net ecosystem calcification as a function of time and space on the Bermuda coral reef platform.

Anderson, A., Umeå University, Umeå, Sweden, agneta.andersson@emg.umu.se

INFLUENCE OF RIVER INFLOW ON THE PRODUCTIVITY AND BIODIVERSITY IN COASTAL AREA OF THE NORTHERN BALTIC SEA

The northern Baltic Sea is exposed to high river inflow, which is rich of humic substances and has a high CNP stoichiometry. Climate change has been predicted to cause increased precipitation in northern Europe, which will lead to increased river inflow to the northern parts of the Baltic Sea. To elucidate how variations in river inflow influence production and biodiversity of phytoplankton and bacteria, we performed a field study in the Ore river estuary, northern Baltic Sea. We hypothesized that coastal phytoplankton would be unfavorably by river discharge, while bacteria would benefit or be unaffected. 19 stations were sampled 9 times during the spring-summer 2010. Secchi depth varied from 0.3 to 6 m and DOC from 4 to 10 mg l-1. The northern Baltic Sea is exposed to high river inflow, which is rich of humic substances and has a high CNP stoichiometry. Climate change has been predicted to cause increased precipitation in northern Europe, which will lead to increased river inflow to the northern parts of the Baltic Sea. To elucidate how variations in river inflow influence production and biodiversity of phytoplankton and bacteria, we performed a field study in the Ore river estuary, northern Baltic Sea. We hypothesized that coastal phytoplankton would be disfavored by river discharge, while bacteria would benefit or be unaffected. 19 stations were sampled 9 times during the spring-summer 2010. Secchi depth varied from 0.3 to 6 m and DOC from 4 to 10 mg l-1. Primary and bacterial production as well as plankton diversity showed large variations that could be attributed to river inflow. We suggest that increased precipitation and river inflow, for example due to climate change, will have major influence on the food web structure and the productivity in seas like the Baltic Sea.

Angel, D., University of Haifa, Haifa, Israel, adror@research.haifa.ac.il
Krost, P., Coastal Research and Management, Kiel, Germany, peter.krost@crm-online.de

DYNAMICS IN SEDIMENT BIOGEOCHEMISTRY FOLLOWING THE REMOVAL OF NET-CAGE FISH FARMS IN THE NORTHERN GULF OF AQABA

Whereas many studies have examined the ecological and biogeochemical changes related to farm development and expansion, few have looked at the environmental
response when the point-source of enrichment is removed. We had an opportunity to examine this process when the Israeli fish farms, Ardag and Dagsuf were removed from the northern Gulf of Aqaba in summer 2008, after close to 20 years of activity in this area. We found that sediments close to the former fish cages recovered more slowly than the sediments at stations 20m or 40m away, even 18 months after cessation of fish-farming. It is likely that this residual material is mostly refractory organic matter since the sediments showed clear signs of bioturbation and oxidized conditions, and supported healthy populations of the local seagrass which had not been observed in these sediments since 1993. Moreover, the sediment oxygen demand in the enriched sediments dropped considerably, with time, in comparison to the oxygen demand measured there in the first months following removal of the cages.

Anselmi-Molina, C. M., University of Puerto Rico at Mayagüez / CaRA-CariCOOS, Mayagüez, Puerto Rico, carlos.anselmi@upr.edu

Aponte-Bermúdez, L. D., University of Puerto Rico at Mayagüez / CaRA-CariCOOS, Mayagüez, Puerto Rico, luis.aponte@upr.edu

González-López, J. O., University of Puerto Rico at Mayagüez / CaRA-CariCOOS, Mayagüez, Puerto Rico, jorge.corredor@upr.edu

Mercado-Irizarry, A., University of Puerto Rico at Mayagüez / CaRA-CariCOOS, Mayagüez, Puerto Rico, julio.morell@upr.edu

CAPICOS COASTAL AND MARINE SPATIAL PLANNING FRAMEWORK

Lack of extended oceanic data records around the Caribbean islands limits the capability for informed Coastal and Marine Spatial Planning (COSP). The Caribbean Coastal Ocean Observing System (CariCOOS) is filling this void by providing a wealth of environmental measurements and numerical models of priority variables identified by local stakeholders including wind, waves, currents, water quality and coastal inundation. We here report on progress in developing data products for application to COSP of waters of Puerto Rico and the US Virgin Islands. We measure coastal waves with two buoys, one off the Atlantic coast and one off the Caribbean coast, and simulate coastal wave conditions using the SWAN wave model. We measure coastal currents with the two buoys and simulate coastal currents conditions using the single layer ADCIRC model. In addition coastal winds are measured with a network of 12 hurricane-hardened meteorological stations and simulate coastal winds using the WRF model. CariCOOS data and data products thus acquired will serve in COSP implementation in the US Caribbean region by providing GIS layers for these key environmental variables.

Appelo, R. S., Department of Marine Sciences, University of Puerto Rico, Mayaguez, Puerto Rico, richard.appeldoorn@upr.edu

Bejarano, L., Department of Marine Sciences, University of Puerto Rico, Mayaguez, Puerto Rico, ivonnebeja@hotmail.com

Nemeth, M., Department of Marine Sciences, University of Puerto Rico, Mayaguez, Puerto Rico, michael.nemeth@hotmail.com

Pagan, F. E., Department of Marine Sciences, University of Puerto Rico, Mayaguez, Puerto Rico, francisco.pagan@upr.edu

Ruiz, H., Department of Marine Sciences, University of Puerto Rico, Mayaguez, Puerto Rico, astreoides@gmail.com

Sherman, C., Department of Marine Sciences, University of Puerto Rico, Mayaguez, Puerto Rico, clark.sherman@upr.edu

GROSS PATTERNS OF MESOPHOTIC CORAL ECOSYSTEM DEVELOPMENT ALONG INSULAR SLOPE ENVIRONMENTS IN THE US CARIBBEAN

The development and distribution of mesophotic coral ecosystems (MCEs) along insular slopes are thought to be dependent upon factors such as geomorphology, slope, wave exposure, and sedimentation/bedload transport. Using observations from ROV and mixed-gas rebreather dives and high-resolution bathymetry, we compared MCEs below 50-m depth along a 350-km longitudinal transect to determine patterns of MCE formation relative to the above factors. Sites were clustered into 6 main areas: Mona Island, La Parguera, Ponce, Vieques, St. Thomas and St. Croix. The following patterns emerged: (1) Severe sediment stress led to no deep MCE development unless (2) the slope was high and there were promontories and channels that raised areas of benthic community development and constrain bedload transport to specific pathways, respectively. (3) Vertical walls showed poor MCE development regardless of other site characteristics. (4) Low slope and moderate bedload stress led to diverse MCE communities. (5) Moderate slope with promontories and channels led to the highest MCE development, often with large colonies of Agaricia. (6) Low bedload stress coupled with unstable substratum (rhomolites) restricted MCE development to deeper depths (80 m).

Apprill, A., Woods Hole Oceanographic Institution, Woods Hole, USA, apprill@whoi.edu

Hughen, K., Woods Hole Oceanographic Institution, Woods Hole, USA, khughen@whoi.edu

Minter, T., Woods Hole Oceanographic Institution, Woods Hole, USA, tminer@whoi.edu

BACTERIAL COMMUNITIES ASSOCIATED WITH HEALTHY AND DISEASED CORALS IN COMPARISON TO REEF WATER BIOGEOCHEMISTRY

Yellow band disease affects diverse species of coral from Caribbean, Indo-Pacific and Red Sea reefs. Cultivation-based studies attribute a consortium of Vibrio spp. to play a major role in this disease state. Here we take a cultivation-independent, deep-sequencing approach to compare and contrast the bacterial community associated with healthy and lesioned corals displaying signs of yellow band disease, and explore the biogeochemistry of the surrounding reef environment. Diseased and healthy Fungiidae corals (Hepolitha limax and Clenactis crispus), as well as the surrounding bacterioplankton community, were compared from eight diverse reef environments in the Red Sea. The hypervariable V1-V3 regions of the SSU rRNA genes were deeply sequenced using 454 Life Sciences pyrosequencing with GS FLX Titanium Series chemistry. The identity and relative abundances of coral-associated bacterial community members will be discussed in relation to metadata about the reef water biogeochemistry, bacterioplankton community composition, and prevalence of coral disease. The longevity of corals is threatened by a number of environmental and climate-related phenomena, and this comparative research will advance our understanding about a disease associated with worldwide reefs and diverse species of corals.

Arache, A. V., Universidad de Puerto Rico, Rio Piedras, Puerto Rico, aarache@upr.edu

Ortiz, J., Universidad de Puerto Rico, Rio Piedras, Puerto Rico, jorgeortiz.ites@gmail.com

RESTORATION OF RIPARIAN FOREST IN CAPETILLO, PUERTO RICO: OPTIMIZATION OF WATER QUALITY AND ECOSYSTEMS FUNCTIONS IN A TROPICAL URBAN SETTING

In some urban centers, water bodies tend to be neglected, becoming waste disposal sites. Urban forests receive runoff from streets, roofs, and leaks from water distribution systems. Knowledge in ecology and sense of stewardship is important qualities in citizens that demonstrate capacity to manage riparian zones. I will investigate the effect of conducting a research educational project, within the “Isa Del Diablo” Urban Forest. A monitoring program will be conducted through educational activities
involving the community in all the scientific techniques of water quality, soil testing, and wild life census for habitat restoration. Analysis, including optimization tech-
niques to evaluate possibilities, implementation and monitoring of the management plan, and publication of scientific literature, will be developed by the community as active participants in collaboration with professionals from multiple disciplines. Sense of stewardship, partnership, and transferred scientific skills, will work together with natural forces to optimize water quality and ecosystem functions.

Aragon, S. J., Eastern New Mexico University, Portales, USA, Steven.aragon@enmu.edu

Doherty, M., University of Maryland Center for Environmental Science/Horn Point Laboratory, Cambridge, USA, mdoherty@umces.edu

Crumpton, B. C., University of Maryland Center for Environmental Science/Horn Point Laboratory, Cambridge, USA, bcrumpton@umces.edu

MICROBIAL COMMUNITY DYNAMICS IN SEASONALLY ANOXIC WATERS OF THE CHESAPEAKE BAY.

Aerobic respiration by bacteria causes seasonal anoxia in bottom waters of stratified estuaries, which forces these bacteria to use alternate lower-energy respiratory metabolism and to grow with reduced efficiency. In Chesapeake Bay, estuarine circulation creates a gradient of redox conditions in bottom waters that extend from newly hypoxic waters in the south to older sulfide waters in the north. We measured bacterial cell abundance, carbon production, and phylogenetic community composi-
tion across this gradient. When all depth classes were considered, bacterial abundance and production peaked in surface waters and correlated with temperature, dissolved oxygen and chlorophyll-a. In bottom waters, abundance was similar under hypoxic and sulfidic conditions, but was reduced under intermediate suboxic conditions (no oxygen, no sulfides). In contrast, production was highest under suboxic conditions, and was negatively correlated with abundance. These results indicate that the loss of oxygen alters both growth and grazing rates in microbial communities, but does not drive a change in species composition. However, as anoxic waters age and alternate electron acceptors are used up, the bacterial community changes composition and begins using low-energy sulfate respiration.

Aranda Lastra, M., King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, manuel.aranda@kaust.edu.sa

Banaszak, A. T., Instituto de Ciencias del Mar y Limnología, Universidad Nacional A, Puerto morelos, Mexico, banaszak@cmar.unam.mx

Bayer, T., Abdullah University of Science and Technology, Thuwal, Saudi Arabia, till. bayer@kaust.edu.sa

Medina, M., School of Natural Sciences, University of California Merced, Merced, USA, mmedina@ucmerced.edu

Voolstra, C. R., Abdullah University of Science and Technology, Thuwal, Saudi Ara-
bia, christian.voolstra@kaust.edu.sa

DIFFERENTIAL SENSITIVITY OF CORAL LARVAE TO NATURAL LEVELS OF ULTRAVIOLET RADIATION (UVR) DURING DEVELOPMENT.

Scleractinian corals are the major builders of the complex structure of coral reef ecosystems. They live in tropical waters around the globe where they are frequently exposed to potentially harmful ultraviolet radiation (UVR). The most sensitive life history stages of corals are probably the eggs and embryos, many of which develop in the shallow waters of coral reefs. We assayed transcriptional changes of coral larvae of Montastraea faveolata exposed to natural levels of UVR at different developmen-
tal stages using large density cDNA microarrays (>10,000 genes). We found that larvae exhibit low sensitivity to natural levels of UVR during most time points ana-
lyzed. However, we identified a time window of high UVR sensitivity that coincides with the motile planula stage and the acquirement of larval competence. UVR affects the expression of developmental and in particular neurogenesis-related genes that can be linked to swimming and settlement behavior and might compromise larval competence at later stages. Our results might allow a better prediction of settlement and recruitment rates after coral spawning events based on UVR climate data.

Aranguren-Gassis, M., Universidad de Vigo, Vigo, Spain, aranguren@uvigo.es

Serret, P., Universidad de Vigo, Vigo, Spain

Fernández, E., Universidad de Vigo, Vigo, Spain

Herrera, J. L., Universidad de Vigo, Vigo, Spain

Domínguez, I. F., IEO-Centro Oceanográfico de Canarias, Tenerife, Spain

Pérez, V., Centro de Investigación e Información Ambiental - CINAM de Lourizán, Lourizán, Spain

Escaréz, I., IEO-Centro Oceanográfico de Canarias, Tenerife, Spain

LAGRANGIAN OBSERVATIONS OF BALANCED PLANKTON METABOLISM IN THE OLOGOTROPHIC NORTH ATLANTIC SUBTROPICAL GYRE.

The prevalence of net heterotrophic metabolism in the Open Ocean and factors controlling the net community metabolism in low productive systems are subjects still under debate. Controversy has been in part attributed to differences in the scale of variation of plankton photosynthesis and respiration, and the derived difficulties to characterize their coupling through standard snapshot measurements of plankton metabolism. Here we present daily plankton metabolism data from two 1-week lagrangian experiments carried out on October-November 2006 in the eastern North Atlantic subtropical Gyre, where previous snapshot observations suggest the preva-
ience of net heterotrophy and the control of community metabolism by the magni-
tude of primary production. Gross primary production and community respiration were simultaneously measured every day in the euphotic zone from in vitro changes in dissolved oxygen after 24h in situ incubations. Net community production was balanced during 86% of the daily observations and net heterotrophy was related with changes in both primary production and community respiration.

Archer, S. D., Plymouth Marine Laboratory, Plymouth, United Kingdom, stds@pml.ac.uk

Stephens, J. A., Plymouth Marine Laboratory, Plymouth, United Kingdom, jas@pml.ac.uk

Stefels, J., University of Groningen, Groningen, Netherlands, j.stefels@rug.nl

Hopkins, F. J., Plymouth Marine Laboratory, Plymouth, United Kingdom, fb@pml.ac.uk

Kinnman, S. A., Plymouth Marine Laboratory, Plymouth, United Kingdom, sukimg@pml.ac.uk

EXPLANATION OF THE TEMPORAL PROGRESSION OF DMS FLUX FROM A COASTAL UPWELLING SYSTEM.

If DMS concentrations are elevated in coastal upwelling waters, the offshore trajec-
tory of air masses that receive the flux may represent a significant source of DMS to the remote marine atmosphere. As part of the NERC UK SOLAS programme we aimed to determine the temporal evolution of DMS flux in the Mauritanian upwelling system as water is driven offshore and alters in physicochemical and biological characteristics. We employed two successive SF6-labelled water masses to provide lagrangian frameworks within an upwelled filament. Concentrations of DMS and its precursor DMSP were monitored and a stable isotope incorporation method used to determine specific DMSP synthesis, loss and turnover rates. We show that differing temporal trends in DMS concentrations in the two water masses could be explained by altering DMSP synthesis rates and turnover of the DMSP pool. We explore the environmental forcing that changes the DMSP synthesis rates and why the balance between DMSP production and loss varies between the two water masses.

We use this information to estimate DMS flux from the upwelling system and compare this to observed atmospheric concentrations.

Arden, M., Duke University, Durham, USA, marcelo.arden@duke.edu

Duff, J. H., US Geological Survey, Menlo Park, USA, jhduff@usgs.gov

Ramirez, A., University of Puerto Rico, San Juan, USA, aramirez@upr.edu

Small, G. E., University of Minnesota, Saint Paul, USA, gsmall11@gmail.com

Jackman, A. P., US Geological Survey, Menlo Park, USA, ajackman@usgs.gov

Triska, F. J., US Geological Survey, Menlo Park, USA, ftriska@usgs.gov

Pringle, C. M., University of Georgia, Athens, USA, cpringle@uga.edu

EXPERIMENTAL ACIDIFICATION OF TWO NEOTROPICAL STREAMS ILLUSTRATES THE SENSITIVITY OF INVERTEBRATE ASSEMBLAGES AND IMPORTANCE OF BICARBONATE BUFFERING.

Seasonal and episodic acidification of neotropical streams has been linked to increased dissolved inorganic carbon. Effects of episodic acidification have been well studied in temperate streams, but not in tropical streams. We experimentally examined consequences of short-term acidification in a low-solute, poorly buffered and a high-solute, well buffered stream in La Selva Biological Station, Costa Rica. We hypothesized that: 1) protonation of bicarbonate (HCO3- ) would buffer most of the acid added in the high-solute stream, while base cation release from the sediments would be the most important buffering mechanism in the low-solute stream; 2) pH declines would mobilize inorganic Al from sediments in both streams; and 3) pH declines would increase macroinvertebrate drift in both streams. In both streams we did not observe significant increases in Al Macroinvertebrate drift increased in both streams in response to acidification and was dominated by Ephemeropera and Chironomidae. Increased DIC could alter both the buffering capacity and acidity of neotropical streams, with potential harmful effects on biota.
Arveño, A. R., University of South Florida, St. Petersburg, USA, arelano@mail.usf.edu
Coble, P. G., University of South Florida, St. Petersburg, USA, pcoble@marine.usf.edu
Connolly, R. N., EPA, Gulf Breeze, Conm.Christian@epamail.epa.gov
INVESTIGATION OF CARBON, NUTRIENTS, AND GROUNDWATER INPUTS IN COASTAL FLORIDA USING COLORED DISSOLVED ORGANIC MATTER
Few studies of the exchange of water between aquifers and the ocean have been conducted along the Florida coast. Progression of residential and agricultural development in coastal areas is leading to increased nutrients from fertilizers and wastewaters to groundwater. Nutrient and carbon inputs through groundwater in certain areas may play an important role in cycling and primary productivity in the coastal ocean. King’s Bay is a spring-fed watershed located on the West Florida Shelf. Over the past 25 years, springs supplying groundwater to King’s Bay have shown a three-fold increase in nitrate concentration and increased invasion of nuisance algae. It has been challenging to track sources of both nutrients and other water quality parameters because there are multiple water supplies to King’s Bay. The goal of this project is to improve the estimate of water, nutrients, and carbon from groundwater discharge into the coastal zone. This paper will present preliminary results of high resolution fluorescence spectroscopy analyzes of the various source water types in the King’s Bay watershed, including deep and shallow aquifers, wells, springs, and surface water sources.

Arellano, A. R., University of Puerto Rico, Mayaguez, Puerto Rico, royarmstrong@upr.edu
Cedeño-Maldonado, D. J., Interamerican University of Puerto Rico, Ponce, Puerto Rico, dcedeno@ponce.inter.edu
FIELD AND AIRBORNE RADIOMETRY DETECTION OF THE HARMFUL DI-NOFLAGELATE COCHLODINUM POLYRYKROIODES IN SOUTHWESTERN PUERTO RICO
The dinoflagellate Cochlodinium polykrikoides is responsible for harmful algal bloom occurrences that can result in massive fish mortalities. During the last 50 years blooms of C. polykrikoides have been recurrently observed in Bahía Fooscorrente, a bioluminescent bay in southwestern Puerto Rico. Since phytoplankton strongly influences the optical properties of natural waters, field and airborne (AVIRIS) hyperspectral data were used to detect and possibly quantify C. polykrikoides populations under bloom conditions. Remote sensing reflectance (RRs) data showed the general spectral response of optically complex coastal waters. However, substantial deviations in the Rrs curves corresponding to dense accumulations of dinoflagellates clearly indicated that the occurrence of these blooms in Bahía Fooscorrente can be detected from hyperspectral data. Moreover, Rrs data can also be used to differentiate the blooms of C. polykrikoides from that of some other bloom-forming species present in Bahía Fooscorrente. Field hyperspectral radiometer data proved suitable for quantitative estimations of C. polykrikoides cell abundance under bloom conditions, through the application of chlorophyll based semi-empirical algorithms.

Armstrong, R. A., Stony Brook University, Stony Brook, USA, rarmstrong@notes.cc.sunysb.edu
Sabat, A., University of Puerto Rico-Rio Piedras, San Juan, Puerto Rico, amsabat@gmail.com
HOW FISH STOCKS HAVE CHANGED IN PUERTO RICO: IS OVERFISHING THE OVERRIDING FACTOR?
Fish stocks in Puerto Rico have decreased as a result of multiple factors, including the loss and degradation of habitats, overfishing, and climate change. This study is focused on documenting and interpreting the current status of fish stocks in some landing areas used by commercial fishermen in Puerto Rico. Existing fishery statistics information for the selected areas will be used to address these specific goals: (1) analyze landing statistics published by the Department of Natural and Environmental Resources; (2) relate the landing statistics with data from the SEAMAP Project; and (3) construct new comprehensive maps of the fishery zones with the information provided by fishermen.

Arocho-Montes, A. L., University of Puerto Rico-Rio Piedras, San Juan, Puerto Rico, arelaco.roc@gmail.com
Spatz, A., University of Puerto Rico-Rio Piedras, San Juan, Puerto Rico, amspat@notes.cc.sunysb.edu
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Arevalo, P. A., Brown University, Providence, USA, philip_arevalo@brown.edu
Rich, J. J., Brown University, Providence, USA, jerry.rich@brown.edu
MICRODIVERSITY OF ANAMMox BACTERIA ALONG ENVIRONMENTAL GRADIENTS IN PUERTO MARGIN SEDIMENTS
Anammox bacteria play a fundamental role in the global nitrogen cycle. These bacteria contribute to the functioning of global nitrogen sinks such as the Peru margin. However, the composition of the anammox community in Peru margin sediments has been little-studied. Using DNA extracted from seven different sites along the Peru margin ranging in depth from 100 m-3240 m, we sequenced clone libraries for the anammox-specific gene hydrazine oxidoreductase (hzd) and 16S rRNA. A total of 82 sequences from the 16S rRNA library formed 19 OTUs at the 98% similarity level and 112 nucleotide sequences from the hzd library formed 22 OTUs at the 96% similarity level. In comparison, hzd amino acid sequences formed eight OTUs at the 99% similarity level indicating that synonymous mutations comprise much of hzd nucleotide diversity. Maximum-likelihood phylogenetic trees for both libraries revealed that all OTUs grouped with sequences from the candidate anammox genus Scalindua. However, values of Yue and Clayton’s theta, an estimator of community structure similarity, and the Sorenson similarity index were sufficiently low to suggest differences between the shell and non-shell anammox community.

Arif, C., King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, chatchanit.arif@kaust.edu.sa
Ferrier-Pagès, C., Centre Scientifique de Monaco, Monaco, Monaco, ferrier@centrestientifique.mc
TOWARDS MICROBIAL COMMUNITY PROFILING OF SOFT CORALS
Most scleractinian corals have been found to live together with not only their dinoflagellate symbionts, but also a characteristic and highly diverse and complex community of bacteria. In contrast, only few studies have looked at the microbial assemblage of the closely related softcorals (Octocorallia, Alcyonacea). This group is particularly interesting as it consists of species that live symbiotically and asymbiotically with zooxanthellae. Here we investigate the bacterial community of the non-symbiotic species Eunicella cavolini at three depths (24m, 30m, 41m) by sequencing of 16S small ribosomal subunit amplicons. We generated ~270,000 sequences, a dataset which allows comparisons of the bacterial assemblage in the same species along a depth gradient, and thus in ecologically distinct areas. In the future we plan to compare our data to the bacterial community from the symbiotic gorgonian species Eunicella singularis. We anticipate highlighting bacterial species that are connected to a symbiotic lifestyle. In a second step, we plan to compare the microbiomes of asymbiotic and symbiotic softcorals to that of scleractinian (hard) corals in order to delineate the ecology and evolution of Anthozoan-associated bacteria.

Arrieta, J. M., IMDEA (CSC-IUIB), Esporles, Spain, txeu@imdea.uib-csic.es
Tovar-Sanchez, A.
Duarte, C. M.
Vaque, D.
Boras, J. A.
Sala, M. M.
TESTING THE EFFECT OF ICE MELTDOWN ON ARCTIC PROKARYOTIC COMMUNITIES

Current global warming scenarios are expected to cause an enhanced ice melt in the Arctic. However, seasonal ice melting releases not only water but also significant amounts of dissolved and particulate materials into the Arctic Ocean. We hypothesized that heterotrophic prokaryotic communities could utilize these organic and inorganic materials released from sea ice. This hypothesis was tested using mixtures of melted ice and seawater as compared to pure water additions. Our results revealed that the addition of ice meltdown products caused a small, but measurable enhancement of prokaryotic growth in all the samples tested. Moreover, the microcosms containing melted ice showed lower rates of prokaryotic respiration as compared to the controls, resulting in enhanced prokaryotic growth efficiency in response to the materials released by Arctic ice. Prokaryotic community structure was almost identical in all treatments, indicating the high lability of the materials contained in sea ice as compared to bulk DOM already present in seawater.

Artigas, L. F., Université Lille Nord de France, Laboratoire d'Océanologie et de Géosciences - ULCO - CNRS UMR 8187, Wimereux, France, Felipe.Artigas@univ-littoral.fr

Aschaffenburg, M. D., University of Delaware, Lewes, USA, mdaschaf@udel.edu

Costigliola, M., Laboratorio de Microbiologia Marina, INIDEP, Mar del Plata, Argentina, mcosta@indep.ed.ar

Dionisio, H. M., CENPAT-CONICET, Puerto Madryn, Argentina, hdionisio@cenpat.edu.ar

Hozbor, C., Laboratorio de Microbiologia Marina, INIDEP, Mar del Plata, Argentina, mchozbor@indep.ed.ar

Otero, E., Departamento de Ciencias Marinas, Universidad de Puerto Rico, Mayagüez, Mayagüez, Puerto Rico, eooter@upr.edu

Paranhos, R., Departamento de Biología Marina, Laboratorio de Hidrobiología, Universidade Federal Rio de Janeiro, Rio de Janeiro, Brazil, rodpar@biology.ufrrj.br

Peressutti, S., Laboratorio de Microbiología Marina, INIDEP, Mar del Plata, Argentina, salvpa_ar@yahoo.com

Piccini, C., Laboratorio de Microbiologia, IIBCE, Universidad de la República, Montevideo, Uruguay, piccina@iibce.edu.uy

Thompson, F. L., Departamento de Genética, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, fabiano.thompson@biologia.ufrj.br

PROKARYOTIC DIVERSITY (EUBACTERIA AND ARCHAEA) IN COASTAL SYSTEMS ALONG A LATITUDE GRADIENT FROM SW ATLANTIC TO THE CARIBBEAN

Marine prokaryotic diversity was assessed by massive 454-tag pyrosequencing of the 16S RNA V6 region, over a latitudinal gradient of coastal systems from the Southwest Atlantic to the Caribbean. Planktonic Eubacteria was analysed in seven sites (from estuarine and coastal lagoons to coastal waters): overall, the highest diversity (defined as groups of sequences with > 97% identity) was observed in the sites located at lower latitudes and the lowest diversity was observed in the sites at higher latitudes. At the order level, the diversity of coastal and plume temperate communities (excepting the Amazon). Comparisons were also made between Eubacterial communities of shallow and deep reef sediments in the Caribbean and of intertidal temperate sediments of two different sites (a very pristine beach and an impacted oil spilling site) in Patagonia. Sediment samples showed similarity even across different climatic regions. Finally, the diversity of Archaea was examined by comparing temperate and tropical estuarine and coastal waters of different anthropogenic influence: estuarine waters were individualized from coastal waters.

Ascanio, D. C., Hatfield Marine Science Center, Oregon State University, Newport, USA, assandon@onid.orst.edu

Chapman, J. W., Department of Fisheries and Wildlife, Hatfield Marine Science Center, Newport, USA, John.chapman@oregonstate.edu

Dumbauld, B. R., USDA ARS, Hatfield Marine Science Center, Newport, USA, brett.dumbauld@ars.usda.gov

Symbiodinium may be at an ecological advantage, as some symbiotics may impart a greater thermal tolerance. Photobiology and growth of the coral Pocillopora were investigated in the Gulf of California in which colonies harbor either Symbiodinium ITS2 types D1 or C1b-c. Patterns of photoacclimation and susceptibility to light stress were examined in naturally bleached Pocillopora harboring C1b-c and healthy Pocillopora harboring D1. Both corals demonstrated an equivalent degree of photoacclimation as well as a slight decline in PSII photochemical capacity when exposed to excess irradiance. Colony growth by skeletal density and linear extension were equivalent in corals with both C and D symbionts. This work indicates that while Pocillopora harboring the C1b-c symbiont may be more susceptible to temperature stress, they also exhibit rapid recovery following natural stress, as well as equal growth and photosynthesis when compared to colonies harboring the D1 symbiont. These results, coupled with the stability and minimal intracolony fluctuation in dominant symbiont populations, provide further insight as to why the physiologically weaker C1b-c symbiont has not been completely selected against in this system.

Ashworth, J., Institute for Systems Biology, Seattle, USA, jashworth@systemsbiology.org

Lee, A., Institute for Systems Biology, Seattle, USA

Baliga, N. S., Institute for Systems Biology, Seattle, USA, nbaliga@systemsbiology.org

Orellana, M., Institute for Systems Biology, Seattle, USA, morellana@systemsbiology.org

MOLECULAR RESPONSES OF DIATOMS TO RISING CO2 LEVELS AND OCEAN ACIDIFICATION

The rapid rise of atmospheric CO2 is increasing the flux of dissolved inorganic carbon into aquatic systems, and threatens to acidify the oceans. This presents a challenge to the adaptability of marine ecosystems, and the biogeochemical equilibria that recycle much of our planet’s important nutrients. Diatoms are responsible for the production of an estimated 40% of all organic carbon in the oceans, and form the base of food webs in coastal and upwelling systems that support important fisheries. Thus the response of diatoms to increased CO2 could largely determine the affect of climate change on these important biological and geochemical processes. Using high-throughput microarray technology, we are measuring the dynamic gene regulatory response of Thalassiosira pseudonana to increased CO2 levels, in order to learn the molecular mechanisms by which its existing genetic program permits adaptation to changes in its environment. This allows us to describe the environment-dependent control of critical cellular processes, and to begin to build a model of the global gene regulatory network for this organism. Funded by NSF-0429285.

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(*) represents Invited presentations.
Astor, Y. M., FLASA/EDIMAR, Punta de Piedras, Venezuela, yastor@edimar.org
Lorenzoni, L., University of South Florida, Saint Petersburg, USA, laural@marine.usf.edu
Thunell, R. C., University of South Carolina, Columbia, USA, thunell@geol.sc.edu
Varela, R., FLASA/EDIMAR, Punta de Piedras, Venezuela, rvarela@edimar.org
Muller-Karger, F. E., University of South Florida, Saint Petersburg, USA, carib@marine.usf.edu
Troccoli, L., Universidad de Oriente, Macanáo, Venezuela, ltroccoli@ne.udo.edu.ve
Taylor, G. T., Stony Brook University, Stony Brook, USA, gtlaylor@notes.cc.sunysb.edu
Scranton, M. I., Stony Brook University, Stony Brook, msscranton@notes.cc.sunysb.edu
Tappa, E. J., University of South Carolina, Columbia, USA, tappa@geo1.sc.edu
Rueda, D. T., University of South Florida, Saint Petersburg, USA, druedaro@mail.usf.edu

TEMPERATURE EFFECT ON fCO2 IN THE CARIACO TIME-SERIES STATION FROM 1996 TO 2008

Sea surface carbon dioxide fugacity (fCO2sea) variability was examined at the Cariaco Basin Time-Series location (10°30′N, 64°40′W) from 1996 through 2008. A closed relationship was observed between fCO2sea and temperature where periods of warm and cold anomalies at the station were related to variability in coastal upwelling intensity. Despite the large seasonal variability, deseasonalized fCO2sea increased at 1.77 ± 0.42 µatm year−1 (p < 0.01), similar to the estimated annual increase in atmospheric CO2 (1.9 µatm year−1). In Cariaco Basin, each increase/decrease of 1 °C coincides with an increase/decrease of 16-20 µatm of fCO2sea. When deseasonalized fCO2sea is normalized to 26.05 °C, mean Cariaco SST, it shows a lower rate of increase (0.64 ± 0.47 µatm year−1). Based on these observations, 64% of the increase in fCO2sea in Cariaco Basin between 1996 and 2008 is caused by warming of surface waters, making this the primary factor controlling fugacity at this location. During this period, the phytoplankton community changed from large diatom-dominated blooms during upwelling in the late 1990s to blooms of shorter duration in the first decade of the twenty-first century.

Atienza, D., Institut de Ciències del Mar-CSIC, Barcelona, Spain, datienza@icm.csic.es
Fuentes, V., Institut de Ciències del Mar-CSIC, Barcelona, Spain
Tilves, U., Institut de Ciències del Mar-CSIC, Barcelona, Spain
Marabini, M., Institut de Ciències del Mar-CSIC, Barcelona, Spain
Gili, J. M., Institut de Ciències del Mar-CSIC, Barcelona, Spain

IMPACT OF THE NEW INVASIVE CTENOPHORE MNEMIOPSIS LEIDYI ON THE NW MEDITERRANEAN

Mnemiopsis leidyi is a versatile species native from estuaries and coastal regions along the eastern coasts of North and South America. Blooms of this invasive ctenophore occurred by the first time in the NW Mediterranean during 2009. Is known that accidental introduction and subsequent explosion of this ctenophore resulted in dramatic decrease in zooplankton, ichthyoplankton, and fisheries. Determination of feeding and major physiological rates (i.e. respiration and excretion), along with monitoring the populations in situ, are necessary to assess the ecological impact of this new invasive ctenophore on the pelagic community of the Catalan coast. Preliminary results about feeding on natural zooplankton (300 μm > x < 1 mm) shows that M. leidyi significantly ingested the dominant zooplanktonic groups as copepods and cladocerans. This ctenophore seems to have an important role on nutrient recycling (C, N, and P). Besides, predation by Pelagia noctiluca on M. leidyi was also evaluated. Results showed that this scyphomedusae can prey upon M. leidy and can be an effective control of this ctenophore population. The possible consequences of the mass occurrence of this ctenophore are being studied.

Auatad, G., Bureau of Ocean Energy Management, Herndon, USA, guillerma.auatad@boemre.gov
Roemmich, D., Scripps Institution of Oceanography, La Jolla, USA, droemmich@ucsd.edu

THE CALIFORNIA CURRENT VIEWED FROM THE ARGO NETWORK

A new and comprehensive description of the California Current (CC) is presented given the unprecedented 4D coverage of the Argo network (average horizontal resolution of 3, and vertical and temporal sampling every 10 m and 10 days respectively) which contrasts with earlier studies of the CC using limited-area or mixed-instrument data sources. Three new and arbitrary definitions of the CC are presented and compared based on its a) hydrographic gradients, b) salinity distribution and c) dynamics. From these we describe a southwestward flow at about 42°N in the easternmost waters covered by Argo which is surface-intensified and most visible during summer. Its location, direction, and low salinity suggest origins in the intense river runoff which characterizes these latitudes in spring and summer. We then insert these descriptions in the context of the general circulation of the North Pacific by assessing the potential influence of two water masses and upwelled coastal waters on the flow and properties of the CC.

Augustine, S., IRSN/DEI/secree/LRE, Saint-Paul-lez Durance, France, starr-light.augustine@irsn.fr
Gagnaire, B., IRSN/DEI/secree/LRE, Saint-Paul-lez Durance, France, beatrice.gagnaire@irsn.fr
Adam-Guillermin, C., IRSN/DEI/secree/LRE, Saint-Paul-lez Durance, France, christelle.adam-guillermin@irsn.fr
Kooijman, S. A., Department of Theoretical Biologie, VU, Amsterdam, Netherlands, bas.kooijman@val.wv.nl

MECHANISTIC MODELLING OF ZEBRAFISH METABOLISM IN RELATIONSHIP TO FOOD LEVEL AND THE PRESENCE OF A TOXICANT: URANIUM

The presence of heavy metals in freshwater systems may impact individual life history traits and affect population and ecosystem function. However, how do effects observed during a particular time (and/or space) frame relate to consequences at individual and population levels? We contribute to this issue by applying a standard Dynamic Energy Budget (DEB) model (Kooijman 2010) to a small freshwater cypri- nidal, zebrafish (Danio rerio). We showed that observed patterns of growth, matura- tion and reproduction in relation to food level are well captured by the maturity concept of DEB theory. The model is parameterized using data pertaining to each life stage and provides an excellent basis for extrapolating effects observed at one stage to consequences over the entire lifecycle. This is further illustrated by applying the model to uranium toxicity data (Bourrachot 2009, Augustine unpublished). The predominant mode of action of uranium on the metabolism is captured by the modification of a model parameter which entails a number of direct and indirect consequences for the individual. We here evaluate which parameter is modified and discuss the implications. This work precedes extrapolations to effects on population dynamics.

Aukamp, J. R., EPA, Gulf Breeze, USA, aukamp.jessica@epa.gov
Schaeffer, B. A., EPA, Gulf Breeze, USA, schaefferblake@epa.gov
Conmy, R. A., EPA, Gulf Breeze, USA, conny.robyn@epa.gov

VARIATION OF AQUATIC INHERENT OPTICAL PROPERTIES IN FOUR NORTHWEST FLORIDA ESTUARIES

Optical properties of water are vital to primary productivity and water clarity, and are measures of ecosystem health in estuarine environments. These properties can be used to discern natural from anthropogenic effects on light attenuation, and are the sum of three constituents: non-pigmented particles (detritus), colored dissolved organic matter (CDOM), and phytoplankton pigments. Determining the propor- tional absorbance by these three constituents will quantify the contributors to Ed within the estuaries. The spatial and temporal variations of λ and CDOM(λ), phyto- plankton (ap(λ)), detrital (ad(Particulate ap (λ)))) absorption coefficients are exam- ined in Pensacola, Fl (acdom) Choctawhatchee, St. Andrew, and St. Joseph Bay over the course of 1-year during 2009-2010. In all systems, CDOM is the dominant factor (range of 0.03 – 17.5214 controlling light attenuation, with an acdom/m-1, where highest concentrations were observed in river-dominated bays during peak river discharge. During peak discharge, larger contributions of TSS were also observed (0.10 – 22.4 mg/l). Phytoplankton were found to contribute least to light attenuation, where chlorophyll values ranged between 0.09 – 24.2 µg/l within all systems.

Austin, B. J., University of Arkansas, Fayetteville, USA, baustin@uark.edu
Jackson, A., University of Arkansas, Fayetteville, USA
Brick, K., University of Arkansas, Fayetteville, USA
Evans-White, M. A., University of Arkansas, Fayetteville, USA
Entrekkin, S., University of Central Arkansas, Conway, USA

IMPACT OF NATURAL GAS WELLS ON METABOLISM AND PERIPHYTON IN HEADWATER STREAMS IN NORTH CENTRAL ARKANSAS

The push for energy independence in the U.S., along with technological advances in well drilling, has resulted in a significant increase in recovery of natural gas from Shale formations. With construction of natural gas wells (NGWs), the potential for sediment erosion into streams increases, which could increase turbidity and decrease primary production. Twelve streams with varying densities of NGWs in

A. represents Tutorial presentations
their catchments (0.00-19.73 wells/1000 hectares) were sampled to examine the impact of NGWs on periphyton and metabolism. Within each stream, a 24h oxygen profile was taken to estimate metabolism and 12 cobbles were collected to quantify periphyton communities during the winter and spring of 2010. Turbidity increased with well density in the winter of 2010 ($R^2$=0.49, p=0.02); however, neither turbidity nor well density significantly related to metabolism or periphyton during either sampling period. Natural variability and confounding factors across sites may have limited detection of changes in metabolism and periphyton. Future studies will employ a BACI design, which may be a more powerful way to detect natural gas drilling impacts on stream processes.

Avery, D. E., University of Connecticut, Groton, USA, david.e.avery@uconn.edu
Dam, H. G., University of Connecticut, Groton, USA, hans.dam@uconn.edu

**INDIVIDUAL VARIATION IN THE RESPONSE OF THE COPEPOD EURYTHEMORA HERDMANI TO THE TOXIC DINOFLAGELLATE ALEXANDRIUM SP.**

In previous work, we have observed significant among-individual variability in the responses of copepods to the toxic dinoflagellate Alexandrium sp. Such variability may provide insight into the adaptive responses of zooplankton to toxic algae. For example, individuals of the species Acartia hudsonica and A. tonsa appear to respond positively to toxic food. To test the generality of this phenomenon, we have extended our studies to the copepod Eurytemora herdmani, which was exposed to both toxic and non-toxic clones of Alexandrium sp. in a variety of experiments. We found that ingestion rates varied approximately 3- to 10-fold among individuals depending on diet. The average ingestion rate declined after 24 hrs of feeding on a sole diet of the toxic clone. Importantly, those individuals with the highest ingestion rates on the toxic clone after 6 hours had the greatest decrease in ingestion after 24 hours, indicating that they were the most sensitive to saxitoxins. Those with the lowest ingestion rates on a sole toxic diet after 6 hours saw their ingestion rates increase or remain unchanged after 24 hrs. They apparently possessed resistance/tolerance to the toxins. We hypothesize that some degree of resistance/tolerance is common among copepod species and present in a portion of all populations. We further hypothesize that to fully understand copepod grazing, toxic blooms of Alexandrium sp., and their interrelationships, we account for the variability of individual responses.

Avery, G. B., University North Carolina Wilmington, Wilmington, USA, averyg@uncw.edu
Thompson, L., University North Carolina Wilmington, Wilmington, USA, thompson@uncw.edu
Mead, R. N., University North Carolina Wilmington, Wilmington, USA, mead@uncw.edu
Southwell, M., University North Carolina Wilmington, Wilmington, USA, m.southwell@flagler.edu
Kieber, R. J., University North Carolina Wilmington, Wilmington, USA, kieber@uncw.edu
Skrabals, S. A., University North Carolina Wilmington, Wilmington, USA, skrabals@uncw.edu

**INFLUENCE OF SEA LEVEL RISE ON THE PHOTOLYTIC RELEASE OF DISSOLVED ORGANIC CARBON FROM ESTUARINE SEDIMENTS**

Six hour photolysis of the less than 10 micron fraction of resuspended estuarine sediments was performed in filtered seawater. Estuarine samples included heavily impacted Elizabeth River and relatively less impacted Cape Fear River sediments. Photolytic release of DOC was always significant compared to dark controls suggesting this was primarily a photo mediated process. Cape Fear River sediment resuspension experiments resulted in higher photolytic DOC fluxes compared to Elizabeth River sediments. The rate and net flux of DOC decreased by approximately half over long-term incubations for Cape Fear River sediments indicating aging of sediments likely impacts photolytic release of DOC. The rate and net flux of DOC for Elizabeth River sediments did not change during long-term sediment incubation experiments suggesting these sediments may have already experienced extensive aging. Biogeochemical setting mimicking a potential sea level rise was also assessed during this study and appears to have no effect on photochemical release rates suggesting the biogeochemical setting of sediments (sulfate reduction vs. methanogenesis) is not a dominant parameter influencing photochemical production of DOC.

Avrani, S., Technion - Israel Institute of Technology, Haifa, Israel, avrani@tx.technion.ac.il
Wurtzel, O., Weizmann Institute of Science, Rehovot, Israel, omri.wurtzel@weizmann.ac.il

Sharon, I., Technion - Israel Institute of Technology, Haifa, Israel, itai@cs.technion.ac.il
Sorek, R., Weizmann Institute of Science, Rehovot, Israel, rotem.sorek@weizmann.ac.il
Lindell, D., Technion - Israel Institute of Technology, Haifa, Israel, dindell@tx.technion.ac.il

**GENOMIC ISLAND VARIABILITY FACILITATES COEXISTENCE BETWEEN MARINE VIRUSES AND THEIR PROCHLOROCOCCUS HOSTS**

Viruses and their hosts have coexisted in nature for billions of years. Genetic variability may lead to the presence of both susceptible and resistant hosts and thus facilitate long-term coexistence with viruses. Prochlorococcus and their viruses are extremely abundant in the oceans making this a valuable system for investigating mechanisms of coexistence. Using an experimental selection approach and genome analysis of 58 resistant hosts we show that resistance mutations were present primarily in non-conserved, horizontally transferred genes that localized to a single hypervariable genomic island. These genes are generally uncommon in nature and carry polymorphisms matching those found experimentally. Viruses have a diminished capacity to attach to the mutants indicating altered cell surface properties. The mutations often exact a fitness cost manifested by significantly slower growth rates or more rapid infection by other viruses due to drastically faster attachment. Our data suggest that viruses are a selective pressure impacting Prochlorococcus genome evolution by enhancing population sequence and gene content diversity in genomic islands. This diversity reduces the effective host population size for infection enabling host-virus coexistence in nature.

Baden, S., University of Gothenburg, Fiskebackskil, Sweden, susanne.baden@marecol.gu.se
Emanuelsson, A., University of Gothenburg/ SKL, Fiskebackskil, Sweden, andreas@mp.se
Pihl, L., University of Gothenburg, Fiskebackskil, Sweden, leif.pihl@marecol.gu.se
Svensson, C. J., University of Gothenburg, Gothenburg, Sweden, carl-joel.svensson@marecol.gu.se
Åberg, P., University of Gothenburg, Gothenburg, Sweden, per.berg@marecol.gu.se

**SHIFT IN SEAGRASS FOOD WEB STRUCTURE OVER DECADES LINKED TO OVERFISHING**

Empirical field studies in seagrass show that overgrowth by filamentous algae, reducing seagrass growth, can be explained by a top-down cascade (due to overfishing) enforced by bottom-up interactions (due to eutrophication) on the Swedish west coast 60% of the seagrass has disappeared since the 1980s. We hypothesize that the 4-8 times increase in nutrient load since the 1930s, and overfishing causing a >90% decline in the cod stock have altered the seagrass structure and function during the last decades. In this study, quantitative samplings from 1980s and 2000s of four feeding guilds: top predatory fish, intermediate predatory fish, omnivorous crustaceans and mesoherbivores are compared. Since 1980s the biomass of top predators (gadoids and trout) has decreased 4 times, intermediate fish predators (gobids and sticklebacks) has increased 6 times whereas mesoherbivores (iodotes and gammarids) has disappeared from the seagrass beds. Thus, we found clear evidence that a shift in seagrass food web structure has occurred over three decades. In concert with eutrophication the lack of grazers resulting from this shift most likely contribute to overgrowth by filamentous algae and vanishing seagrass.

Bachoon, D. S., Georgia College & State University, Milledgeville, USA, dave.bachoon@gcsu.edu
Otero, E., University of Puerto Rico, Puerto Rico, ernesto.oteroc@upr.edu
Ramsbuah, A., University of the West Indies, St. Augustine, Trinidad and Tobago, adesh.ramsbuah@sta.uwi.edu
Phillips, T., GCSU, Milledgeville, USA, trisha.phillips@ecats.gcsu.edu
Sherchan, S., GCSU, Milledgeville, USA, samendra.sherchan@ecats.gcsu.edu

**RAPID DETECTION AND QUANTIFICATION OF FECAL INDICATOR BACTERIA ESCHERICHIA COLI O157:H7 AND ATRAZINE DEGRADERS IN THE CARIBBEAN**

Samples were collected from Georgia, Puerto Rico and Trinidad in over 50 stations to compare results of standard fecal contamination tests (enterococci and E. coli counts) with QPCR estimates of fecal bacteria. In addition samples were screened for pathogenic E.coli O157:H7 (fuf gene) and atrazine degraders azA gene (atrazine chlorohydrolase). Based on MF, 50-60% of the stations exceeded USEPA acceptable values. Detection of Bifidobacter sp. was achieved in >70% of Trinidad and PR
samples while B. adolescents (human fecal marker) was detected only in PR (37% of samples). Quantification of Escherichia coli and Enterococcus coli O157:H7 in 24 locations in Puerto Rico and 18 locations in Trinidad indicated that 62.5% of the Puerto Rico sites had E. coli equal to or greater than 5.12 X 10^6 gene number/100 ml of water sampled. 94.8% of the Trinidad sites had E. coli equal to or greater than 5.46 X 10^6 gene number/100 ml of water sampled. The toxic serotype O157:H7 indicated that this serotype for E.coli was present only in a few sites.

Bailey, J. A., Graduate School of Oceanography, University of Rhode Island, Narragansett, USA, jbailey@gso.uri.edu
Byrne, T. A., Graduate School of Oceanography, University of Rhode Island, Narragansett, USA, ryne@gso.uri.edu
Durbin, E. G., Graduate School of Oceanography, University of Rhode Island, Narragansett, USA, edurbin@uri.edu

TROPHIC DYNAMICS IN THE BERING SEA: INTERPLAY OF SPECIES DIVERSITY, PREY SPECTRUM, AND PARASITE INFECTION IN PSEUDOCALANUS COPEPODS

In the Southeastern Bering Sea, the calanoid copepods, Pseudocalanus spp. are important secondary producers. To examine Pseudocalanus species diversity and in situ prey spectrum, samples were collected from the Bering Sea during spring, 2010. To determine localized species diversity, 30 Pseudocalanus individuals were isolated from two stations and the 18S rDNA and mitochondrial cytochrome oxidase 1 gene were sequenced. At least three species of Pseudocalanus coexisted at both stations. Approximately 5% of all Pseudocalanus copepods at each station were infected with an external parasite. We removed the parasites from 3 copepods, sequenced their 18S rDNA, and identified the parasite as Hemiarthrus abdominalis. To date, the only hosts documented for H. abdominalis were shrimp of the family Hippolytidae. Given the significant role that Pseudocalanus plays in the Bering Sea ecosystem, impacts from the parasite on feeding and prey field may be substantial. We are currently conducting analyses of prey DNA in the stomachs of parasitized and unaffected Pseudocalanus to identify impacts of H. abdominalis infection on food web dynamics.

Bailey, S. A., Fisheries and Oceans Canada, Burlington, Canada, sarah.bailey@doc.mpo.gc.ca
Briski, E., GLIER/University of Windsor, Windsor, Canada, briski@uwindsor.ca
Koops, M. A., Fisheries and Oceans Canada, Burlington, Canada, marten.koops@doc.mpo.gc.ca
Wiley, C. J., Fisheries and Oceans Canada/Transport Canada, Sarnia, Canada, chris.wiley@doc.mpo.gc.ca

POTENTIAL VS. ACTUAL PROPAGULE PRESSURE: COMPARATIVE ESTIMATES OF INVASION RISK IN THE GREAT LAKES USING BALLAST WATER VOLUME VS. BIOLICAL SAMPLING

Many studies estimating risk of ballast water invasions use ballast water volume or number of ship arrivals to estimate potential propagule pressure while others incorporate biological sampling programs to determine density of entrained taxa (actual propagule pressure). Studies estimating potential propagule pressure tend to generate measures of relative invasion risk, while studies incorporating actual propagule pressure can generate invasion probabilities. While the precautionary principle favours vector management actions based on potential risk, regulatory management decisions typically require quantified probability estimates. Here, we examine activities of domestic commercial vessels operating in the Great Lakes (Lakers) as a vector for introduction and spread of aquatic invasive species. We compare results of a study measuring total ballast water volume moved by Lakers with results of a study incorporating biological sampling to compare estimates of invasion risk based on measurements of potential and actual propagule pressure. We find that management actions based on potential propagule pressure could result in spreading limited resources too thinly. In contrast, targeted management activities based on actual propagule pressure, while theoretically less precautionary, can result in more effective management.

Baines, S. B., Dept. Ecology and Evolution, Stony Brook University, Stony Brook, NY, USA, sbaines@ms.cc.sunysb.edu
Twining, B. S., Bigelow Laboratory of Ocean Science, West Boothbay Harbor, ME, USA, btwining@bigelow.org
Brzezinski, M. A., Marine Science Institute, University of California, Santa Barbara, CA, USA, mark.brzezinski@lifesci.ucsb.edu
Krause, J. W., Marine Science Institute, University of California, Santa Barbara, CA, USA, jeffrey.krause@lifesci.ucsb.edu

A SURPRISING ROLE FOR PICOCYANOBACTERIA IN THE MARINE SILI-CON CYCLE

Picocyanobacteria play a dominant role in many oceanic nutrient cycles, but they have yet to be implicated in the oceanic silicon cycle. Single cell analysis of cellular elemental content reveals that Si and S:S ratios of picocyanobacteria collected from the Eastern Equatorial Pacific (EEP) were 40 and 60%, respectively, of those observed for diatoms. Synechococcus from the Sargasso Sea also contained measurable amounts of Si, although the maximum amount at any one station was at least 3.5-fold less than observed in the EEP and varied by 20-fold among stations and depths. In the EEP, calculations indicate that the total pool of Si within picocyanobacteria is comparable to that in diatoms. Culture studies of cell quotas and silicate uptake kinetics using 32Si bear out the potential for some cultured strains of Synechococcus to accumulate significant amounts of silicon, but there was a wide degree of vari-ability among strains. Nonetheless, the ability of picocyanobacteria to accumulate Si could have a substantial impact on the cycling of silicon in the ocean and, therefore, the spatial distribution and magnitude of diatom production.

Baker, B. C., University of Arkansas, Fayetteville, USA, bcbaker@uark.edu
Scott, J. T., University of Arkansas, Fayetteville, USA, js6004@uark.edu

LEAF LITTER STOICHEMETRY AND DECOMPOSITION IN RESPONSE TO PHOSPHORUS ENRICHMENT FROM NUTRIENT DIFFUSING SUBSTRATA

Many studies have investigated the effects of nutrient (N and P) enrichment on leaf litter decomposition in streams, but few have explored how P addition alone affects leaf litter stoichiometry (namely C:P). This study will examine how the C:P and decomposition rate of two types of leaf litter (the recalcitrant C. rubra and the labile A. saccharinum) respond to P enrichment from nutrient diffusing substrata (NDS). Leaf bags housed with NDS (agar with P) inside unique PVC containers will be placed into an Orark stream for 10 weeks. Three treatments will be used for each litter type: no P, a medium level supply of P, and a high level supply of P. The PVC container design allows for the NDS to be replaced periodically throughout the experiment after P diffusion rates have slowed. Preliminary results from a diffusion experiment indicate that agar will need to be replaced once a week. The results of the in-stream experiment which will include the change in C:P and decomposition rates in response to P addition and leaf litter type will be presented.

Baker, D. B., Heidelberg University, Tiffin, USA, dbaker@heidelberg.edu
Ewing, D. E., Heidelberg University, Tiffin, USA, eewing@heidelberg.edu
Kramer, J. W., Heidelberg University, Tiffin, USA, jkramer@heidelberg.edu
Richards, R. P., Heidelberg University, Tiffin, USA, rprichard@heidelberg.edu

APPLICATION OF ANALYTICAL METHODS FOR WATER SAMPLES DIRECTLY TO SOILS: LESSONS LEARNED

Phosphorus testing in soils has different objectives and uses different analytical methods than phosphorus testing in surface waters. In soils, phosphorus testing is used to guide fertilization recommendations, while for waters, it is used to assess concentrations as they may impact eutrophication. Our studies of the extent of phosphorus stratification in no-till and reduced till fields have provided us with hundreds of soil samples analyzed by the Mehlich-3 P–ICP soil test method. We have applied a set of surface water methods to dilute aqueous extracts of these soil samples (1g/L) and compared the resulting phosphorus concentration data with the original soil test values. Dissolved reactive phosphorus correlated very closely with Mehlich-3 P over a wide range of Mehlich 3 values (10-150 ppm). Particulate phosphorus, which is often the dominant form of phosphorus in storm runoff, had a very low correlation with Mehlich-3 P concentrations. The particulate phosphorus to sediment ratios for soil samples were much lower than the same ratios observed in rivers during storm runoff events, illustrating the phosphorus enrichment of sediments during erosional and transport processes.

Baker, D. M., Carnegie Institution of Washington, Washington, DC, USA, dbaker@ciw.edu
Fogel, M. L., Carnegie Institution of Washington, Washington, USA, mfogel@gl.ciw.edu

A BIOGEOCHEMICAL BASIS FOR CORAL-ALGAL ASSOCIATIONS

The breakdown of the coral-algal symbiosis via thermally induced bleaching is the biggest threat to the future of coral reefs. There is evidence that corals can change the algal symbiont type they host in an effort to adapt to a warming environment as some rare algal strains are more resistant to bleaching (Clade D), than the more abundant strains (Clade C). But, why don’t all corals already host Clade D? Our hypothesis was that there is a biogeochemical cost of thermal tolerance in the
form of reduced cycling of photosynthates (C) and nutrients (N). In a dual \(^{14}\text{NO}_2\) and \(^{13}C\) enrichment experiment with \textit{Acropora tenuis} "infected" with these symbionts, C1 translocated more N to its host at 28°C than D. However, at 30°C (the sub-bleaching threshold) Clade D outperformed C1 in supplying fixed C to the host. Thus, D sustained the symbiosis at high temperatures by preserving energy flow. Since N is needed for growth and reproduction, we hypothesize that C1 has come to dominate reef communities by boosting colony fitness at ambient temperatures and/or outcompeting other clades in vivo.

Baker, L. A., University of Minnesota, St. Paul, USA, bakerl27@umn.edu
Hobbe, S., University of Minnesota, St. Paul, USA, shobbe@umn.edu
Nidziorski, D., University of Minnesota, St. Paul, USA, dnidzi@umn.edu
fissore, C., University of Minnesota, St. Paul, USA, cinzia.fissore@gmail.com
King, J., University of California-Santa Barbara, Santa Barbara, USA, jykking@geog.ucsb.edu

MOVEMENT OF P THROUGH URBAN ECOSYSTEMS

Loss of P from urban ecosystems is causes widespread surface water eutrophication. Despite years of regulatory effort, there is little evidence that P export from urban watersheds has been substantially reduced, except through improvements in wastewater treatment or by diversion. This policy failure motivates us to take a closer look at sources of P entering urban watersheds and its biochemical transformations. We examined fluxes of P through residential landscapes and at the scale of an entire metropolitan region. For residential landscapes, we used several different approaches to quantify inputs, outputs, and storage, and explored the potential effect of Minnesota’s laws P fertilizer law on long-term P export. For the entire Twin Cities watershed, we examined the effect of a realistic but comprehensive urban P conservation strategy to reduce the need for diminishing phosphate rock resources. In this scenario, P inputs were reduced by 15%, loss to aquatic systems was reduced by 74% and storage was reduced by 70%, while reuse of wastes (sludge; compost) increased by 1280%, supplying peri-urban agriculture with enough P to produce food for the city.

Baker, L. J., University of Hawaii at Manoa, Honolulu, USA, lorydjeanne@gmail.com
Kemp, P. F., University of Hawaii at Manoa, Honolulu, USA, bakerhyd@hawaii.edu

EXPLORING THE BACTERIA-DIATOM METAORGANISM USING SINGLE-CELL WHOLE GENOME AMPLIFICATION

Diatoms and bacteria are often associated closely with one another (Grossart, 2010), with possible implications for the loci of bacterial metabolism (Grossart, 2010) and factors that maintain (Smith et al., 1995), influence or even cause diatom blooms. We are describing the bacterial communities present on single diatom cells at Station ALOHA (22°45'N, 158°00'W), and examining whether or not bacterial-diatom interactions constitute a complex biological network across multiple hierarchical levels. Our description of the bacterial assemblages on individual diatoms from different species is limited to smaller diatoms (between 20 and 100 um) due to the constraints of low flow cytometry. The initial goal is to test whether bacteria have a close, surface-attached, and possibly obligate association with diatoms. Subsequently, we will examine genes that may encourage or discourage diatom health, such as genes that result in the production of vitamin B12 or silicate. If the data suggest that bacteria-diatom associations have the potential to act as a metaorganism with unique composite metabolic capabilities, then the potential implications for ocean biogeochemistry will be considered.

Baldes, J. E., Montana State University, Bozeman, U.S. Virgin Isles, jason.baldes@gmail.com
Gross, J. A., US Geological Survey, Bozeman, USA, igross@usgs.gov
Webb, M., US Fish & Wildlife Service, Bozeman, USA, mwebb@usgs.gov
Gresswell, B., US Geological Survey, Bozeman, USA, bgresswell@usgs.gov

EFFECTS OF CARBON DIOXIDE ON RAINBOW TROUT LARVAE: APPLICATIONS FOR INVASIVE FISH ERADICATION

Currently, efforts are underway to eradicate invasive fish species that threaten the ecological integrity of water bodies and aquatic ecosystems. In this study, various early life stages of rainbow trout (Oncorhynchus mykiss) larvae, were exposed to carbon dioxide in the form of dry ice pellets to determine the critical period of sensitivity for mortality in a model salmonid species. Studies were conducted in aluminum tanks (n = 3 tanks per treatment, with three chambers in each tank with 40 larvae per chamber) with 68 liters of filtered creek water (dissolved CO2 = 4 mg/l, dissolved O2 = 8.125 mg/l, pH = 7.78, temperature = 12.9°C, conductivity = 55 mS, alkalinity = no data for control). Larvae exposed at post hatch day 5 had increased susceptibility to the CO2 when compared with earlier embryonic stages. The results of the experiment indicate that early rainbow trout life history stages are susceptible to CO2 but only at late embryonic stages and may have implications for systematically eradicating invasive salmonids.

Balistrieri, L. S., US Geological Survey, Seattle, USA, balistri@usgs.gov
Cox, S. E., US Geological Survey, Tacoma, USA, secox@usgs.gov
Swarzenski, P. W., US Geological Survey, Santa Cruz, USA, pswarzen@usgs.gov

USING DIFFUSIVE GRADIENTS IN THIN FILMS (DGT) TO MONITOR DIS-SOLVED LABILE CONCENTRATIONS OF TRACE ELEMENTS IN THE UPPER COLUMBIA RIVER, WA, USA

Historical releases of slag from upstream smelter facilities have resulted in deposition of metal-enriched sediment in the Upper Columbia River. The mobilization of metals from slag into groundwater, coupled with daily variations in river-water levels due to diurnal patterns in hydroelectric power demands at nearby dams, could result in pulses of metal-enriched groundwater into the river. Studies using radon and DGT were conducted to examine groundwater-surface water interactions and to evaluate riverine metal concentrations. Radon in groundwater and surface water showed variations with gage height, and time-series excess Rn was modeled to assess groundwater discharge rates. DGT provided information on dissolved labile concentrations of Cd, Cu, Mn, Ni, Pb, and U in the river. No differences were observed in DGT available metal concentrations between near-bottom and surface river water. Speciation calculations using the Windermere Humic Aqueous Model (WHAM VI) are consistent with DGT results and indicate that Cu and Pb primarily exist as metal-organic complexes, about 80-90% of Cd, Mn, and Zn exist as inorganic species, and > 98% of Ni and U species are inorganic.

Ballantine, D. L., University of Puerto Rico, Mayaguez, Puerto Rico, david.ballantine@upr.edu
Ruiz, H., University of Puerto Rico, Mayaguez, Puerto Rico, astreoides@gmail.com
Aponte, N. E., University of Puerto Rico, Mayaguez, nilda.aponte@upr.edu

ALGAL COMPOSITION AND COMMUNITY DYNAMICS AT TWO PUERTO RICAN MESOPHOTIC REEF SITES

Mesopelagic algal abundance (as percent cover) was evaluated at two Puerto Rican shelf edge sites at each of two depths (50 and 70 m). Algae dominate live benthic cover at both 50 and 70 m depths with total algal cover exceeding 70% at 50 m and approaching 50% at 70 m. Much of the algal cover is dominated by crustose coralline algae as well as a number of Peyssonnelia species, some of which are restricted to deep-water habitats. Variability in temporal cover data was compared with that taken earlier at a 30 m site, indicating a decrease in temporal variability at greater depths. Multidimensional scaling analysis of average abundances of benthic organisms (algae, sponges and corals) indicated significant differences in community composition with respect to habitat (steep slope and high rugosity vs. gentler slope and low rugosity) and depth.

Ballester, K. E., North Carolina State University, Raleigh, USA, karina_ballester@ncsu.edu
Ramirez-Toro, G., Interamerican University of Puerto Rico, San German, Puerto Rico, gramirez@inter.edu
Hertler, H., Interamerican University of Puerto Rico, San German, Puerto Rico, hherter@inter.edu
Escudero, B. I., North Carolina State University, Raleigh, USA, blanca_escudero@ncsu.edu
Jaykus, L. A., North Carolina State University, Raleigh, USA, pajkus@ncsu.edu
Levine, J. F., North Carolina State University, Raleigh, USA, jf_levine@ncsu.edu

USING OCCURRENCE OF MICROBIAL INDICATORS AND FRANK PATHOGENS IN WATER, SEDIMENT AND MOLLUSKS IN DEVELOPING A LOCAL SHELLFISH SANITATION PROGRAM IN PUERTO RICO

Surface water fecal contamination from residential, commercial, agricultural or sylvan sources contributes to the burden of shellfish-associated gastroenteritis. Shellfish are harvested from near-shore areas of different bays in the southwest and south of Puerto Rico and sold in local markets. This study was initiated to estimate the prevalence of enteric pathogens in molluscan shellfish harvested and sold locally. Standard sampling protocols developed by ISSC were used to conduct a survey of Puerto Rico’s four primary shellfish rearing areas. Each of these areas were sampled for water, sediment, and bivalves bimonthly and after five storm events during an 18
Balseiro, E., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, e.balseiro@comahue-conicet.gob.ar
Souza, M. S., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, solsbv@gmail.com
Laspoumanderes, C., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, claspoumanderes@comahue-conicet.gob.ar
Modenutti, B., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, bmodenutti@comahue-conicet.gob.ar

INDIRECT EFFECT OF UVR AND STOICHIOMETRIC CONSTRAINTS IN PLANKTONIC COPEPODS

Balseiro, E., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, e.balseiro@comahue-conicet.gob.ar
Souza, M. S., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, solsbv@gmail.com
Laspouna-mandes, C., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, claspouna-mandes@comahue-conicet.gob.ar
Modenutti, B., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, bmodenutti@comahue-conicet.gob.ar

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Balseiro, E., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, e.balseiro@comahue-conicet.gob.ar
Souza, M. S., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, solsbv@gmail.com
Laspouna-mandes, C., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, claspouna-mandes@comahue-conicet.gob.ar
Modenutti, B., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, bmodenutti@comahue-conicet.gob.ar

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Souza, M. S., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, solsbv@gmail.com
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Souza, M. S., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, solsbv@gmail.com
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Souza, M. S., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, solsbv@gmail.com
Laspouna-mandes, C., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, claspouna-mandes@comahue-conicet.gob.ar
Modenutti, B., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, bmodenutti@comahue-conicet.gob.ar

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Souza, M. S., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, solsbv@gmail.com
Laspouna-mandes, C., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, claspouna-mandes@comahue-conicet.gob.ar
Modenutti, B., Lab Limnología, INIBIOMA, CONICET-UNComahue, Bariloche, Argentina, bmodenutti@comahue-conicet.gob.ar

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Peterson, T., Oregon Health & Science University, Beaverton, USA

BRINGING TOGETHER TRIBAL AND QUANTITATIVE OCEANOGRAPHIC PERSPECTIVES IN A SCIENTIFIC FRAMEWORK FOR COASTAL MARGINS

Tribal and quantitative oceanographic perspectives are being integrated in the development of a scientific framework to address natural resource issues in the U.S. Pacific Northwest coastal margin. In response to pressing resource management concerns, the NSF Science and Technology Center for Coastal Margin Observation & Prediction has engaged in several collaborations with Tribal institutions. Two such collaborations (and their cross-linkage) are highlighted here: one is focused on glacier-based characterization of ocean conditions off the Quinault Indian Reservation, in the Washington continental shelf; the other is focused on the observation and prediction of fisheries-relevant physical and ecological processes in the Columbia River estuary and plume, including the analysis of potential impacts associated with the impending re-negotiation of the Columbia River Treaty. Oxygen depletion in the estuary associated with shell hypoxia, will be used to illustrate linkages across the two collaborations. Also described will be an emerging workforce development pathway, crossing the ‘K-gray’ spectrum, which is being developed in support of better mutual understanding of Tribal and western perspectives.

Barba, A. P., University of Maryland, Cambridge, USA, abarba@umces.edu
Roman, M. R., University of Maryland, Cambridge, USA, roman@umces.edu
Pierson, J. J., University of Maryland, Cambridge, USA, jpierson@umces.edu

COMPARING ZOOPLANKTON RESPONSE TO HYPOXIA IN CHESAPEAKE BAY

Hypoxia is a common occurrence in fresh and salt water worldwide and can have negative effects on local fish and zooplankton including in the Chesapeake Bay. Copepods, specifically Acartia tonsa, are the most abundant type of zooplankton in the mesohaline reaches of the Bay. They occupy the base of the food web in many aquatic systems, including in Chesapeake Bay, and play a large role in transferring energy and material to higher trophic levels. We compared copepod behavior and fitness at both a hypoxic and an oxic site over three seasons, spring, summer and fall. It is hypothesized that low oxygen water will reduce the fitness of copepods and alter the migration behavior. To test this hypothesis, we observed copepod behavior and fitness using nets and traps, and we focused on migration patterns, population dynamics and RNA/DNA ratios.

Bargar, T. A., US Geological Survey, Gainesville, FL, USA, tbargar@usgs.gov
Garrison, V. H., US Geological Survey, St. Petersburg, FL, USA
Orazio, C., US Geological Survey, Columbia, MO, USA

CONTAMINANTS ASSESSMENT OF CORAL REEFS IN THE VIRGIN ISLANDS NATIONAL PARK (VINP)

Tropical coral reefs around the world have been exhibiting signs of stress over the past 20 years. Contamination from coastal sources may be one of the causative factors and could be a stressor to reefs within the Virgin Islands National Park (Park) and Coral Reef National Monument (Monument). A pilot study was conducted in May 2010 to assess contamination levels in several reefs and associated biota within the Park and Monument. Passive samples were deployed at four different reefs (Hawksnest Bay, Whistling Cay, Tektite, Round Bay) to determine organic contaminant concentrations in reef waters. Sampler extracts were also subjected to the Yeast Estrogen Screen to assess estrogenicity of the contaminant mixture. Plankton (undifferentiated species), fish (Stegastes planifrons), coral (Montastrea annularis), and detritus samples were also collected from those reefs to determine contaminant concentrations at different trophic levels. Contaminant concentrations detected in the different matrices will be used to (1) assess the possible biological effects to reef organisms due to the contamination and (2) determine the possible local land-based sources of pollution to the reefs of the Park and Monument.

Bargu, S., Louisiana State University, Department of Oceanography and Coastal Sciences, Baton Rouge, LA, USA, sbargu@lsu.edu
Silver, M., Department of Ocean Sciences, University of California, Santa Cruz, Santa Cruz, CA, USA, msilver@ucsc.edu

THE CONSEQUENCES OF THE PRESENCE OF ALGAL TOXINS IN AQUATIC FOOD WEBS

The consequences of an increased presence of phycotoxins in aquatic systems are relatively poorly known on scales other than those of acute, short-term exposures of individual animals or populations. Other consequences could include, for example, sub lethal effects on individuals that lead to impaired immune systems, reductions in fitness, and to exodus of vulnerable, mobile species from communities. On longer time scales, the structure of communities likely would change with increasing toxic exposure, including to dominance of tolerant species, as well as reductions in overall animal diversity. Additionally, reduction in grazing on toxic phytoplankton could result in enhanced phytoplankton levels and reduction of secondary and tertiary production relative to primary production. Our goal for this review is to discuss the consequences of an increasing presence of toxin-producing algae in aquatic communities, including topics that historically have been a focus of terrestrial ecologists. These include a range of subjects from individual fitness to plant-herbivore interactions to broader community-level changes, and include short-term to evolutionary-scale consequences of the likely-increasing presence of toxic algae in aquatic systems.

Barckley, H., Princeton University, Princeton, USA, hbarckley@princeton.edu
Cohen, A., Woods Hole Oceanographic Institution, Woods Hole, USA, acohen@whoi.edu
de Putron, S., Bermuda Institute of Ocean Sciences, St Georges, Bermuda, samantha.deputron@bios.io
Davis, C., Woods Hole Oceanographic Institution, Woods Hole, USA, cdavis@whoi.edu
Pacala, S., Princeton University, Princeton, USA, pacala@princeton.edu

ESTABLISHING LINKS BETWEEN BASIN-SCALE CLIMATE VARIABILITY AND THE GROWTH OF ATLANTIC CORALS: AN EXPERIMENTAL INVESTIGATION

Growth of important reef-building corals in the tropical North Atlantic is strongly influenced by large scale modes of climate variability. During extended negative (cool, high-productivity) phases of the North Atlantic Oscillation (NAO) and Atlantic Multidecadal Oscillation (AMO), rates of skeletal growth are 30-50% higher than during extended positive (warm, low productivity) phases. IPCC AR4 Coupled GCMs predict shifts in both NAO and AMO over the 21st century. Thus, predicting the full impact of climate change on Atlantic coral reef ecosystems requires understanding the mechanisms linking coral growth and ocean variability. We investigated the relative influence of temperature and food availability on the Atlantic coral, Favia fragum, rearing zooxanthellate juveniles in 4-week culture experiments under 22°C, 25°C, 28°C, combined with fed or unfed conditions. Corals in cold, nutrient-replete conditions were >50% larger and polyps had higher lipid and symbiont densities than those reared under warmer, nutrient-depleted conditions. These results highlight the importance of heterotrophic feeding and by extension, ocean productivity in fueling the growth of reef-building corals, with important implications for the health of coral reef ecosystems over the 21st century.

Barnard, A. H., WET Labs, Inc, Philomath, USA, andrew@wetlabs.com
Koch, C., WET Labs, Inc, Philomath, USA, corey@wetlabs.com
Egl, P., SubChem Systems, Inc, Narragansett, USA, pete@subchem.com
Hanson, A., SubChem Systems, Inc, Narragansett, USA, hanson@subchem.com
Gregory, T., University of New Hampshire, Durham, USA, tom.gregory@unh.edu
Ragan, M. A., University of Southern California, Los Angeles, USA, mragan@usc.edu
Jones, B., University of Southern California, Los Angeles, USA, bjones@usc.edu
Campbell, R., Prince William Sound Science Center, Cordova, USA, campbel@pwssc.org
Needoba, J., Oregon Health and Science University, Beaverton, USA, needoba@ohsb.org

PERFORMANCE VALIDATION OF THE CYCLE-PO4, AN INSTRUMENT FOR IN-SITU AND LONG-TERM ORTHOPHOSPHATE MONITORING.

The CYCLE-PO4 is an in-situ orthophosphate analyzer designed for long-term monitoring. The instrument is capable of sampling twice per hour over deployments of weeks to months (~1000 samples). The chemical analysis system is based on the standard heteropoly blue method, and the CYCLE utilizes a cartridge based reagent delivery system to enable rapid field servicing. The CYCLE-PO4 has a precision of 50 nM, a range of ~75 nM (detection limit) to over 10 μM, and an on-board standard to verify instrument performance. As part of the commercialization plan for the CYCLE-PO4, extensive verification and validation has been conducted in collaboration with representative end users. These users have deployed the CYCLE-PO4 in a variety of sampling situations: coastal ocean, estuaries, lakes, and rivers. A comparison of reactive phosphate values measured using the CYCLE-PO4 and conventional grab sampling followed by laboratory analysis has been performed over several years, and validation results indicate accuracy near 100 nM. Through extensive field studies the instrument has been shown to be robust and as accurate as typical laboratory analysis of grab samples.
THE IMPACT OF GROWTH RATE AND NUTRIENT ACQUISITION STRATEGY ON THE ECOCLOGICAL SUCCESSION OF DIATOMS AND DINOFLAGELLATES

We hypothesize that these dynamics are related to two functional traits: maximum potential growth rate and nutrient acquisition strategy (autothrophy, mixotrophy, or heterotrophy). Diatoms tend to have higher maximum potential growth rates than dinoflagellates of the same size, and within groups, growth rate scales with cell mass to the -1/4 power. Using published cell size estimates as a proxy for growth rate, we argue that smaller diatoms bloom before larger diatoms because of their higher growth rates. Because of their slower growth rates, such opportunism does not appear to be an effective strategy for dinoflagellates. Unlike the photoautotrophic diatoms, most dinoflagellates are either heterotrophs (consuming organic matter but not photosynthesizing) or mixotrophs (with heterotrophic and autotrophic capabilities). When separated by nutrient acquisition strategy, we find that both dinoflagellate subgroups peak later than diatoms, with the mixotrophs dominating the period between the spring diatom and summer heterotrophic dinoflagellate maxima. The functional traits discussed here, in addition to others reported previously, offer a promising approach to understanding the ecological dynamics seen in the CPR survey.
networks for GHG exchange from inland waters are needed and should be developed in line with existing networks focusing on other ecosystems.

Bates, N. R., Bermuda Institute of Ocean Sciences, St George’s, Bermuda, nick.bates@bios.edu
Amat, A., Bermuda Institute of Ocean Sciences, St George’s, Bermuda
Andersson, A. J., Bermuda Institute of Ocean Sciences, St George’s, Bermuda, andreas.andersson@bios.edu

THE CARBONATE CHEMISTRY CORAL REEF ECOSYSTEM FEEDBACK (CREF) HYPOTHESIS

Despite the potential impact of ocean acidification on ecosystems such as coral reefs, there is very limited field data on the relationships between calcification and seawater carbonate chemistry. In this study, contemporaneous in situ datasets of seawater carbonate chemistry and calcification rates from the high-latitude coral reef of Bermuda over annual timescales provide a framework for investigating the present and future potential impact of rising CO₂ levels and ocean acidification on coral reef ecosystems in their natural environment. A strong correlation was found between in situ rates of calcification for the major framework building coral species Diploria labyrinthiformis and the seasonal variability of [CO₂]^− and aragonite saturation state. These field observations provide sufficient data to hypothesize that there is a seasonal “Carbonate Chemistry Coral Reef Ecosystem Feedback” (CREF hypothesis) between the primary components of the reef ecosystem (i.e., scleractinian hard corals and macroalgae) and seawater carbonate chemistry that can either suppress or enhance coral calcification during different seasons.

Bauer, B., University of Potsdam, Potsdam, Germany, bauerb@uni-potsdam.de
Vos, M.

DIVERSITY INFLUENCES ECOSYSTEM FUNCTION THROUGH SYNCHRONIZATION AND COMPENSATORY DYNAMICS

Diversity is thought to stabilize ecosystem function by promoting compensatory dynamics where increases in some species’ biomass make up for decreases in others. Compensation is thought to arise when a sufficient number of functionally different species coexist and compete with each other. Therefore, discerning the effects of species richness from those of functional diversity is an important challenge. We addressed it by extending a previously described two-trophic-level plankton model. We varied species diversity and functional differences between species. Our aim was the exploration of the conditions for compensation and synchronization among predator and prey species which affect the biodiversity-ecosystem function relationship. At low species numbers we encountered compensatory dynamics even at low functional diversity. Increasing species numbers increases their trophic similarity. This enhances the chance of synchrony by causing the predators’ biomasses to track the oscillations of increasingly similar sets of prey species. Overall, we found that different ranges of species diversity have contrasting effects on the reliability of ecosystem function by inducing either synchronization, compensatory dynamics or stasis.

Bauer, J. E., Ohio State University, Columbus, USA, bauer.362@osu.edu
Moyer, R. P., US Geological Survey, St. Petersburg, USA, rmoyer@usgs.gov
Raymond, P. A., Yale University, New Haven, USA, peter-raymond@yale.edu
Grottoli, A. G., Ohio State University, Columbus, USA, grottoli.1@osu.edu
Levas, S. J., The Ohio State University, Columbus, USA, levas.1@osu.edu
Warner, M. E., University of Delaware, Newark, USA, mwarner@udel.edu

THE EFFECTS OF REPEAT BLEACHING ON P/R AND FEEDING RATES OF THREE SPECIES OF CARIBBEAN CORAL

Bleaching events are predicted to increase as a result of rising sea surface temperatures. Paired fragments of the Caribbean corals Porites divaricata, Porites astreoides, and Montastraea faveolata were experimentally bleached (treatment), or not bleached (control) in outdoor flow-through seawater tanks at temperatures of 31.5 °C and 29.5 °C, respectively, for 2.5 weeks. Half of the fragments were immediately collected, and half were returned to the reef to recover for one year at ambient temperature, flowed by repeat bleaching following the summer. Single and repeat bleaching had no significant effect on the P/R ratio of P. astreoides but did result in higher feeding rates. However, both single and repeat bleaching caused a significant decrease in P/R in M. faveolata despite there being no effect on feeding rates. Thus, Porites corals can compensate for loss in P due to bleaching by decreasing R and increasing feeding. Conversely, M. faveolata do not adjust their feeding rates to compensate for P losses due to bleaching. Subtle differences between single and repeat bleaching stress will be explored.

Baumann, Z., Stony Brook University, Stony Brook, USA, zosia@ravenblond.com
Fisher, N. S., Stony Brook University, Stony Brook, USA, nsfisher@notes.cc.sunysb.edu

RELATING SEDIMENTARY METAL PHASE SPECIATION TO ITS BIOAVAILABILITY

We studied the influence of sediment geochemistry on bioavailability of arsenic, cadmium and chromium in deposit-feeding polychaetes. Metal phase speciation in sediments was determined with a sequential extraction scheme, and assimilation efficiencies (AEs) of ingested metals were determined by pulse-chase feeding experiments using γ-emitting isotopes. Metal AEs were positively related to the exchangeable and carbonate sedimentary fractions and inversely related to their fractionation in iron and manganese oxides, AVS, and pyrite. Arsenic was most bioavailable from pure algae (72%), less from sediments mixed with algae (24-70%) and least from sediments labeled with added algae (1-12%). Arsenic AEs in sediments showed a positive correlation with sedimentary Mn and Al and negative correlation with Fe. Cadmium AEs were positively correlated with salinity and negatively correlated with sedimentary organic carbon. AEs of Cr from sediments or algae were < 5%, but 34% from pure goethite by quantifying the relationship of metal mineral phase speciation in sediments with their bioavailability for deposit-feeding polychaetes. This study provides new insight into understanding metal bioaccumulation in benthic invertebrates.
Bayindirli, C., University of East Anglia, Norwich, United Kingdom, C.Bayindirli@uea.ac.uk
Thomas, S., Plymouth Marine Laboratory, Plymouth, United Kingdom, simona@pml.ac.uk
Gilbert, J., University of Chicago, Chicago, USA, gilbertjack@gmail.com
Tarran, G., Plymouth Marine Laboratory, Plymouth, United Kingdom, gat@pml.ac.uk
Widdicombe, C., Plymouth Marine Laboratory, Plymouth, United Kingdom, CLST@pml.ac.uk
Woodward, M., Plymouth Marine Laboratory, Plymouth, United Kingdom, EMSW@pml.ac.uk
Torres, R., Plymouth Marine Laboratory, Plymouth, United Kingdom, rito@pml.ac.uk
Achterberg, E., National Oceanography Centre, Southampton, United Kingdom, eric@noc.soton.ac.uk
Mingkwan, P., National Oceanography Centre, Southampton, United Kingdom, Robinson, C., University of East Anglia, Norwich, United Kingdom, Carol.Robinson@uea.ac.uk

TEMPORAL SUCCESSION IN MICROBIAL COMMUNITY STRUCTURE AND GENE EXPRESSION DURING A LAGRANGIAN STUDY IN THE NORTH WEST AFRICAN UPWELLING

The upwelling region off the coast of Mauritania is one of the most productive areas of the world ocean, yet little is known of the temporal and spatial variability in prokaryotic community structure and metabolic activity there, and crucially how this contributes to global elemental cycles. During a NERC SOLAS funded Lagrangian study, we determined bacterial and archaeal community structure and gene expression using the V6 region of the 16S ribosomal RNA gene. To allow maximal coverage of diversity, we utilised the tag sequencing technique on the 454 pyrosequencing platform. In this presentation we describe the temporal changes in prokaryotic community structure and the metabolic activity of specific groups such as Archaea and bacterial phyla, Proteobacteria, in relation to the complex upwelling environmental conditions (mixing, chlorophyll, dissolved organic and inorganic nutrients). Turbulence and dissolved organic carbon appear to play an important role. Although the microbial community is dominated by Proteobacteria both in the coastal and the offshore part of the upwelling plume, the Archaeal gene expression, as well as the gammaproteobacteria, Oceanospirillales, increases dramatically during the middle of the filament.

Beaver, J. R., BSA Environmental Services, Inc., Beachwood, USA, j.beaver@bsaenv.com
Hickman, G. J., U.S. Bureau of Reclamation, Boulder City, USA
Rosati, T. C., BSA Environmental Services, Inc., Beachwood, USA
Maynard, M., U.S. Bureau of Reclamation, Beachwood, USA
Thorson, M., U.S. Fish & Wildlife Service, Parker, USA
Scotese, K. C., BSA Environmental Services, Inc., Beachwood, USA

TROPHIC LEVEL INTERACTIONS IN LAKE HAVASU, AZ-CA FOLLOWING INVASION BY DREISSINID MUSSELS

Unlike larger reservoirs on the Colorado River, Lake Havasu is relatively shallow, has a short hydraulic residence time and minimal variation in lake elevation, lacks significant primary production in Lake Havasu is extremely limited with an almost complete lack of Daphnia veligers were comparable to trends in Lake Mead. Significant increases in water clarity following quagga mussel establishment in Lake Havasu. Current zooplankton dynamics in the spring and winter, but was not a primary driver during summer. Bacterial growth efficiency (BGE) and bacterial respiration (BR) were correlated with urban land use over the course of the year; however, this relationship was weak. In addition, BGE and BR were inversely correlated with aquatic N and P concentrations, and not correlated with DOC concentrations.

Bedsole, P., University of Rhode Island Graduate School of Oceanography REU, Narragansett, USA, Pbedsole@gmail.com

DIATOM-BOUND NITROGEN ISOTOPES: TRACKING CHANGES IN NUTRIENT CONCENTRATION AND ECOSYSTEM FUNCTION IN A WESTERN GULF SLOPE RIVER SYSTEM

Riverine ecosystems are a vitally important link between terrestrial and aquatic ecosystems, but the relationships between patterns of land-use, in-stream nutrient dynamics, and riverine ecosystem function are often complex. Aquatic nutrient and ecosystem function data was collected three times at 37 sites in the central and lower Brazos River watershed (Texas) seasonally in 2008-2009. Sampling was conducted in mainstream and tributary sites across six large sub-watersheds. GIS was used to assess land-use/land-cover parameters in the watershed and tributary sub-basins. The effects and scale of land use and environmental parameters changed throughout the year, but there was generally a gradient between intensive human landscape modification and lower impact uses. Urban land use was a strong driver of nutrient dynamics in the spring and winter, but was not a primary driver during summer. Bacterial growth efficiency (BGE) and bacterial respiration (BR) were correlated with urban land use over the course of the year; however, this relationship was weak. In addition, BGE and BR were inversely correlated with aquatic N and P concentrations, and not correlated with DOC concentrations.

Behl, S., Ludwig-Maximilians-Universität Munich, München, Germany, behl@zi.biolologie.uni-muenchen.de
de Schryver, V., Ludwig-Maximilians-Universität Munich, München, Germany
Stibor, H., European Institute for Marine Studies, Brest, France, herwig.stibor@univ-brest.fr
TROPHIC EFFECTS OF PHYTOPLANKTON DIVERSITY ON THE PERFORMANCE OF DAPHNIA MAGNA POPULATIONS

Diversity has been recognized to be one important factor shaping community and ecosystem dynamics. However, most studies have mainly focused on diversity effects within single trophic levels, such as primary producer communities, in both aquatic and terrestrial environments. Hence, so far, only little is known about how diversity effects may translate from one trophic level to the next higher one. We did short-term (11d) and long-term (240d) laboratory experiments with the freshwater cladoceran Daphnia magna feeding on different diverse algal communities in batch and semi-batch cultures. Additionally, we exposed the plankton communities to different ratios of light: nutrient supply, in order to investigate stoichiometric effects on population growth. We measured growth rates of the algal species, total biomass accrual and reproductive performance of Daphnia in the different treatments. We found that life expectancy of founder individuals and total biomass yield of D. magna populations were higher in more diverse phytoplankton communities, and that algal stoichiometry had only minor effects on that. Moreover diversity had a strongly stabilizing effect on the total biomass of Daphnia populations.

A. M. Beijbom, O., Department of Computer Science and Engineering, University of California San Diego, La Jolla, USA, obei@cs.ucsd.edu
Treibitz, T., Department of Computer Science and Engineering, University of California San Diego, La Jolla, USA, tali@cs.ucsd.edu
Neal, B. P., Scripps Institution of Oceanography, University of California San Diego, La Jolla, USA, bneal@spg.ucsd.edu
Kriegerman, D., Department of Computer Science and Engineering, University of California San Diego, La Jolla, USA, kriegenman@cs.ucsd.edu
Belongie, S., Department of Computer Science and Engineering, University of California San Diego, La Jolla, USA, sbj@cs.ucsd.edu
Edmunds, P. J., California State University Northridge, Northridge, USA, peter.edmunds@csun.edu
Kline, D. L., Coral Reef Ecosystems Lab, Global Change Institute, University of Queensland, St Lucia, Australia, d.kline@uq.edu.au
Moriarty, V., California State University Northridge, Northridge, USA, vmoriarty@csun.edu
Mitchell, B. G., Scripps Institution of Oceanography, University of California San Diego, La Jolla, USA, gmitchell@ucsd.edu

AUTOMATED CORAL REEF ANALYSIS USING COMPUTER VISION

Large sets of images are routinely acquired as part of coral reef surveys. From these images, benthic reef population statistics are estimated using random point sampling. This method requires an expert to classify the benthic substrate of a number of randomly distributed points overlaid on an image. For a typical survey, a human would have to arduously annotate 50,000 - 100,000 points. Previous reef analysis tools like this, such as Coral Point Count (CPCe), have concentrated on facilitating graphical annotations, but are not capable of automatic classification. We have built a tool that provides automated coral reef community statistics using texture and color analyses methods, developed with techniques from the computer vision and machine learning communities. The classification engine is trained on previously labeled images annotated with the CPCe method. Experiments on the NSF-funded Moorea Coral Reef Long Term Ecological Research site (MCR-LTER) database yield encouraging results, and the techniques can be readily applied to other digital image datasets. We also look at advantages and disadvantages of our method compared to other automated coral community analysis methods.

A. M. Beijbom, O., McGill University, Department of Biology, Montreal, Canada, magnus.bein@mail.mcgill.ca
McIntyre, P. B., University of Wisconsin, Centre of Limnology & Department of Zoology, Madison, Canada, pmcintyre@wisc.edu
Vadeboncoeur, Y., Wright State University, Department of Biological Sciences, Dayton, California, yvonne.vadeboncoeur@wright.edu
De Mazancourt, C. S., McGill University, Department of Biological Sciences, St Lucia, Canada, claire.demazancourt@mcgill.ca
Loreau, M., McGill University, Department of Biology, Montreal, Canada, michelloreau@mcgill.ca

OPTIMAL PRODUCTIVITY IN AQUATIC ECOSYSTEMS: THEORETICAL INSIGHTS AND OBSERVATIONS FROM THE LITTORAL ZONE OF LAKE TANGANYIKA

Many kinds of ecosystems manage to maintain stable, high primary productivity despite low ambient nutrient levels. The littoral zone of Lake Tanganyika, one of the great tropical lakes of the world, offers opportunities to untangle the biological and physical processes that give rise to low-nutrient, high-productivity ecosystems. We have developed theoretical models of nutrient cycling in the littoral zone to clarify the mechanisms for maintaining high primary production in the face of intensive grazing and fluctuating nutrient inputs. After parameterizing these models using field data, we find that the form of the functional relationships between consumers and their resources, the frequency of nutrient inputs from upwelling, and the presence of both benthic and planktonic food chains are all essential for understanding the productivity of this ecosystem. These theoretical results accord well with field results, which indicate that phytoplankton respond more strongly to upwelling than benthic producers, and grazing fishes may actually enhance littoral productivity by retaining and recycling nutrients. These results provide evidence for the grazing optimization hypothesis, and suggest that climate warming and fishing will strongly affect the functioning of this unique ecosystem.

M. W. Beijbom, O., McGill University, Department of Biology, Montreal, Canada, magnus.bein@mail.mcgill.ca
McIntyre, P. B., University of Wisconsin, Centre of Limnology & Department of Zoology, Madison, Canada, pmcintyre@wisc.edu
Vadeboncoeur, Y., Wright State University, Department of Biological Sciences, Dayton, California, yvonne.vadeboncoeur@wright.edu
De Mazancourt, C. S., McGill University, Department of Biological Sciences, St Lucia, Canada, claire.demazancourt@mcgill.ca
Loreau, M., McGill University, Department of Biology, Montreal, Canada, michelloreau@mcgill.ca

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A. M. Beijbom, O., McGill University, Department of Biology, Montreal, Canada, magnus.bein@mail.mcgill.ca
McIntyre, P. B., University of Wisconsin, Centre of Limnology & Department of Zoology, Madison, Canada, pmcintyre@wisc.edu
Vadeboncoeur, Y., Wright State University, Department of Biological Sciences, Dayton, California, yvonne.vadeboncoeur@wright.edu
De Mazancourt, C. S., McGill University, Department of Biological Sciences, St Lucia, Canada, claire.demazancourt@mcgill.ca
Loreau, M., McGill University, Department of Biology, Montreal, Canada, michelloreau@mcgill.ca
Beltrán Rodríguez, D. M., Macquarie University, Sydney, Australia, Belo.Couto@gmail.com

Maharaj, A. M., Macquarie University, Sydney, Australia, angela.maharaj@mq.edu.au

Holbrook, N. J., University of Tasmania, Hobart, Australia, neil.holbrook@utas.edu.au

INTERNATIONAL PATTERNS OF GLOBAL NET PRIMARY PRODUCTION

In the ocean, the creation of highly energetic organic compounds, which involves fixing solar energy to inorganic elements, is known as primary productivity (PP). This activity is mainly carried out by microscopic drifting phytoplankton composing the very first trophic level of most of the ecosystems’ food chain and therefore is crucial to all forms of oceanic life. Net PP (NPP) rates are mainly regulated by phytoplankton distribution, which is essentially determined by sunlight and nutrient availability. These two limiting variables are fundamentally related to climate variability, mainly through atmosphere and ocean dynamics. Although intra-annual patterns of climate variability explain approximately 65% of the spatial and temporal variance in NPP, significant interannual variability is also observed. Here we uncover three independent modes of NPP interannual variability that explain ±73 to ±126 Tg C in a decade. El Niño–Southern Oscillation dynamics have been suggested as the main driver of oceanic NPP interannual variability. We not only confirm this but also isolate this pattern and quantify it. Furthermore, in this paper we also isolate a decadal mode that explains ±131 to ±256 Tg C day⁻¹ during the same time period. Finally, we reveal the Indian Ocean to be an important region for global NPP variability.

Beltrán Rodríguez, D. M., University of Puerto Rico/Sea Grant College Program, Mayaguez, Puerto Rico, dbeltran@cima.uprm.edu

Morales Núñez, A. G., University of Puerto Rico/Sea Grant College Program, Mayaguez, Puerto Rico

BRINGING MARINE KNOWLEDGE TO THE COMMUNITY: A CASE OF PUERTO RICO

The education division of the University of Puerto Rico Sea Grant College Program is one of the components of Marine Outreach Program. The main objective of the division is offer marine education, including the current status of coastal and marine ecosystem in different population groups; such as schools, communities groups and general public at diverse forums. In recent years the Education Division has focused its efforts on implementing activities assuring get there with clear and simple message of conservation marine resources, dangerous marine species, and coastal sustainable development to people. We offer different educational activities through lectures at schools, fairs and marine exhibitions around the island, allowing to all people access to this information and develop the motivation on teachers and student to create new groups which work in to disclose our information and helping to preserve the marine resources.

Beman, J. M., University of California, Merced, Merced, USA, mbeman@ucmerced.edu

MICROBIAL DIVERSITY IN THE OXYGEN MINIMUM ZONE OF THE EASTERN TROPICAL NORTH PACIFIC OCEAN AS REVEALED BY PYROSEQUENCING

Oxygen minimum zones (OMZs) are biogeochemically-important regions of the world’s oceans that are expanding as a consequence of climate change. Microorganisms play direct and indirect roles in creating OMZs, and their activities in these regions have an enormous influence on global elemental cycles. Here I report patterns in diversity, abundance, and activity of multiple microbial groups across an oceanographic transect through the OMZ of the eastern tropical North Pacific Ocean. To generate a comprehensive view of OMZ microbial communities, variations in community composition and diversity with depth and between stations were mapped with 454 pyrosequencing of 16S rDNA. These results compared favorably with enumeration of specific microbial groups using quantitative PCR, and provided new insight into the dominant microbial groups involved in nitrogen cycling in the eastern tropical North Pacific (ETNP)—including ammonox bacteria and nitrifying bacteria and archaea. Bacterial diversity was also typically greatest along the margins of the OMZ, where substrate availability and metabolic coupling may enrich bacterial community diversity. Based on my findings, the ETNP OMZ hosts diverse microbial communities involved in oceanic nitrogen and carbon cycling.

Benitez-Nelson, C., University of South Carolina, Columbia, USA, cbnelson@geol.sc.edu

Thunell, R., University of South Carolina, Columbia, USA, thunell@geol.sc.edu

FERRIOL, P., UNIVERSITAT DE LES ILLES BALEARS, PALMA DE MALLORCA, Spain, perreferriol@gmail.com

STAL, L. J., NIOO-KNAW, YERSEKE, Netherlands, lstal@nioo.knaw.nl

DOMINANCE OF UNCELLULAR DIAZOTROPHY IN THE NORTHEAST ATLANTIC BOUNDARY CURRENT

Fractionated (< and >10 μm) gross and net diazotrophic activity and Trichodesmium abundance were studied in a macroscale cruise along the Northeast Atlantic boundary current system and during two mesoscale experiments in the upwelling systems of Cape Silleiro (NW Iberia) and Cape Ghir (NW Africa). The abundance of Trichodesmium (< 0.5 filaments μ²⁻¹) and its associated N₂ fixation rates (< 0.1 μmol N m⁻² d⁻¹) were low, showing a trend to accumulate at frontal sites. In oligotrophic oceanic waters the < and >10 μm fractions contributed similarly to total gross N₂ fixation although most of the N₂ fixed by the >10 μm organisms was probably lost as dissolved organic nitrogen, as suggested by an average empirical C:H:N₂ ratio of 22.591. N₂ fixation rates were always < 0.4 nmol N l⁻¹ d⁻¹ and only reached a peak of 0.98 nmol N l⁻¹ d⁻¹ off the NW African coast. The <10 μm fraction provided 66 - 89% of total N₂ fixation in cold nutrient-rich areas. The predominance of unicellular diazotrophy in upwelling sites suggests its distribution and activity are wider than originally envisioned.

Benitez-Nelson, C., University of South Carolina, Columbia, USA, BENNETT@mailbox.sc.edu

BACTERIAL CONTRIBUTIONS TO REFRACTORY DOM IN THE GLOBAL OCEAN*

Autotrophic and heterotrophic bacteria play dominant roles in marine biogeochemical cycles. Cyanobacteria account for a substantial fraction of primary production in the ocean, and heterotrophic bacteria are the primary decomposers of DOM, one of the largest global reservoirs of fixed carbon. More recent studies have begun to highlight the role of bacteria as a source of DOM. Two approaches have been used to investigate bacterial contributions to DOM: bioassay experiments that directly measure DOM production and bioactivity, and oceanic surveys of the abundance and distribution of bacterial biomarkers in DOM. Bioassay experiments indicate that bacteria release DOM during growth, and that the released DOC accounts for 10-30% of bacterial C production. These experiments also reveal that bacterial DOM is chemically complex and that some components are very resistant to decomposition. Ocean surveys indicate that bacterial biomarkers are abundant and ubiquitous in DOM. The D-enantiomers of amino acids comprise a high mol% of the total (D- + L-) dissolved amino acids throughout the water column, indicating bacterial DOM is likely an important component of the refractory DOM in the ocean.

Bennett, J. M., College of Charleston, Hollings Marine Laboratory, Charleston, USA, juniper.be@gmail.com

Sedwick, P. N., Old Dominion University, Ocean, Earth & Atmospheric Sciences, Norfolk, USA, psedwick@odu.edu

DiTullio, G. R., College of Charleston, Hollings Marine Laboratory, Charleston, USA, gtditullio@cofc.edu

EFFECTS OF IRRADIANCE ON THE GROWTH AND PHYSIOLOGY OF THE ANTARCTIC DIATOM, FRAGILARIOPSIS CYLINDRUS

Future climate warming may produce significant changes in the mixing-irradiance regime, and supply of macro- and micronutrients in the highly productive waters of the Antarctic continental shelf. In this context, there is a need to understand the response of the major groups of Antarctic phytoplankton to environmental changes. The diatom Fragilariopsis cylindrus is a prolific species on the Antarctic shelf, inhabiting both sea-ice (low irradiance) and open-water (high irradiance) regimes. We have performed laboratory culture experiments to examine the growth and physiology of this diatom at irradiances of 5-500 μE m⁻² s⁻¹. Cell number, biovolume, photosynthetic efficiency and absorption cross section, pigments, reactive oxygen species, and intracellular dimethylsulfoniopropionate (DMS) were measured. Our results indicate that Fragilariopsis maintains high growth rates over a wide range of irradiance, using various physiological mechanisms including anaplerotic cycling and decreasing effective absorption cross section at higher irradiance (> 150 μE m⁻² s⁻¹). Cellular DMS, which decreased with increasing irradiance, may also be involved. We are currently conducting experiments to examine the combined effects of iron and irradiance on the growth of this diatom species.

Bennett, M. A., University of South Carolina, Columbia, USA, BENNETTA@email.sc.edu

Ranhofer, M., Furman University, Greenville, USA, melissa.ranhofer@furman.edu

Bell, M. E., University of South Carolina, Columbia, USA, cbnelson@geol.sc.edu

Thunell, R., University of South Carolina, Columbia, USA, thunell@geol.sc.edu

24 (~) represents Tutorial presentations
Plessinger, W., University of South Carolina, Columbia, USA, wplessinger@geol.sc.edu
Tappa, E., University of South Carolina, Columbia, USA, tappa@geol.sc.edu

**BIOAVAILABILITY OF P ACROSS AN OXIC/ANOXIC BOUNDARY**

Phosphorus (P) was measured within sinking particles in the Carrao Basin, Venezuela, a region that contains both oxygenated and anoxic waters. Samples were collected using sediment traps at 5 depths (150-1200m) from 2005 to 2006 and analyzed using SEDEX, a sequential extraction method that separates various P phases by chemical reactivity. Results indicate that while total P decreases significantly with depth, not all P phases were present in equal amounts, nor did they decrease at the same rate, if at all. Organic P dominated the P pool (20.8±1.12µmoles P g$^{-1}$) followed by oxide associated (17.37±3.04µmoles P g$^{-1}$), loosely-bound (9.5±0.3µmoles P g$^{-1}$), authigenic (2.92±1.68µmoles P g$^{-1}$), and detrital P (0.72±0.04µmoles P g$^{-1}$). While organic and authigenic P decreased rapidly only in the oxic waters, loosely bound and oxide associated P decreased throughout the water column. Detrital P remained relatively constant with depth, consistent with its hypothesized low reactivity. These results suggest that P composition is critical to understanding the magnitude of P recycling in the water column with depth and under both oxic and anoxic conditions.

Bennington, V., University of Wisconsin, Madison, USA, benesh@wisc.edu
McKinley, G. A., University of Wisconsin, Madison, USA, gmeckinley@wisc.edu
Vasy, V., University of Wisconsin, Madison, USA, vvasy@gmail.com
Desai, A. R., University of Wisconsin, Madison, USA, desai@aoe.wisc.edu
Urban, N. R., Michigan Technological University, Houghton, USA, nurb@mtu.edu

**LAKE SUPERIOR WITHIN THE REGIONAL CARBON BUDGET**

Globally, inland waters play an important role in the carbon cycle (Tianvik et al., 2009) but are generally ignored in regional carbon budgets. Lake Superior is the deepest of the Laurentian Great Lakes, containing approximately 10% of the global surface fresh water. Previous carbon budgets for Lake Superior have remained unbalanced, but suggest a regionally significant efflux. Observational studies have been limited by location and timing, which likely accounts for part of the imbalance. We develop a group of three dimensional hydrodynamic-ecosystem models of Lake Superior to determine whether spatial and temporal heterogeneity in Lake Superior can account for discrepancies in the carbon budget. The models capture observations of chlorophyll, net primary production (Sterner, 2010), pCO2 (Atilla et al., 2010), and respiration (Urban et al., 2004). We show the seasonal cycle of lake pCO2, the resulting air-lake CO2 exchange, and close the lake carbon budget. Influence maps show a lake influence of 20% at the nearby WLEF tall tower. Lake fluxes are detectable part of the year and likely cause an overestimate of terrestrial respiration in winter and an underestimate of the fall terrestrial sink.

Berger, S. A., Skidaway Institute of Oceanography, Savannah GA, USA, Stella.berger@bio.ubn.no
Diehl, S., Umeå University, Umeå, Sweden, sebastian.diehl@emg.umu.se
Stibor, H., Technopôle Brest-Iroise, Plouzané, France, herwig.stibor@univ-brest.fr

**CLIMATIC DRIVERS AND GRAZER COMMUNITY STRUCTURE AFFECT SPRING SUCCESION OF TEMPERATE LAKE PLANKTON – A SYNTHESIS OF MULTIPLE MESOCOSM EXPERIMENTS**

Global warming affects light- and temperature-dependent biological processes differently and may have its strongest impact on lake plankton in spring, when light availability and temperatures change rapidly with stratification onset. We conducted several field mesocosm experiments disentangling the impacts of climatic drivers (water temperature, timing and depth of stratification) and zooplankton trophic structure on cardinal phenological events (phytoplankton spring bloom, grazer peak, clearwater phase). Higher light availability after earlier stratification and in shallower surface layers accelerated primary production. Warming accelerated consumption and growth of Daphnia. Both factors speeded up successional dynamics driven by trophic feedbacks, leading to earlier phytoplankton peaks, clearwater phases and Daphnia peaks. Peak densities were unaffected by temperature but increased with light availability at shallower stratification. In most experiments temperature and stratification effects on phytoplankton did not extend beyond the clearwater phase. In one experiment, however, warming led to early dominance of inedible phytoplankton, failure of grazer development, and complete absence of a clearwater phase. Thus, while impacts of early season climate variability were often buffered later in the season, warming showed potential to produce regime shifts.

Berges, J. A., U. Wisconsin-Milwaukee, Milwaukee, USA, berges@uwm.edu
Engelov, P. M., U. Wisconsin-Milwaukee, Milwaukee, USA, engelov@uwm.edu
Grondquist, D. J., U. Wisconsin-Milwaukee, Milwaukee, USA, davidgj@uwm.edu
Sandgren, C. D., U. Wisconsin-Milwaukee, Milwaukee, USA, sandgren@uwm.edu

**IMMUNOCHEMICAL APPROACHES TO DETERMINE EFFECTS OF INVASIVE, ZOOPLANKTON PREDATORS IN PELAGIC, LAKE MICHIGAN FOODWEBS**

The carnivorous cladocerans Bythotrephes longimanus and Ceriodaphnia pengoi invaded Lake Michigan from the Pontic-Caspian and were established by 1986 and 2000, respectively. Both species become abundant in warmer surface waters in summer/autumn; $B. longimanus$ appears offshore, while $C. pengoi$ is prevalent nearshore in western Lake Michigan. Determining the effects of these predators is complicated by the fact that their appearance coincided with other events (e.g. expansion of invasive dreissenid mussel populations, regional climate changes), but also because they selectively ingest soft tissues, making assessments of prey preference through analysis of gut contents impossible. From 2007 through 2009, alongside field surveys and laboratory grazing studies, we developed polyclonal antisera to 7 species of putative prey (including copepods, rotifers, herbivorous cladocerans, and velger larvæ), as well as $B. longimanus$ and $C. pengoi$ themselves. In all cases, antisera raised in rabbits were of high titer, effectively allowing detection of prey protein in guts of single predators. Antisera were of varying specificity, in some case cross reacting within phyla, and in others only within smaller taxa; currently, antisera are being refined using subtractive cross-purifications.

Berggren, M., Université du Québec à Montréal, Montréal, Canada, martin.berggren@emg.umsu.ca
Paul, G. A., Université du Québec à Montréal, Montréal, Canada, del_giorgio.paul@uqam.ca

**HIGH BACTERIAL RESPIRATORY QUOTIENTS IN NET HETEROTROPHIC LAKES**

In most studies of bacterioplankton carbon metabolism, the need to assume a respiratory quotient (RQ, mole of CO2 produced per mole of O2 consumed) introduces a fundamental source of uncertainty. Many studies have assumed a fixed value, often close to 1, but this assumption has little empirical support, and ignores potential variability in RQ caused by physiological mechanisms and by varying oxygen contents of respired substrates. Here we present over 50 direct measurements of bacterioplankton RQ that we have carried out in epilimnion samples of lakes distributed across the temperate and boreal regions of Quebec, using O2 and CO2 sensitive mini sensors attached to the inside of closed incubation flasks. RQ was mostly in the range of 0.5-2, with the lowest values in net autotrophic and the highest in net heterotrophic systems. A plausible explanation is that bacteria were utilizing oxygen-rich organic acids in the net heterotrophic lakes (e.g., formed by photo-chemical processes), and relatively oxygen-poor phytoplankton exudates in the net autotrophic lakes. The results suggest that respiration measured with the O2 consumption method assuming RQ=1 may underestimate the role of bacterial respiration as cause of lake net heterotrophy.

Berman-Frank, I. R., Bar Ilan University, Ramat Gan, Israel, ibermanfrank@gmail.com
Levitan, O., Bar Ilan University, Ramat Gan, Israel, levitan@gmail.com
Spingarn, D., Bar Ilan University, Ramat Gan, Israel, daddi@walla.com

**TRICHODESMIUM’S CELLULAR ARSENAL FOR THRIVING IN THE FUTURE OCEANS**

Trichodesmium, the nitrogen-fixing cyanobacterium dominant in the tropical oceans, increases both N2 fixation and growth rates under elevated pCO2, while photosynthetic rates and C:N stoichiometry are relatively constant. We studied changes in gene expression, protein pools, and enzymatic activity of key components in the fixation and assimilation of carbon and nitrogen and in the energy metabolism by accelerating laboratory cultures of *Trichodesmium* (IMS101) to different pCO2 (250, 400, 900 µatm pCO2) and in combination with varying temperatures, light, or P concentrations. Elevated pCO2 shifted transcript patterns synchronizing the diel expression of several genes ($nfH$, psac, pshB) and did not influence CO2 concentrating mechanism genes which were constitutively-expressed throughout the day. At high pCO2, *Trichodesmium* can enhance N2 fixation and growth by: increasing enzyme activity with no changes in protein abundance (e.g. N2 fixation and NifH); maintaining flexible P stoichiometry, synthesizing more AtpB protein and increasing the activity of ATPase. These strategic reallocations of cellular resources and energy enable *Trichodesmium* grown at elevated temperatures and pCO2, to extend its niche in the future oceans including in P-limited areas.
Bernstein, W. N., Massachusetts Institute of Technology/Woods Hole Oceanographic Institution, Woods Hole, USA, wberstein@whoi.edu
Murry, S., Oberlin College, Oberlin, USA, smurry@oberlin.edu
Ossolinski, J., Woods Hole Oceanographic Institution, Woods Hole, USA, jossolin-sk@whoi.edu
Kneeland, J., Massachusetts Institute of Technology/Woods Hole Oceanographic Institution, Woods Hole, USA, kneedlean@whoi.edu
Davis, R., Woods Hole Oceanographic Institution, Woods Hole, USA
Hughen, K. A., Woods Hole Oceanographic Institution, Woods Hole, USA, khughen@whoi.edu
A 240-YEAR RECORD OF THE PHYSIOLOGICAL RESPONSE OF A RED SEA CORAL TO SEASONAL TEMPERATURE EXTREMES
The successful persistence of coral reefs during periods of climate change largely depends on the continued ability of corals to rapidly produce strong carbonate skeletons, which serve critical functional roles in the life cycle of individual corals and in the ecological strength of a reef community. Laboratory and mesocosm studies and paleorecords from coral drill cores show that growth rates increase with temperature up to an optimal temperature range beyond which coral growth rates rapidly decline due to thermal stress. Here we present a 240-year biweekly record of Red Sea temperatures based on coral Sr/Ca data that we compare to coral health indicators, including annual extension rates and molecular proxies of stress. We examine the impacts of annual to multi-decadal temperature anomalies, including mean annual, summer and winter extremes and seasonality, on coral health extending from the end of the Little Ice Age to the present. This work sets the stage for future work examining the community calcification rates in response to variability in temperature, saturation state and nutrients.

Bertics, V. J., IFM-GEOMAR, Kiel, Germany, vberties@ifm-geomar.de
Sommer, S., IFM-GEOMAR, Kiel, Germany, ssommer@ifm-geomar.de
Dale, A., IFM-GEOMAR, Kiel, Germany, adale@ifm-geomar.de
Teupe, M., IFM-GEOMAR, Kiel, Germany, mteupe@ifm-geomar.de
Treude, T., IFM-GEOMAR, Kiel, Germany, ttreude@ifm-geomar.de
BENTHIC NITROGEN AND SULFUR DYNAMICS OF A SEASONALLY HYPOXIC REGION OF THE BALTIC SEA, ECKERNFÖRDE BAY
Despite the wide occurrence of hypoxic regions, benthic nitrogen cycling within these areas is still poorly understood and until recently denitrification was assumed to be the dominant process. However, sulfate reduction can be an important process for organic matter degradation in hypoxic sediments and many sulfate-reducing bacteria (SRB) have the genetic ability to fix N₂. Therefore, SRB may supply fixed nitrogen to these systems, counteracting some nitrogen lost via denitrification and anaerobic ammonium oxidation. Our objective was to determine if N₂-fixation, possibly by SRB, plays a role in nitrogen cycling within seasonally hypoxic sediments from Eckernförde Bay and if variations in these microbial processes correlate to changes in oxygen concentrations. Monthly samplings were performed to measure benthic N₂-fixation and sulfate reduction rates. Additionally, important geochemical profiles, such as sulfate and nitrogen compounds, were determined in surface sediments. While samplings are still underway, here we present the results from our first 10 months where N₂-fixation rates increase as bottom-water oxygen concentrations decrease. Results indicate that N₂-fixation may play a role in benthic marine nitrogen cycling within hypoxic regions.

Bertoni, B., CNR Institute of Ecosystem Study, Verbania, Italy, cbertoni@iise.cnr.it
Callieri, C., CNR Institute of Ecosystem Study, Verbania, Italy, c.callieri@iise.cnr.it
Contesini, M., CNR Institute of Ecosystem Study, Verbania, Italy, m.contesini@iise.cnr.it
ECOLOGICAL EFFECTS OF LEVEL FLUCTUATIONS IN LAKE MAGGIORE (NORTHERN ITALY)
In the oligotrophic Lake Maggiore, a deep subalpine lake in Northern Italy, blooms of Anabaena lemmermannii appeared in recent years despite in-lake TP concentration always being <10µg L⁻¹. In the same years, the regular summer lake-level fluctuation was altered due to the interaction between climate change and human exploitation of water resource. Seeking a causal relation linking level fluctuations and cyanobacterial blooms, we investigated the appearance of pulse injections of organic matter from lake shore after drought. We simulated the arid and flood periods exposing artificial substrates for 30 days near the lake shore. The substrates were recovered and analysed for organic carbon and total phosphorous, the limiting nutrient for this lake. The C and P release upon rewetting was measured after 3 and 30 days. The C/P ratio of the leaked material resulted two orders of magnitude lower than in freshly recovered organic matter from artificial substrates. We hypothesised that rain washout of lake shore in a low lake-level state may supply P enrichment, promoting the germination of Anabaena lemmermannii akinetes, thus starting the bloom.

Bertrand, E. M., MIT/WHOI Joint Program in Chemical Oceanography, Woods Hole, MA, USA, ebertrand@whoi.edu
Saito, M. A., Woods Hole Oceanographic Institution, Marine Chemistry and Geochemistry Dept, Woods Hole, USA, msaito@whoi.edu
A VITAMIN B12 STRESS MARKER FOR DIATOMS: QUANTITATIVE PROTEOMIC MASS SPECTROMETRY AS AN EMERGING TOOL FOR MONITORING MICRONUTRIENT STRESS
Vitamin B₁₂, a cobalt-containing organometallic microminutrient produced by bacteria and archaea and required by many eukaryotic phytoplankton. Its availability has been shown to limit phytoplankton growth in some areas of the Southern Ocean, but there are currently no reliable methods for tracking or predicting vitamin limitation in phytoplankton populations. This is in part because many poorly characterized biological and chemical factors contribute to B₁₂ availability. In order to develop probes to test for vitamin limitation, we designed mass spectrometry based assays to identify and measure proteins regulated by B₁₂ availability in diatoms. We have identified a number of vitamin-regulated proteins, many with currently unknown roles. One protein in particular was only detected under low vitamin availability in two diatoms. The function of this protein is unknown, but model results indicate that it has three dimensional structural similarity to previously described vitamin B₁₂ binding proteins. This protein has been identified as a potential biomarker for vitamin stress in diatoms. These studies demonstrate the utility of mass spectrometry for identifying and quantifying proteins indicative of micronutrient stress in marine phytoplankton.

Best, C. H., University of Southampton, Southampton, United Kingdom, charlotte.best@soton.ac.uk
Purdie, D. A., University of Southampton, Southampton, United Kingdom, duncan.purdie@soton.ac.uk
Lomas, M. W., Bermuda Institute of Ocean Sciences, St. George’s, Bermuda, michael.lomas@bios.io
TEMPORAL DYNAMICS OF MICROPLANKTON IN THE SARGASSO SEA
An archive of microplankton samples collected monthly since 1997 at the Bermuda Atlantic Time-series Study site has not previously been studied. Preliminary results of February and August sample analysis show an apparent increase in total cell abundances between the periods of 2002-2005, before declining through to August 2008. The percentage contribution of seven main groups (diatoms, dinoflagellates, tintinnids, radiolarians, foraminifera, acantharia and silicoflagellates) to total abundance remains relatively consistent throughout the period of 1999-2007, although some small seasonal variations are seen in some groups such as the foraminifera. The analysis of 41 samples for three one-year periods documents the variability of the timing and magnitude of the spring bloom (microplankton fraction) at BATS. Continuing species identification has resulted in the identification of 56 organisms to species level that are found as part of the microplankton community at BATS. Although high variability (seasonal, annual and inter-annual) has already been documented for the upper ocean at the BATS site, this study investigates the temporal changes in the dominant microplankton at BATS and their role in biogeochemical cycling in the Sargasso Sea.

Bhaskaran, H., Wicomico County Board of Education, Salisbury, USA, hbhaskar@wcboe.org
Rhodes, M., JHT Inc/NOAA, Oxford, USA, matt.rhodes@noaa.gov
Hutchinson, L., Maryland State Department of Education, Oxford, USA, leann.hutchinson@noaa.gov
Hammond, J., NOAA Teacher at Sea Program, Silver Spring, USA, jennifer.hammond@noaa.gov
Jacobs, J., NOAA/NCCOS Oxford Lab, Oxford, USA, john.jacobs@noaa.gov
NOAA’S TEACHER IN THE LAB PROGRAM: COMMUNICATING NOAA SCIENCE TO THE CLASSROOM
Teacher in the Lab (TIL) is a program offered by NOAA, where teachers work with NOAA scientists and conduct research. The goal of the program is to increase teachers’ knowledge about research and to transfer NOAA science to students and the teaching community through the teachers participating in TIL. This program
addresses the overall goal of providing environmental literacy and workforce development. The intent of this presentation is to introduce the NOAA TIL Program, provide an example of a teacher research experience and offer a lesson plan developed for high school students. This program offers a unique mechanism for enhancing awareness of NOAA research while engaging the community and a new generation of scientists.

**Bianucci, L.** Dalhousie University, Halifax, Canada, laura.bianucci@dal.ca

**Denman, K. L.,** Canadian Centre for Climate Modelling and Analysis, Victoria, Canada, denmanl@uvic.ca

**CARBON AND OXYGEN CYCLES ON THE VANCOUVER ISLAND SHELF: ROLE OF THE COASTAL CURRENT AND SENSITIVITY TO CHANGES IN ENVIRONMENTAL FORCING**

In the last decade, corrosive waters and unusual hypoxic events have been observed in shallow waters within the California Current System (CCS). Hypoxia has not been observed in waters shallower than 90 m over the Vancouver Island shelf, a summer wind-driven upwelling margin off Western Canada that represents the northern end of the CCS. This study uses the Regional Ocean Modeling System (ROMS) in a 2D configuration of the shelf (cross-shelf section with uniform properties alongshore) to investigate the factors that protect the inner shelf off Vancouver Island from developing hypoxia and corrosive conditions. Moreover, the proximity of this shelf to the Oxygen Minimum Zone (OMZ) offshore and the observed decline of oxygen in the Northeast Pacific lead us to explore the sensitivity of the system to a shoaling of the OMZ and a strengthening of the upwelling season. Results suggest that these scenarios increase the potential for the development of coastal hypoxia and corrosive conditions, except in the region influenced by the Vancouver Island Coastal Current.

**Bidle, K. D.** Rutgers University/Institute of Marine and Coastal Sciences, New Brunswick, NJ, USA, bidle@marine.rutgers.edu

**Kwityn, C. I.,** Rutgers University/Institute of Marine and Coastal Sciences, New Brunswick, NJ, USA, ckwityn@gmail.com

**Liao, W.,** Rutgers University/Institute of Marine and Coastal Sciences, New Brunswick, NJ, USA, wanjiang@marine.rutgers.edu

**A ROLE FOR CASPASE ACTIVITY AND METACASPASE EXPRESSION AS SUBCELLULAR DETERMINANTS OF VIRAL SUSCEPTIBILITY IN THE COCCOLITHOPHORE, EMILIANIA HUXLEYI**

As part of their strategy to infect the globally important cocolithophore Emiliania huxleyi, Cocclosiphoviruses recruit host caspase activity and metacaspase expression. These death proteases not only facilitate viral lysis, but may be important subcellular determinants of infection. We examined the link between basal levels of caspase activity and metacaspase expression in exponentially-growing resistant and sensitive E. huxleyi strains and virus susceptibility. Resistant strains were characterized by low caspase specific activity and a relatively simple metacaspase expression profile. In contrast, sensitive strains had markedly elevated caspase specific activity and expressed more diverse metacaspase proteins. Using pooled data from triplicate experiments, we observed statistically significant relationships between infectivity, caspase activity, and metacaspase expression, with each strain forming unique clusters within a gradient in viral susceptibility. While our data reveal inherent differences among sensitive and resistant strains for these cellular markers, they suggest that resistance or sensitivity is not a fixed trait. Rather, our findings implicate the importance of physiological regulation of these death proteases to determine cell fate. Using genome-enabled proteomics, we identified putative peptidase candidates that were associated with dramatically elevated caspase specific activity and can possibly serve as subcellular determinants of infection.

**Bienfang, P. K.,** University of Hawaii at Manoa, Honolulu, USA, bienfang@soest.hawaii.edu

**DeFelice, S. V.,** University of Hawaii at Manoa, Honolulu, USA, svd@hawaii.edu

**Dowling, A. E.,** East Carolina University, Greenville, USA, dowlinga10@students.ecu.edu

**EVALUATION OF CIGUATERA BY CIGUA-CHECK® AND N2A BIOASSAY METHODS IN HERBIVOROUS AND CARNIVOROUS FISH FROM HAWAII**

This study analyzed the operator variability and effectiveness of the Cigua-Chek® Fish Poison Test Kit in comparison to N2a bioassay methods to assess the presence of ciguatera in two taxa of fish from Oahu and other Hawaiian Islands. The project collected over a hundred samples for each of the two target fish species from Oahu and the other Hawaiian Islands and tested each fish for Ciguatera using Cigua-Chek® and N2a bioassay methods. Four different operators blindly interpreted the Cigua-Chek® test kit to outcomes for the presence of ciguatoxins. The project collected over a hundred samples for each of the two target fish species from Oahu and other Hawaiian Islands and tested each fish for Ciguatera using Cigua-Chek® and N2a bioassay methods. Four different operators blindly interpreted the Cigua-Chek® test kit to outcomes for the presence of ciguatoxins. Additionally, the Cigua-Chek® kit was found to produce inconsistent results when interpreted by various individuals.

**Bigham, D. L.,** University of Florida, Gainesville, USA, dbigham@ufl.edu

**DO FLORIDA LAKES SHOW DECADAL-SCALE TRENDS IN WATER QUALITY?**

The assumption of many scientific and regulatory frameworks is anthropogenic eutrophication causes lake water quality degradation over time. Long-term changes in lake water quality, however, have not been well defined among a population of lakes. This paper explores methods of analysis to best detect patterns of long-term change. A population of 44 Florida lakes with 20 years of monthly total phosphorus, total nitrogen, total chlorophyll, and water clarity measurements were examined. Least-squared linear regression analysis best detected increasing and decreasing monotonic patterns. For total phosphorus 68% of the lakes increased, 16% decreased, while 16% showed no change. For total nitrogen, 57% increased, 18% decreased, and 25% showed no change. For chlorophyll-45% increased, 32% decreased, and 23% showed no change. For water clarity, 52% decreased, 20% increased, and 28% showed no change. The ARIMA time series model provided a more sensitive method of detection indicating decadal patterns of change in water quality for many Florida lakes. Although time series analysis better describes patterns of long-term water quality change, linear regression analysis is useful as missing data hinders time series applicability.

**Bird, K. C.,** Kellogg Biological Station, Michigan State University, Hickory Corners, USA, birdkali@kbs.msu.edu

**Lennon, J. T.,** Kellogg Biological Station, Michigan State University, Hickory Corners, USA, lennonja@msu.edu

**SPECIALIST AND GENERALIST UTILIZATION OF PHOSPHORUS FORMS BY AQUATIC MICROBES: A MECHANISM FOR MAINTAINING MICROBIAL DIVERSITY?**

A key goal of ecology is to understand the factors maintaining species coexistence in diverse communities. Aquatic microbial communities are usually extremely diverse and are frequently limited by phosphorus (P) availability. P is often viewed as a single resource, but actually exists in many forms of varying availability to microbes. Microbial species coexistence may be influenced by their ability to specialize on these different P forms. To determine whether bacteria can partition P forms, we studied 30 strains isolated from a low- and high-P lake. We measured growth rates of each isolate on fourteen different P compounds. We found that bacteria vary in their ability to use P forms. Most strains were 'generalists, ' capable of utilizing nearly all of the P sources, while some were 'specialists, ' able to use only a few. We also found that a growth rate trade-off can result from this specialization, such that the specialist grows faster than other species on its preferred P source. Our results suggest that aquatic bacteria are able to partition the P pool, which may contribute to diversity maintenance.
Bluhm, B. A., University of Alaska Fairbanks, Fairbanks, USA, bluhm@ims.uaf.edu
Ikien, K., University of Alaska Fairbanks, Fairbanks, USA, iken@ims.uaf.edu
Mincks Hardy, S. L., University of Alaska Fairbanks, Fairbanks, USA, smhardy@alaska.edu
Sireenko, B. I., Zoological Institute Russian Academy of Sciences, St. Petersburg, Russian Federation, marine@zin.ru
Holliday, B. A., University of Alaska Fairbanks, Fairbanks, USA, baholliday@alaska.edu

We present quantitative data on and environmental drivers of the poorly studied benthic epifauna from the Arctic Chukchi Sea shelf, an area experiencing substantial climate change effects. We collected 60 beam trawl samples in the Russian and US Chukchi Sea in 2004 and 2007-2009. Gross abundance estimates ranged from 229-70879 ind. 1000 m^-2, and gross biomass estimates ranged from 1628-217,023 g wet wt 1000 m^-2. Abundance and biomass were dominated by echinoderms (66 and 45%, respectively) and crustaceans (17 and 31%, respectively). The ophiuroid Ophiura sarsi and the snow crab Chionoecetes opilio overwhelmingly dominated. A total of 165 taxa (mostly species) were identified; the highest numbers were Mollusca (46) and Crustacea (33). Six distinct community clusters were separated largely based on substrate type and latitude. Water mass characteristics and indices of food availability appeared less influential in generating the observed patterns. Comparisons with previous studies suggested an increase in overall epibenthic biomass since 1976, including an increase in the biomass of C. opilio, a crab of commercial value in the Bering Sea.
Atlantic Central Water, Antarctic Intermediate Water, North Atlantic Deep Water, and the Antarctic Bottom Water). Using simple image analysis, we were able to demonstrate that a combination of particle numbers, particle size, Lloyd index of patchiness, and the ratio of the major particle axes, were characteristic of each of the water masses, and gave each of them a distinct particle signature. In contrast to the surface water, where many large signals were attributable to the presence of macrozooplankton (especially salps in the equatorial upwelling region), most of the deep-sea particles were amorphous, and were not ascribable to larger organisms.

Boecht, J. G., Federal University of São João do Rei, São João do Rei, Brazil, boecht@ufsj.edu.br
Gückler, B., Federal University of São João do Rei, São João do Rei, Brazil, email@bioeng-geucker.de
Krüger, A., Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, krueger@igb-berlin.de
Figueroedo, C. C., Federal University of Minas Gerais, Belo Horizonte, Brazil, cleber-algale@hotmail.com
Giani, A., Federal University of Minas Gerais, Belo Horizonte, Brazil, agiania@ic.ufmg.br

AGRICULTURAL LAND USE AFFECTS THE LIPID COMPOSITION OF STREAMMICROBIAL COMMUNITIES

We investigated whether the lipid composition (fatty acids and sterols) of benthic microbial mats, which represent an important basal food resource for stream food webs, differs between tropical streams located in protected pristine and agricultural Cerrado savannah areas. In parallel to differences in water quality and hydrodynamic characteristics, total microbial biomass and the lipid composition differed significantly between pristine and agricultural streams. Agricultural streams exhibited lower total biomasses of benthic microbial mats than pristine streams, but the lipid composition of agricultural streams showed higher quality than the lipid composition of pristine microbial mats, based on the presence of some essential polyunsaturated fatty acids. Pristine stream microbial communities had higher total concentrations of saturated fatty acids, dihydrocholesterol, desmosterol and stigmasterol than those of agricultural streams, reflecting their heterotrophic microbial communities. Land-use induced changes in the total biomass and lipid composition of microbial communities may affect trophic transfer of energy in stream food webs, leading to changes in the composition and productivity of primary consumers and their predators, and thus stream ecosystem functioning. Financial support: CNPq, German Academy of Sciences Leopoldina; FAPÉMIG.

Bohlen, L., IFM GEOMAR, Kiel, Germany, lbohlen@ifm-geomar.de
Sommer, S., IFM GEOMAR, Kiel, Germany, sommer@ifm-geomar.de
Dale, A. W., IFM GEOMAR, Kiel, Germany, adale@ifm-geomar.de
Hensen, C., IFM GEOMAR, Kiel, Germany, chensen@ifm-geomar.de
Walllmann, K., IFM GEOMAR, Kiel, Germany, kwallmann@ifm-geomar.de

SEDIMENTS UNDERLYING THE PERUVIAN OXYGEN MINIMUM ZONE – SOURCE OR SINK FOR REACTIVE NITROGEN SPECIES?

Oxygen minimum zones (OMZs) represent key regions for nitrogen turnover in the water column as well as in the sediments. However, whether the sediments act as a sink or a source for reactive nitrogen (NO\textsubscript{2} \textsuperscript{-} + NO\textsubscript{3} \textsuperscript{-} + NH\textsubscript{4} \textsuperscript{+}) is not well established. To address this question, we studied benthic nitrogen cycling under different bottom water oxygen concentrations along a transect traversing the Peruvian OMZ at 11°S. Our approach combines measurements of in situ fluxes and porewater profiles of nitrogen species as well as numerical analysis using a 1D reaction-transport model. Measurements showed that the sediments at the upper fringe of the OMZ acted as a source for reactive N, whereas they became a sink at greater water depths. The model identified dissimilatory nitrate reduction to ammonium (DNRA) as the principle source of reactive N and further predicted that denitrification, as opposed to ammonox, was responsible for reactive N losses. The partitioning of NO\textsubscript{2} \textsuperscript{-} and/or NO\textsubscript{3} \textsuperscript{-} into DNRA or denitrification was a key factor determining the benthic source-sink N function.

Boland, R. C., Pacific Islands Fisheries Science Center/NMFS/NOAA, Honolulu, USA, Raymond.Boland@noaa.gov
Parrish, F. A., Pacific Islands Fisheries Science Center/NMFS/NOAA, Honolulu, USA, Frank.Parrish@noaa.gov
Rooney, J. J., Pacific Islands Fisheries Science Center/NMFS/NOAA, Honolulu, USA, John.Rooney@noaa.gov

FISH COMMUNITIES OF THE MESOPHOTIC ECOSYSTEMS IN THE HAWAIIAN ARCHIPELAGO.

Discovery of mesophotic coral reefs in Hawaii that form extensive tracts of low bottom structure has prompted interest in the role the reefs serve as habitat for fish communities. Such habitat could be important for resident deep fish species and as a refuge or nursery ground for shallower fish taxa. Using towed camera systems, submersibles and technical scuba diving, we surveyed this community from depths ranging from 45 to 130+ meters to create baseline data for 84 fish species, including information on their abundance and size. At all sites, fish were found to be primarily shallower fish species (81%) with only minor representation of “deep” species (19%). The highest density of fish was found on Montipora reefs at depths ranging from 45 to 60 meters with 0.15 fish/m². Comparisons of Montipora and Leptoseres reef communities at 60-75 meters depth indicated similar fish abundance (0.05-0.06 fish/m²) but different species composition. At depths deeper than 75 meters, mesophotic coral reef habitats and their fish communities were sporadic.

Boling, W. B., University of Oklahoma, Norman, USA, wilford.b.boling-1@ou.edu
Wawrik, B., University of Oklahoma, Norman, USA, bwawrik@ou.edu
Sinclair, J., Louisiana universities marine consortium, Chauvin, USA, gs Sinclair@lumcon.edu

MOLECULAR DETECTION OF CALANOID PREY SPECIES BY GUT CON- TENT ANALYSIS

Marine copepods diets are traditionally assessed by pigment and microscopic analysis of gut contents for diagnostic hard parts. This requires an exhaustive knowledge of prey morphology, and may miss minor prey components or those that lack undigestible exoskeletons. Molecular tools have been used to detect phytoplankton DNA in copepod fecal pellets, suggesting that DNA may present an alternative route to assess copepod feeding, eliminating many of the limitations of microscopy analysis. To this end, gut contents of planktonic copepods (Order Calanoida) were assayed using PCR primers for the large subunit gene of RubiCook (rbcL) across a transect of the Louisiana shelf. PCR products were cloned and inserted sequenced. Diagnostic pigments from HPLC analysis indicate that the ratio of dinoflagellates to diatoms decreased from 1.3 at the shallowest to about 0.37 at the deepest station. Despite differences in phytoplankton community composition sequence analysis suggests that calanoids were predominantly feeding on diatoms belonging to the families Thalassiosiracea, Chaetoceracea, and Bacillariaceae. Sequences belonging to the Pelagophyceae and Chlorophyceae were also detected, suggesting that calanoid diets may include members of these taxonomic groups.

Bolte, S., IFM-Geomar, Evolutionary Ecology of Marine Fishes, Kiel, Germany, sbolte@ifm-geomar.de
Roy, A. S., IFM-Geomar, Biological Oceanography, Kiel, Germany, sroy@ifm-geomar.de
Kleinz, S., IFM-Geomar, Evolutionary Ecology of Marine Fishes, Kiel, Germany, solveig@kleinz.de
Sparwel, M., University of Münster, Institute for Evolution & Biodiversity, Plant Evolutionary Ecology, Münster, Germany, sparwel@gmail.com
Moss, A. G., Auburn University, Biological Sciences, Auburn, USA, mossant@auburn.edu
Javidpour, J., IFM-GeoMar, Experimental Ecology—Food Webs, Kiel, Germany, javid@ifm-geomar.de
Feulner, P., University of Münster, Institute for Evolution & Biodiversity, Evolutionary Bioinformatics, Münster, Germany, pfeunieer@uni-muenster.de
Bornberg-Bauer, E., University of Münster, Institute for Evolution & Biodiversity, Evolutionary Bioinformatics, Münster, Germany, ebb@uni-muenster.de
Rosenstiel, P., University Medical Center Schleswig Holstein, Institute of Clinical Molecular Biology, Kiel, Germany, prrosenstiel@macosa.de
Reusch, T. B., IFM-Geomar, Evolutionary Ecology of Marine Fishes, Kiel, Germany, treusch@ifm-geomar.de

MOLECULAR ECOLOGY OF MNEMIOPSIS LEIDYI INVASIONS INTO EUROPE

The Ctenophore Mnemiopsis leidyi has successfully invaded several European Seas. After invasion of the Black and Caspian Sea during the 1980s and 90s this Ctenophora established populations in the North and Baltic Sea after 2006 and recently colonized the Mediterranean Sea. Using the first microsatellites in the phylum Ctenophora, we demonstrate that M. leidyi has successfully invaded Europe at least twice from two different source regions. An earlier introduction into Black and Caspian Sea could be traced back to the Gulf of Mexico whereas the recent invasion of North and Baltic Sea originated from the Coast of New England. Our current research aims to understand the adaptive evolution that accompanies these biological invasions on the
transcriptomic and genomic level. Using next generation sequencing in combination with population wide SNP-calling we are investigating the molecular adaptation of these basal metazoans to new environments. A special focus is the immune repertoire which allows these animals to survive and spread in new habitats. We also present data on the mating system and reproductive strategies that may explain the high reproductive output of this invasive species.

**Bombar, D.** Leibniz Institute for Baltic Sea Research, Rostock, Germany, bombar@io-warnemuende.de

Dippner, J. W., Leibniz Institute for Baltic Sea Research, Rostock, Germany, joachim.dippner@io-warnemuende.de

Korth, F., Leibniz Institute for Baltic Sea Research, Rostock, Germany, frederike.korth@io-warnemuende.de

Loick-Wilde, N., Leibniz Institute for Baltic Sea Research, Rostock, Germany, natalie.loick-wilde@io-warnemuende.de

Lisikow, I., Leibniz Institute for Baltic Sea Research, Rostock, Germany, iris.lisikow@io-warnemuende.de

Ngoc, L., Institute of Oceanography, Nha Trang, Vietnam, babviet@dong.vnn.vn

Doan, H. N., Institute of Oceanography, Nha Trang, Vietnam, habsea@dong.vnn.vn

Voss, M., Leibniz Institute for Baltic Sea Research, Rostock, Germany, mareven.voss@io-warnemuende.de

**INFLUENCE OF RIVER DISCHARGE AND UPWELLING ON NITROGEN FIXATION IN THE SOUTH CHINA SEA: LESSONS FROM MESOCOSM EXPERIMENTS AND ECOSYSTEM MODELING**

The influence of the Mekong River discharge and coastal upwelling on pelagic nitrogen fixation in the South China Sea (SCS) was investigated in land-based mesocosm experiments containing natural phytoplankton assemblages. We simulated a river plume- (530 L oligotrophic surface water + 70 L Mekong freshwater) and an upwelling scenario (300 L surface water + 300 L nutrient-rich water from below the chlorophyll maximum). Control mesocosms contained only surface water. In the controls, $^{15}N$ fixation decreased from $\geq 236$ to $\leq 21$ nmol N L$^{-1}$ d$^{-1}$ within 5 days and remained low until the experiment ended after 11 days. In the river plume- and upwelling mesocosms, $^{15}N$ fixation was initially low but then strongly increased within 7 days (respectively up to 117 and 480 nmol N L$^{-1}$ d$^{-1}$) as nitrate concentrations fell below detection. Thus, both Mekong discharge and upwelling can potentially enhance pelagic nitrogen fixation in the SCS. The experiments are complemented by an ecosystem model which utilizes the initial conditions from the experiments, and which can be used for N-budget calculations and a better understanding of key processes in the local N-cycle.

**Booe, T. L.** Texas A&M University, Galveston, USA, booe@tamug.edu

Steichen, J. L., Texas A&M University, Galveston, USA, jlsteichen@gmail.com

Windham, R., Texas A&M University, Galveston, USA, windhamr@tamug.edu

Dorado, S., Texas A&M University, Galveston, USA, dorado_sam@yahoo.com

McInnes, A. S., Texas A&M University, Galveston, USA, aliskinner41@yahoo.com

Jiang, Y., Texas A&M University, Galveston, USA, jiangy@tamug.edu

Quigg, A. S., Texas A&M University, Galveston, USA, quigg@tamug.edu

**INFLUENCE OF FRESHWATER INFLOWS ON SPATIAL AND TEMPORAL PATTERNS OF WATER QUALITY IN GALVESTON BAY.**

Examination of the impacts of freshwater inflow and bay circulation is a priority area for National Estuary Programs, and specifically the Galveston Bay program in Texas. Programs endeavor to define beneficial freshwater inflows necessary for salinity, nutrient and sediment loading regimes adequate to maintain productivity of economically important and ecologically significant species. With a rapidly expanding urban population in Texas, particularly in coastal municipalities, the challenge to meet human’s needs for water while maintaining critical freshwater inflows will be the greatest challenge in the coming decades. We used a Dataflow, a flow-thru water quality instrument, to map temperature, salinity, chlorophyll, dissolved organic matter, pH, conductivity and transmittance. We found that spatial and temporal distributions are dependent on the magnitude and duration of freshwater inflow events. Depending on antecedent conditions, the response to freshwater inflows also varied. Our findings will ultimately be used to develop intense process-based understanding of the linkages between the magnitude of freshwater inflows and nutrient loading on primary productivity for the Galveston Bay ecosystem.

**Booth, M. G.** University of Georgia, Marine Institute, Sapelo Island, USA, booth@uga.edu

Gifford, S., University of Georgia, Athens, USA, sgifford@uga.edu

Doherty, M., University of Maryland, Horn Point, USA, mdoherty@umces.edu

Moran, M. A., University of Georgia, Athens, USA, mmoran@uga.edu

**SINGLE-GENE TRANSCRIPT QUANTIFICATION OF TWO UNUSUAL METABOLIC GENES IDENTIFIED THROUGH TRANSCRIPTOMIC ANALYSIS OF ESTUARINE BACTERIAL COMMUNITIES.**

Coastal DOM is a complex mixture of compounds, dominated by structural biomolecules derived from lignin, cellulose, and soil/sediment organic matter, and much of the available carbon is refractory in nature. The Sapelo Island Microbial Observatory (SIMO) has created transcriptomic libraries, seasonally and diurnally, from an estuary that is significantly marsh-influenced, and periodically riverine-influenced. We present data on the temporal abundance and expression of two genes involved in the metabolism of unusual substrates. The first is 4-carboxymuconolactone decarboxylase, pcrC, which is involved in the breakdown of aromatics from lignin. The second is taunine dioxygenase, tauD, typically involved in sulfate starvation. Gene abundance and expression were quantified utilizing qPCR and RTqPCR analyses of bacterial DNA and RNA samples collected quarterly (both day and night). qPCR-derived gene and transcript copy numbers did not correspond to each other or to estimates in the transcriptomes. The significance of this work lies in comparing the results of single gene quantification analyses to estimates of gene expression derived from transcriptomic analysis. This has important implications on the utilization of these estimates for biogeochemical models.

**Bootsma, H. A.** University of Wisconsin-Milwaukee, Milwaukee, USA, hbootsma@uwm.edu

Olson, W., University of Wisconsin-Milwaukee, Milwaukee, USA, absoluto@uwm.edu

Schafer, J. S., University of Wisconsin-Milwaukee, Milwaukee, USA, jsjss@uwm.edu

Fillingham, J. H., University of Wisconsin-Milwaukee, Milwaukee, USA, jhf@uwm.edu

**INFLUENCE OF EXTERNAL P LOADING AND INTERNAL P RECYCLING ON NET CARBON FLUX IN A LARGE LAKE.**

Increased internal and external loads of phosphorus often lead to increased algal production in aquatic systems. However, the links between phosphorus dynamics and net carbon flux have received much less attention. Because increased $P$ supply is often accompanied by increased organic carbon loading, it is not obvious how these inputs might alter the balance between autotrophic and heterotrophic carbon fluxes. We used an in situ, autonomous CO$_2$ monitoring system to examine the influence of two major P sources – internal recycling by dreissenid mussels and allochthonous loading resulting from storm events – on net ecosystem metabolism in Lake Michigan. Continuous monitoring on a nearshore buoy, along with in situ measurements of $P$ recycling, suggest that the net effect of dreissenid mussels is to increase $P$ recycling resulting in nuisance blooms of benthic algae. In contrast, large rain events appear to induce heterotrophy in the nearshore. However, P loading resulting from large rain events promotes net carbon fixation in deeper waters, eventually extending across the entire lake.

**Boras, J. A.** Institut de Ciències del Mar CSIC, Barcelona, Spain, sboras@icm.csic.es

Sala, M. M., Institut de Ciències del Mar CSIC, Barcelona, Spain, msala@icm.csic.es

Arrieta, J., Institut Mediterrani de Estudis Avançats CSIC, Esporles, Mallorca, Spain, txetu@imedita.uib.csic.es

Sà, E. L., Institut de Ciències del Mar CSIC, Barcelona, Spain, elsabetaia@icm.csic.es

Agusti, S., Institut Mediterrani de Estudis Avançats CSIC, Esporles, Mallorca, Spain, sagusti@uib.es

Duarte, D. M., Institut Mediterrani de Estudis Avançats CSIC, Esporles, Mallorca, Spain, carlosduret@isic.uib.es

Vaquè, D., Institut de Ciències del Mar CSIC, Barcelona, Spain, dolors@icm.csic.es

**EFFECT OF THE ARCTIC ICE MELTING ON BACTERIAL CARBON FLUXES VIA VIRAL LYSIS AND PROTISTAN GRAZING.**

During the last few years extensive sea ice melting in the Arctic due to climate change has been detected, which could potentially modify the organic carbon fluxes in the Arctic Ocean. To evaluate this process, we studied bacterial carbon channeling by phages to the DOM pool, and by protists up into the trophic web in the melting-affected waters. The study was carried out during the cruise in the northern Greenland Sea and Arctic Ocean in the summer of 2007. Significantly higher losses of bacterial production caused by protists (PPMM$_{prot}$) and lower losses caused by viruses (VMM$_{prot}$) were detected in melting-affected waters compared with unaffected waters. Consequently, significantly more bacterial carbon was channelled by protists.
in melting-affected waters (12.05 ± 5.98 μgC l⁻¹) than in unaffected waters (8.91 ± 8.33 μgC l⁻¹). Viruses channelled 2.63 ± 2.45 μgC l⁻¹ in melting-affected waters, and 4.27 ± 5.54 μgC l⁻¹ in unaffected waters. Our results suggest that the sea ice melting may have a substantial influence on the organic carbon fluxes in the Arctic, and finally modify the ecosystem productivity.

Borg, D. T., The Ohio State University, Columbus, USA, borg.5@osu.edu
Grottioli, A. G., The Ohio State University, Columbus, USA, grottioli.1@osu.edu
Olesik, J. W., The Ohio State University, Columbus, USA, olesik.2@osu.edu

NATURAL VARIABILITY OF TRACE METALS IN TWO SPECIES OF SCLEROSPONGES FROM PALAU AND SAIPAN

Elemental proxies are used to reconstruct oceanic conditions that pre-date modern records. Such proxies have been established in corals, but few attempts have been made in sponges. Acarnochoetetes welsii (high Mg-calcite, collected from an upwelling site in Palau and a non-upwelling site in Saipan) and Astrosclera williyanu (aragonite, collected in Saipan only) were stained and left to grow on the reef for two years. We measured P, Pb, Ba, and Sr (standardized to Ca) in two-year bulk samples from all specimens. Sclerosponge P/Ca was higher, and Pb/Ca was lower, in Palau than in Saipan suggesting that these elements are sensitive to upwelling. Interspecific differences in P/Ca, Pb/Ca, Ba/Ca, and Sr/Ca are likely due to mineralogical effects. High resolution elemental analyses are in progress and will be presented.

Borsheim, K. Y., Institute of Marine Research, Bergen, Norway, yngve.borsheim@imr.no
Milutinovic, S., Bjerknes Centre for Climate Research, Bergen, Norway, svetlana.militinovic@ncer.no

DYNAMICS OF SATELITE-SENSED SURFACE CHLOROPHYLL DURING SPRING BLOOM

The study used time series to determine the geographical distribution of phytoplankton net specific accumulation rate and maximal abundance. Bloom characteristics such as the timing of the initiation and the culmination of the spring bloom were determined over the region investigated. In addition, primary production was estimated. The spring blooms last longer in the Greenland Sea than in the Norwegian Sea, and accumulation rate and chlorophyll at culmination of the bloom is higher. However, the primary production during spring bloom was slightly higher in the Norwegian Sea compared to the Greenland Sea. The highest primary production during spring bloom was located in gyres close to the continental shelf breaks.

Bosch, D. D., USDA-ARS Southeast Watershed Res. Lab, Tifton, GA, USA, david.bosch@ars.usda.gov
Potter, T. L., USDA-ARS Southeast Watershed Res. Lab, Tifton, GA, USA, tom.potter@ars.usda.gov
Rodriguez, J. M., USGS, San Juan, Puerto Rico, jrodusgs@gmail.com
Dieppa, A., JBNERR, Salinas, Puerto Rico, adieppa@gmail.com
Sotomayor-Ramirez, D., Univ. of Puerto Rico, Mayaguez, Puerto Rico, david.soto-mayor@upr.edu
Ardila-Sierra, G., Univ. of Puerto Rico, Mayaguez, Puerto Rico, gerson.ardila@upr.edu
Strickland, T. C., USDA-ARS Southeast Watershed Res. Unit, Tifton, USA, tim.strickland@ars.usda.gov
Lowrance, R. R., USDA-ARS Southeast Watershed Res. Unit, Tifton, USA, richard.lowrance@ars.usda.gov
Hubbard, R. K., USDA-ARS Southeast Watershed Res. Unit, Tifton, USA, bob.hubbard@ars.usda.gov
Marshall, L., Ohio EPA, Xenia, USA, hzhikm@att.net

GROUNDWATER FLOW, VARIABILITY, AND TRANSPORT PATHWAYS IN THE MAR NEGRO OF THE JOBOS BAY NATIONAL ESTUARINE RESEARCH RESERVE, PUERTO RICO

The Jobos Bay National Estuarine Research Reserve (JBNERR) is a semi-enclosed ecosystem along the southeast coast of Puerto Rico. Agriculture, including vegetable, row crop, tree fruit, pasture, and poultry, is an important land use within the watershed. To better understand the potential impact of agriculture on JBNERR, the watershed was designated as the first U.S. Department of Agriculture (USDA) tropical Conservation Effects Assessment Project (CEAP). An agricultural field near the Mar Negro region of JBNERR was identified for detailed study. A series of piezometers were installed upgradient, within, and downgradient to study groundwater flow and agrichemical movement within the surficial aquifer. Continuous water table measurements were collected, combined with topographic data, and hydraulic gradients determined. Pump tests were performed at six wells to characterize saturated hydraulic conductivity (Ksat). Agrichemical concentrations were determined from monthly samples. Ksat data were combined with gradient data to determine flow rates. Concentrations were related to flow rates to evaluate dominant transport pathways from the field into the Mar Negro estuary area via the surficial aquifer.

Bosch, J. A., University of Maryland CES Horn Point Laboratory, Cambridge, USA, jbosch@umes.edu
Kemp, W. M., University of Maryland CES Horn Point Laboratory, Cambridge, USA, kemp@umes.edu
EXPLORING THE EFFECTS OF SURFACE-FEEDING POLYCHAETE DENSITY AND DISSOLVED OXYGEN ON SEDIMENT FLUX RATES OF INORGANIC NITROGEN

The biogenic activity of polychaetes can elevate microbial ammonification, nitrification and/or denitrification in estuarine sediments as well as increase the flux of inorganic nitrogen across the sediment-water interface. Surface-feeding polychaetes inhabit burrows that are intermittently irrigated/ventilated as the animal respires bringing fresh, oxygenated water to deep, anaerobic sediments while flushing remineralized solutes to the overlying water. Chronic eutrophication and expanding seasonal hypoxia in Chesapeake Bay have altered benthic communities in favor of opportunistic species. It has been suggested that the efficient decomposition of organic material is enhanced by the presence of polychaetes that quickly populate an area at a time when there is a large amount of organic material settling to the bottom. Fine-tuning the relationships between DO, polychaete density and inorganic nitrogen fluxes can help develop biogeochemical models of coastal ecosystems. Results of a laboratory experiment using polychaetes (Alitta (Neanthes) succinea) historically dominant in the mesohaline Chesapeake Bay benthic community are used to quantify the influence of varying densities of opportunistic surface-feeding polychaetes on sediment inorganic nitrogen flux rates in natural, undisturbed sediments under varying oxygen conditions.

Böttjer, D., University of Hawaii, Honolulu, USA, dbottjer@hawaii.edu
Church, M. J., University of Hawaii, Honolulu, USA, mjchurch@hawaii.edu
Letelier, R. M., Oregon State University, Corvallis, USA, letelier@coas.oregonstate.edu
Sadler, D., University of Hawaii, Honolulu, USA, sadler@hawaii.edu
Viviani, D., University of Hawaii, Honolulu, USA, viviani@hawaii.edu
Watkins-Brandt, K. S., Oregon State University, Corvallis, USA, kwaterkin@coas.oregonstate.edu

DIAZOTROPH ACTIVITY AND POPULATION STRUCTURE IN AN INCREASED CO2 WORLD

Human reliance on fossil fuel combustion continues to alter atmospheric and oceanic CO2 inventories. Because CO2 readily dissolves in the surface ocean, its impact on ocean chemistry can be significant, as seen by the long-term increase in surface ocean pCO2 (1.92 μatm year⁻¹) and concomitant decrease in upper ocean pH (0.0019 year⁻¹) recorded at Station ALOHA (A Long-term Oligotrophic Habitat Assessment; 22°45N, 158°00W). How these changes affect ocean ecosystem processes and the planktonic food web structure still remains uncertain. We explored the response of natural assemblages of marine dinitrogen (N2) fixing bacteria to increased CO2 and nutrient perturbation experiments, carried out between May and October 2010, suggest a complex response in rates of N2-fixation and diazotrophic community structure in response to short term (24-72 hours) variations in CO2 (387 vs. 1100ppm) and nutrient availability (phosphorus, iron and/or silica). These preliminary findings, as well as ongoing analysis, will be placed into the context of the monthly Hawaii Ocean Time-series (HOT) measurements of diazotroph dynamics in the NPSG.

Bouchard, J. N., National Oceanography Centre, Southampton, United Kingdom, joseph_bouchard@yahoo.com
Purdie, D. A., National Oceanography Centre, Southampton, United Kingdom
DIFFERENTIAL EFFECT OF ELEVATED TEMPERATURE, DARKNESS AND HYDROGEN PEROXIDE ON OXIDATIVE STRESS-INDUCED CELLULAR MORTALITY OF MICROCYSTIS AERUGINOSA.

To verify the implication of oxidative stress in the cellular stress response of Microcystis aeruginosa, replicate cultures grown at 25 °C were exposed to elevated temperature (32 °C), darkness and hydrogen peroxide (0.5 mM) for 96 h. The cel-
lular abundance, the chlorophyll a concentration, the photosynthetic efficiency (Fv/Fm), the production of intracellular oxidative stress, the cellular mortality and the activation of caspase 3-like proteins were assessed every 24 h. Elevated temperature was beneficial to the cells and did not trigger the death of the cells. In darkness, cells did not grow and the slow increase in the production of intracellular oxidative stress coincided with a 15 % increase in mortality and the activation of caspase 3-like proteins. Exposure to hydrogen peroxide had the most drastic effect as it prevented cell growth, caused a decline in Chl a and Fv/Fm. The two-fold increase of oxidative stress matched the 40 % increase in mortality and the activation of caspase 3-like proteins. These results demonstrate the implication of oxidative stress in the stress response and mortality of *M. aeruginosa*.

Bourgeois, S., UPMC, Banyuls sur Mer, France, solveig.bourgeois@obs-banyuls.fr
Pruski, A. M., UPMC, Banyuls sur Mer, France, aly.pruski@obs-banyuls.fr
Charles, F., CNRS, Banyuls sur Mer, France, francois.charles@obs-banyuls.fr
Riviere, B., CNRS, Banyuls sur Mer, France, beatrice.riviere@obs-banyuls.fr
Vétion, G., CNRS, Banyuls sur Mer, France, gilles.vetion@obs-banyuls.fr

**LABORATORY STUDIES OF ORGANIC MATTER DEGRADATION IN PRO-Deltaic SEDIMENTS (Gulf of Lions, France)**

The Rhône River is the major source of freshwater and terrigenous material to the Mediterranean basin. It is characterized by high deposition rates and efficient transformation of sedimentary organs, which is typical for River-dominated Ocean Margins. Yet, despite the obvious importance of prodelta, the mechanisms governing the fate of organic carbon in these dynamic environments are not fully understood. For instance, carbon recycling was evaluated in this study area (Cathalek et al. 2010), but the biochemical degradation of organic matter (OM) compounds has not been assessed yet. In order to examine the kinetics of OM degradation in estuarine environments, we conducted microcosm experiments by incubating sediments from the Rhône prodelta in simulated oxic sediment–water interface systems. Variations in concentration of bulk parameters and molecular-level proxies were followed over 6 weeks to determine degradation rate constants of major compounds of OM. These biochemical proxies provide information on degradation kinetics of origin biomarkers (pigments and fatty acids) and quality descriptors (amino acids) of sedimentary OM. The biochemical degradation of OM under laboratory-controlled conditions will be discussed.

Bowen, J. L., University of Massachusetts Boston, Boston, USA, jennifer.bowen@umb.edu
Holcomb, M., Centre Scientifique de Monaco, Monaco-Ville, Monaco
Ward, B. B., Princeton University, Princeton, USA, bwb@princeton.edu

**ACIDIFICATION REDUCES DIVERSITY AND ALTERS SPECIES COMPOSITION OF NITRIFYING MICROBIAL COMMUNITIES**

Increasing atmospheric CO₂ concentrations are causing decreases in the surface ocean pH over large expanses of the world's oceans. The extent to which this acidification will alter the biogeochemical cycling of carbon and nitrogen is unclear, although there is some evidence to suggest that ammonia oxidizing bacteria (AOB) are pH sensitive. We sampled the microbial communities from two different experiments: a large volume (200 L) acidified incubation of Monterey Bay surface seawater and an aquarium tank experiment with CO₂ bubbled flowing seawater. We found that acidic incubation significantly altered the AOB community composition by promoting the expansion of one phototype and diminishing overall assemblage diversity and evenness. Initial shifts in the community were apparent within as little as six days. Assessment of acidification effects on ammonia oxidizing archaea is currently underway. The role that reduction in microbial diversity plays in altering rates of nitrification requires further investigation but considering the role that diversity plays in promoting ecosystem stability, these data suggest that acidification could have broad repercussions for oceanic nitrogen cycling.

Bowen, J. D., University of North Carolina - Charlotte, Charlotte, USA, jdbowen@uncc.edu
Noble, R. T., University of North Carolina Institute of Marine Sciences, Morehead City, USA, rtnoble@email.unc.edu
Luettich, R. A., University of North Carolina Institute of Marine Sciences, Morehead City, USA, rick_luettich@unc.edu

**TESTING SIMPLE MECHANISTIC MODELS OF BACTERIAL FATE AND TRANSPORT FOR THE NEUSE RIVER ESTUARY, NORTH CAROLINA**

Mechanistic fate and transport models of various groups of bacteria are being developed for the Neuse River Estuary, North Carolina. The models benefit from a long-term monitoring program that has collected roughly biweekly hydrologic, water quality, and phytoplankton and bacterial abundance information at approximately 15 stations spanning the length of the estuary. Dynamic, three-dimensional hydrodynamic, water quality, and microbial abundance models have been developed using an existing code (EFDC) that has been adapted to add simple mechanistic models of fecal indicator bacteria (FIB) and Vibrio dynamics. The FIB model uses a hybrid mechanism/empirical approach, in which the hydrodynamic model is used to calculate bacterial travel times, which are then used with monitoring data to determine mortality rates. A sediment source term is necessary to simulate abundances in the portion of the estuary near New Bern. The *Vibrio* model is based upon simple bacterial growth models that have also been used to model aerobic and endogenous growth in wastewater treatment plants. This model also depends upon a sediment source term to simulate *Vibrio* dynamics in the estuary.

Bowman, K. L., Wright State University, Dayton, USA, bowman.49@wright.edu
Hammerschmidt, C. R., Wright State University, Dayton, USA, chad.hammerschmidt@wright.edu

**DECOMPOSITION OF METHYLMERCURY IN SURFACE WATER OF THE NORTHWEST ATLANTIC OCEAN**

Biological and photochemical processes can decompose toxic monomethylmercury (MMHg) and render mercury less available for biological uptake. However, and in contrast to freshwater systems, little is known about MMHg decomposition in the marine environment. We are investigating the kinetics and mechanisms of MMHg decomposition in seawater from multiple locations on the continental margin of the northwest Atlantic Ocean. Ship-deck incubation tests were performed during oceanographic cruises in 2009 and 2010. Preliminary results suggest that: 1) both biotic and photochemical pathways are important, 2) rate constants of decomposition are similar among locations and comparable to those determined in freshwater lakes, and 3) the mechanism of photochemical destruction in seawater is different from that in lakes. Experiments in 2010 sought to identify alternative photochemical pathways. Quantitative knowledge of the kinetics and mechanisms of MMHg decomposition in seawater will help constrain oceanic budgets and cycling models.

Bowser, C. H., Cornell University Water Resources Institute, Staatsburg, USA, cbbowser@gwdec.state.ny.us
O’Reilly, C. M., Bard College, Annandale, USA, oreilly@bard.edu
Mount, S. J., NY State Dept of Environmental Conservation, Staatsburg, USA, sjm@gwdec.state.ny.us

Hudson River Eels Project: Engaging Students and Citizens in Research

American eels (Anguilla rostrata) are important catadromous migratory fish along the Atlantic Coast, yet recent declines are poorly understood. The Hudson River Eels Project, initiated the NYSED Hudson River Estuary Program, involves over 150 diverse community members in shared goals and methodologies to study juvenile eels during their migrations from sea to stream. Each spring, fyke nets are staked in tidal tributaries spanning 150 miles of the Hudson River and checked daily by teams of trained citizen-scientists from high schools, colleges, nature centers, and watershed groups. Thousands of young-of-the-year &eell; newly arrived from the Atlantic, are counted, weighed and released. The data have yielded information about the timing and strength of migrations and have helped managers prioritize restoration efforts such as barrier passage.

Bradbury, I. R., University of Windsor Ontario, Windsor, Canada, ibradbury@me.com

**CONNECTIVITY AND DISPERSAL IN AQUATIC SYSTEMS: DEFINING A ROLE FOR NATURAL SELECTION AND ADAPTATION**

Connectivity among populations is a key factor promoting the stability and persistence of metapopulations, and is the culmination of habitat heterogeneity, dispersal, and survival. In aquatic species, studies using population genetic comparisons, parentage analysis, individual assignment, and geochemical tags have dramatically improved our understanding of dispersal. Nonetheless, the importance of adaptation in defining spatial trends in connectivity remains unclear. Using examples of studies examining otolith geochemical composition and variation at neutral and non-neutral genetic loci, I will illustrate how adaptation may influence and ultimately shape the scale of aquatic connectivity. Results in both anadromous and marine species demonstrate significant fine-scale spatial structure associated with local adaptation despite high larval and adult dispersal potential. Possible selective agents such as trophic strategy and ocean climate will be discussed highlighting future research.
directions. Results suggest measures of local adaptation and selective mortality be incorporated into models of aquatic connectivity, and support the possibility of a new conservation paradigm whereby spatial management in aquatic species is based on functional and adaptive diversity.

**Brading, P.** University of Essex, Colchester, United Kingdom, pbrading@essex.ac.uk

**Warner, M. E.** University of Delaware, Lewes, USA, mwarner@udel.edu

**Smith, D. J.** University of Essex, Colchester, United Kingdom, djsmitc@essex.ac.uk

**Suggitt, D. J.** University of Essex, Colchester, United Kingdom, dsuggitt@essex.ac.uk

**THE COMBINED EFFECT OF TEMPERATURE AND CO2 ON CARBON ACQUISITION IN SYMBIODINIUM (DINOPHYCEAE): A COMPARISON OF PHYLOTYPES**

Algae of the genus *Symbiodinium* are of global international interest given their role as key ecosystem engineers with unparalleled genetic diversity. Much work has been aimed at understanding how *Symbiodinium* spp. and, in turn, the viability of coral-algal symbioses respond to environmental change. We have recently demonstrated that the effect of ocean acidification (OA) upon the productivity and growth of *Symbiodinium* will be phylotype-specific, with OA potentially preferentially selecting for certain phylotypes. In particular, independent increases (ca. 60%) in both growth and photosynthesis rates were observed for *Symbiodinium* phylotypes A1.1 and A2, respectively. Whilst these responses suggest differences in inorganic carbon species preference and carbon-concentrating mechanism (CCM) regulation, the underlying physiological processes were not clear. Consequently, we have investigated these processes using 13C-labelling approaches for phylotypes A1.1 and A2 within an experimental context of simultaneous elevated seawater temperatures and CO2 concentrations. The data from this work will be further discussed in relation to future biogeochemical cycling by dinoflagellates as well as the potential implications for the future viability of reef forming corals.

**Bradley, C. J.** University of Hawaii at Manoa, Department of Oceanography, Honolulu, Hawaii, USA, cbradley@hawaii.edu

**Popp, B. N.** University of Hawaii, Department of Geology and Geophysics, Honolulu, Hawaii, USA, popp@hawaii.edu

**DEO WATER DEPTH CHANGE THE ACQUISITION AND ALLOCATION OF CARBON AND NITROGEN IN MESOPHOTIC CORAL SYMBIOSES?**

Sources and pathways of carbon and nitrogen in mesophotic coral symbioses were investigated using three stable isotope techniques. Samples from species of Leptoseris were collected at depths ranging from 65 to 130m in a mesophotic coral ecosystem (MCE) in the Au’a channel between the Hawaiian Islands of Maui and Lanai. To determine how the proportion of nutrients in the coral polyp derived from heterotrophic inputs changed with water depth, bulk carbon and nitrogen isotopic compositions were measured in both zooxanthellae and coral tissue. In addition, the trophic position of coral polyps as a function of depth was determined from compound specific nitrogen isotopic analysis of the amino acids glutamic acid and phenylalanine. Lastly, pulse-chase experiments with labeled H13CO3 and 15NO3 were used to trace the path of inorganic nutrients as they were photosynthetically fixed and translocated from zooxanthellae to coral polyp. Changes in bulk carbon and nitrogen isotopic compositions of zooxanthellae and coral polyps suggest that heterotrophy increases with water depth. Results from all three techniques and their implications for the acquisition and allocation of nutrients will be discussed.

**Brandy, P. M.** USGS, Columbia, USA, pbrandley@usgs.gov

**Wright, J. H.** USGS, Boulder, USA, jwright@usgs.gov

**Barber, L. B.** USGS, Boulder, USA, lbarber@usgs.gov

**McMahon, P. M.** USGS, Denver, USA, pmcmahon@usgs.gov

**Gray, J. L.** USGS, Denver, USA, j蒋gray@usgs.gov

**Kolpin, D. W.** USGS, Iowa City, USA, dwkolpin@usgs.gov

**BIODEGRADATION OF ENDOCRINE DISRUPTING CHEMICALS IN STREAMS**

In situ biodegradation of endocrine disrupting alkylphenol surfactant compounds (e.g. 4-nonylphenol (NP)) as well as natural (e.g. 17β-estradiol (E2), estrone (E1), and testosterone (T)) and synthetic (e.g. 17α-ethinylestradiol (EE2)) hormones was investigated in WWTP-impacted streams in the US. Relative differences in mineralization of 14C-substrates were assessed in oxic microcosms containing epilithon, sediment or water-only from locations upstream and downstream of the WWTP outfall in each system. Upstream samples provided insight into the biodegradative potential of sediment microbial communities that were not under the immediate impact of WWTP effluent. Downstream samples provided insight into the impacts of effluent on reproductive hormone biodegradation. In general, biodegradation was most efficient for NP and least efficient for EE2, with the natural hormones (E1, E2, and T) exhibiting intermediate degradation potentials. The results of this study indicate that, in combination with sediment sorption processes which effectively scavenge hydrophobic contaminants from the water column and immobilize them in the vicinity of the WWTP outfall, aerobic biodegradation of reproductive hormones can be an environmentally important mechanism for non-conservative (destructive) attenuation of endocrine disruptors in effluent-impacted streams.

**Braeckman, U.** Ghent University, Marine Biology Section, Ghent, Belgium, Ulrike. braeckman@UGent.be

**Provoost, P.** Netherlands Institute of Ecology (NIOO-KNAW), Centre for Estuarine and Marine Ecology, Yerseke, Netherlands, P.Provoost@nioo.knaw.nl

**Soetaert, K.** Netherlands Institute of Ecology (NIOO-KNAW), Centre for Estuarine and Marine Ecology, Yerseke, Netherlands, K.Soetaert@nioo.knaw.nl

**Middelburg, J. J.** Darwin Center for Biogeoosciences, Utrecht, Netherlands, JMiddelburg@geo.uu.nl

**Vinck, M.** Ghent University, Marine Biology Section, Ghent, Belgium, Magda. Vincc@UGent.be

**Vanaverbeke, J.** Ghent University, Marine Biology Section, Ghent, Belgium, Jan. Vanaverbeke@UGent.be

**MICROSCLALE MINERALISATION RATES UNDER DIFFERENT MIXING REGIMES**

Through a series of microcosm experiments, we tried to unravel how the small-scale creation of microniches by different mixing regimes affects organic matter mineralisation. Our new approach uses the bioturbation microcosm technique, where biologically different mixing regimes (bio-irrigator/biotorbulkator) in mineralisation rates. The bio-irrigator had a stronger influence on mineralisation rates (faunal stimulation of sediment community oxygen consumption, nutrient fluxes, denitrification) due to its flushing behaviour drawing oxygen-rich water into the subsurface. In contrast, the biotorbulkator reworked the sediment and its organic matter, but the stimulation of mineralisation was limited. In a next step, we contrasted biological and physical mixing events and traced 13C labeled phytoferredit dus down the food web. The total C budget encompassing sediment community oxygen consumption, leftovers of 10C in the sediment and very limited phytoferredit assimilation by both the biological mixers and the metazoan lower food web revealed a larger role of bacterial mineralisation in the bio-irrigated and control sediments. Significantly more organic matter remained in the biotorbulkated and physically mixed treatments, which is explained by the subsurface burial hence delayed degradation of organic matter.

**Brandt, M. E.** University of the Virgin Islands, St Thomas, US Minor Outlying Isles, mbrandt@uvi.edu

**Smith, T. B.** University of the Virgin Islands, St Thomas, US Minor Outlying Isles, tsmith@uvi.edu

**THE ECOLOGY OF EPIDEMIC WHITE PLAGUE DISEASE IN THE FACE OF MULTIPLE DISTURBANCES**

In the fall of 2010 Brewers Bay Reef, located on the south side of St. Thomas (USVI), was exposed to moderate bleaching conditions from high temperatures as well as severe swell from the close passage of two tropical storms. Storm passage resulted in fragmentation of the dominant framework species Montastraea annularis, and an outbreak (prevalence > 70%) of putative white plague disease was observed on fragments and intact colonies exhibiting a range of bleaching intensities. Disease occurrence was found to be more influenced by fragmentation than by bleaching, as fragments had a significantly higher prevalence of disease but average bleaching extent did not differ between diseased and unaffected fragments or intact colonies. Primary infection likely occurred through sediment contact stimulated by fragmentation, as fragments had a significantly higher prevalence of disease but average bleaching occurrence was found to be more influenced by fragmentation than by bleaching, suggesting a microbial etiology for the lesions. Measured spatial clustering of disease was limited. In a next step, we contrasted biological and physical mixing events and investigated the role of different biological mixing regimes (bio-irrigator/biotorbulkator) in mineralisation rates. The bio-irrigator had a stronger influence on mineralisation rates (faunal stimulation of sediment community oxygen consumption, nutrient fluxes, denitrification) due to its flushing behaviour drawing oxygen-rich water into the subsurface. In contrast, the biotorbulkator reworked the sediment and its organic matter, but the stimulation of mineralisation was limited. In a next step, we contrasted biological and physical mixing events and traced 13C labeled phytoferredit dus down the food web. The total C budget encompassing sediment community oxygen consumption, leftovers of 10C in the sediment and very limited phytoferredit assimilation by both the biological mixers and the metazoan lower food web revealed a larger role of bacterial mineralisation in the bio-irrigated and control sediments. Significantly more organic matter remained in the biotorbulkated and physically mixed treatments, which is explained by the subsurface burial hence delayed degradation of organic matter.
Brault, E. K., Oregon State University, Corvallis, USA, Stephen.brault@oregonstate.edu
Roman, M., University of Maryland, Center for Environmental Science, Cambridge, USA, roman@btl.umces.edu
Pierson, J., University of Maryland, Center for Environmental Science, Cambridge, USA, jpierson@umces.edu
Kolesar, S., Oregon State University, Corvallis, USA, sarah.kolesar@oregonstate.edu
Boicourt, B., University of Maryland, Center for Environmental Science, Cambridge, USA, boicourt@umces.edu
Selling, C., Oregon State University, Corvallis, USA, cynthia.selling@oregonstate.edu

HOW DOES HYPOXIA AFFECT HABITAT QUALITY OF FISHES?
Nutrient abatement programs to reduce the effects of cultural eutrophication are often implemented in an effort to reduce hypoxia and mitigate hypoxic effects on fishes. Yet, it is unclear how hypoxia actually affects habitat quality for fishes, particularly those in midwater. Reduced oxygen availability has the potential to cause mortality or indirect sublethal effects, including reduced feeding and growth rates, changes in behavior and distribution, and increased encounter frequency with predators or prey. Detailed analyses of spatial distributions of environmental factors and fishes in the Great Lakes, Chesapeake Bay and the Northern Gulf of Mexico suggest that spatial distributions and other habitat features, such as water temperature and the timing of hypoxia, have species and ecosystem specific effects. Indeed some fishes may actually benefit from hypoxia. Research needs to focus on these complex interactions, including the degree of overlap between predators and prey habitats, and changes in the habitat quality and growth rate potential of fishes. Comparisons across ecosystem may yield further insights into intra-specific and food-web variability in response to hypoxia and eutrophication.

Brault, E. K., Virginia Institute of Marine Science, Gloucester Point, USA, emily.brault@gmail.com
Dickhut, R. M., Virginia Institute of Marine Science, Gloucester Point, USA, rdickhut@vims.edu
Geisz, H. N., Virginia Institute of Marine Science, Gloucester Point, USA, heidig@vims.edu
Cochran, M. A., Virginia Institute of Marine Science, Gloucester Point, USA, mco-chran@vims.edu

CHEMICAL TRACERS FOR STUDYING THE ANTARCTIC MARINE FOOD WEB
Chemical tracers such as persistent organic pollutants (POPs), stable isotope ratios, and mercury, are emerging tools for quantifying trophic interactions and food webs. By analyzing suites of tracers in long lived, high trophic-level species, such as penguins and marine mammals, it is possible to gain insight into short-term versus long-term dietary preferences, as well as seasonal diet shifts (e.g. during the breeding season). In order to select useful chemical tracers to evaluate the feeding ecology of high trophic level Antarctic predators, we analyzed phytoplankton, mixed zooplankton, and krill collected from previous research cruises along the western Antarctic coast. We identified a number of tracers at detectable concentrations in these lower trophic levels including mercury and various POPs, which will enable us to evaluate the contribution of these prey items in the diets of higher trophic level organisms. Future efforts will focus on determining the chemical signatures of penguins, seabirds, fish, and marine mammals from western Antarctica.

Brans, M., Helmholtz Centre for Environmental Research GmbH, Magdeburg, Germany, mario.brans@fz-juelich.de
Friese, M., Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, friese@igf-berlin.de
Graeber, D., Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, graeber@igf-berlin.de
von Schiller, D., Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, daniel.vonschiller@igf-berlin.de

RESOURCE QUALITY BUT NOT SPECIES IDENTITY AIDS STABLE ISOTOPE FRACTIONATION OF FRESHWATER MACROINVERTEBRATES
Stable isotopes of carbon and nitrogen are widely used as tracers for the study of organic matter flows in food webs. Knowledge on the degree of trophic fractionation, defined as the isotopic difference between a consumer and its resource, constitutes one of the most important requirements for the analysis of consumer-resource interactions. While specific fractionation factors exist for a variety of consumers, knowledge on specific fractionation factors and their relationship with resource quality for freshwater benthic macroinvertebrates is largely lacking. We investigated trophic fractionation factors of five benthic macroinvertebrates species fed with five food resources with distinct qualities as determined by different C:N ratios. Most species reached isotopic equilibrium after five weeks and the half-life of tissue turnover ranged from 14 to 40 days. Species identity had no effect on trophic fractionation as fractionation factors did not significantly differ among species. However, there was a significant relationship between trophic fractionation and resource quality and fractionation factors increased with decreasing C:N ratios. These results can be used to establish resource-specific fractionation factors to improve the analysis of consumer-resource interactions.

Breck, J. E., Michigan Dept Natural Resources, Institute for Fisheries Research, Ann Arbor, USA, breck@umich.edu
Rutherford, E. S., NOAA Great Lakes Environmental Research Laboratory, Ann Arbor, USA, Edwin.Rutherford@noaa.gov
Simon, C. P., University of Michigan, Ann Arbor, USA, cpsimon@umich.edu
Low, B. S., University of Michigan, Ann Arbor, USA, bobblow@umich.edu
Lamberson, P. J., Massachusetts Institute for Technology, Cambridge, USA, pjamin@mit.edu
Swank, D. R., NOAA National Marine Fisheries Service, Santa Cruz, USA, David.Swank@noaa.gov

PREDICTING CLIMATE CHANGE AND FISHING EFFECTS ON FISH AGE AT MATURITY USING AN ANALYTIC LIFE HISTORY MODEL
Fishing and climate change are expected to result in changes in fish population growth and life history traits such as age at maturation. We use life history theory and Fisher's reproductive value to quantify the effects of fishing and climate change on optimal age at first reproduction for semelparous and iteroparous females in different Laurentian Great Lakes environments. We use IPCC scenarios of climate change, a 3-dimensional model of lake temperature, and bioenergetics models to predict climate impacts on individual fish growth. For the range of predicted individual growth rates and a range of fishing intensities, we calculate the resulting optimal age at maturation for semelparous Chinook salmon and iteroparous steelhead living in the Great Lakes. We describe the sensitivity of fish age at maturity to growth, size-specific survival, and reproduction parameters. We show that age at maturity is especially sensitive to juvenile survival. We describe the corresponding reaction norms that relate age of maturity to growth rates, and compare and contrast the patterns we find to previously published reaction norms.

Breitbart, D., Smithsonian Environmental Research Center, Edgewater, USA, breitb@dseis.gov
Hondorp, D., USGS, Ann Arbor, USA, dhondorp@usgs.gov
Audemard, C., Virginia Institute of Marine Science, Gloucester Point, USA, audemard@vims.edu
Carnegie, R., Virginia Institute of Marine Science, Gloucester Point, USA, carnegiervims.edu
Burrell, R., Smithsonian Environmental Research Center, Edgewater, USA, burrellr@sei.edu
Clark, V., Smithsonian Environmental Research Center, Edgewater, USA, clarkv@sei.edu

BREATHELESS NIGHTS: DIEL-CYCLING HYPOXIA AND THE PREVALENCE OF PERKINSUS MARINUS (DERMO) INFECTIONS IN CHESAPEAKE BAY OYSTERS
Little is known about the consequences of chronic exposure to diel-cycling hypoxia that is common in nutrient enriched shallow waters and is characterized by dissolved oxygen concentrations that vary from supersaturated during mid-day to between near zero and about 50% saturation in early morning hours. Laboratory and field experiments both indicated that diel-cycling hypoxia increases acquisition of Perkinsus marinus (dermo) infections by oysters, most likely by reducing immune responses. Oyster filtration rates declined in response to decreasing DO, but rapidly recovered as DO increased. qPCR assays for waterborne P. marinus indicated that Perkinsus marinus (dermo) infections by oysters, most likely by reducing immune responses. Oyster filtration rates declined in response to decreasing DO, but rapidly recovered as DO increased. qPCR assays for waterborne P. marinus indicated that Perkinsus marinus (dermo) infections by oysters, most likely by reducing immune responses. Oyster filtration rates declined in response to decreasing DO, but rapidly recovered as DO increased. qPCR assays for waterborne P. marinus indicated that
RESPONSES OF MICROBIAL FOOD WEB TO THE PROLONGED SEASONAL HYPOXIA IN A BOREAL LAKE

The boreal clearwater Lake Vesińärvi in an urban setting is experiencing annual periods of hypolimnetic hypoxia and anoxia but the consequences of this for the microbial food web have been unknown. We determined changes in stocks of bacteria, picophytoplankton, nanoflagellates and ciliates over the growing season in relation to oxygen concentrations. During spring mixing the herbivorous taxa accounted for 26% of ciliate numbers, and bacterivorous and omnivorous species for 31% and 43%, respectively. At the onset of hypoxia, numbers of ciliates increased throughout the water column, but herbivores disappeared in the hypolimnion. Concurrently, ciliate herbivory persisted in the oxygenated epilimnion. The numerous and diverse ciliate community was positively correlated with bacteria in hypolimnion and picophytoplankton in epilimnion, indicating strong grazing pressure. In the epilimnion, bacterial numbers and production followed the seasonal dynamics of phytoplankton, and high densities of nanoflagellates coincided with the picophytoplankton maximum. In the hypolimnion, nanoflagellates were related to bacteria. Thus, the hypoxia/anoxia divided the water column into two radically different layers, where two distinctively operating microbial wood webs evolved.

Bressac, M., ACRI-ST/Laboratoire d’Océanographie de Villefranche, CNRS-INSU, Villefranche-sur-mer, France, bressac@obs-vlfr.fr
Guieu, C., Laboratoire d’Océanographie de Villefranche, CNRS-INSU, Villefranche-sur-mer, France, guieu@obs-vlfr.fr
Doxaran, D., Laboratoire d’Océanographie de Villefranche, CNRS-INSU, Villefranche-sur-mer, France, doxaran@obs-vlfr.fr
Bourrin, F., CEFREM-CNRS, Perpignan, France
Wagener, T., Leibniz Institute of Marine Sciences (IFM-GEOMAR), Kiel, Germany
Obolensky, G., Laboratoire d’Océanographie de Villefranche, CNRS-INSU, Villefranche-sur-mer, France

FATE AND EFFECTS OF SAHARAN DUST IN SEAWATER: A SIMULATED DUST DEPOSITION DURING THE DUNE (DUST EXPERIMENT IN A LOW NUTRIENT LOW CHLOROPHYLL ECOSYSTEM) PROJECT

The impact of lithogenic aerosols on POC fluxes in the ocean is still debated. The interaction between DOM, POC aggregates and suspended ‘ballast’ minerals has recently been considered as a possible major control over POC flux. Furthermore, Saharan dust deposition may lead to physico-chemical processes (dissolution, adsorption, etc.) which could affect the biogeochemical cycles of nutrients. The present study aims at contributing to a better understanding of these processes. In the frame of the DUNE project, large mesocosms have been deployed in the Scandola Preservation area (Corse) with the aim to study in situ the response of an oligotrophic ecosystem to atmospheric forcing. Optical properties (light attenuation, absorption, backscattering coefficients and particles size distributions) have been measured before and after an artificial seeding with Saharan dust to follow the formation of aggregates and sink of particles. These measurements have been complemented by chemical analyses of Fe, N and P in different size fractions (e.g. cross-flow ultrafiltration) to understand in what extent the particle sink in the water column can affect the distribution of nutrients and micro-nutrients on the dissolved-colloidal-particle continuum.

Brix, L. D., Brown University / Marine Biological Laboratory, Providence, USA, lindsay_brix@brown.edu
Rich, J. J., Brown University, Providence, USA, jeremy_rich@brown.edu
Gilibin, A. E., Marine Biological Laboratory, Woods Hole, USA, aggilbing@mlbl.edu

QUANTIFYING LABILE ORGANIC PHOSPHORUS IN SUSPENDED PARTICulates AND AQUATIC SEDIMENTS: AN ADAPTATION TO THE SEDEX METHOD FOR SELECTIVE P EXTRACTION

This study evaluates the selectivity and efficiency of a Bligh Dyer-type lipid extraction technique for separately quantifying labile organic phosphorus (OP) in aquatic suspended particulate matter and bottom sediments. Monospecific phytoplankton cultures were used as ‘analogue’s for labile particulate organic matter. Our objective was to insert a step to precede the full SEDEX method that will remove a small portion of the OP pool prior to subjecting samples to the harsher extractants that make up the balance of the SEDEX scheme. Although the SEDEX method includes a step for quantifying OP, it is not optimal for capturing and quantifying labile OP because in the current scheme OP is quantified in the final step. Thus, labile OP can be solubilized in prior steps and incorrectly quantified as inorganic P. The ability to accurately quantify labile OP is essential for quantifying living biomass P and labile non-living OP, the pools mostly likely to generate mineralized P to support new cycles of primary production.

Bristow, L. A., School of Marine Science and Technology, University of Massachusetts Dartmouth, New Bedford, USA, lbirstow@umassd.edu
Altabet, M. A., School of Marine Science and Technology, University of Massachusetts Dartmouth, New Bedford, USA, malthabet@umassd.edu
Larkum, J. A., School of Marine Science and Technology, University of Massachusetts Dartmouth, New Bedford, USA, jlarkum@umassd.edu
Chan, F., Oregon State University, Corvallis, USA, chanft@science.oregonstate.edu
Letelier, R. M., College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, USA, letelier@coas.oregonstate.edu

Ruttenberg, K. C., University of Hawaii, Honolulu, USA, kcr@soest.hawaii.edu
Ciotti, A. M., CEBIMAR-USP, Laboratório Aquarela, São Sebastião, SP, Brazil, ciottiam@me.com

USING NITRATE ISOTOPES TO UNDERSTAND SEASONAL HYPOXIA ON THE OREGON SHELF

Eastern boundary currents are highly productive systems as a result of wind driven upwelling of nutrient rich waters. In the case of the central Oregon coast, seasonal upwelling also transports oxygen poor waters onto the shelf and along with respira-
tory oxygen loss results in the development of shelf hypoxia. Understanding the potential interplay between hypoxia and the biogeochemical cycling of nitrogen is crucial to determine the impacts on fundamental N cycle pathways. Here we use time series observations from 2010 of N and O isotopes of nitrate along with concentration data to identify sources and transformations of N in this system. Samples collected to date indicate a clear regime shift from one dominated by recycling (i.e. nitrification) pre-upwelling to one with a consistent isotopic signature thought to be associated with upwelled waters below the thermocline. Elevated N and O isotope values at the surface throughout the period of upwelling to date suggest N assimilation. Sampling will continue till late October allowing a full seasonal cycle to be analyzed and presented.

Brocco, B. A., University of Puerto Rico, Mayaguez, Puerto Rico, belynuska@gmail.com

Morell, J., University of Puerto Rico, Mayaguez, Puerto Rico, jilo.moorell@up.edu

Corredor, J., University of Puerto Rico, Mayaguez, Puerto Rico, jorge.corredor@up.edu

López, J. M., University of Puerto Rico, Mayaguez, Puerto Rico, jose.lopez55@up.edu

Antoun, H., University of Puerto Rico, Mayaguez, Puerto Rico, antounorame@gmail.com

MODULATION OF THE PLANKTONIC HETEROTROPHIC ACTIVITY IN THE EASTERN CARIBBEAN SEA BY THE ORINOCO RIVER PLUMES

Planktonic communities of tropical and subtropical waters have been reported to exhibit a net heterotrophic metabolism. The organic carbon required to support such condition implies an allochthonous input from either net productive adjacent areas and/or external source(s). The influence of the Orinoco River Plume (ORP) in the planktonic metabolic balance in the Eastern Caribbean Sea was estimated in a gradient along the plume's dispersal axis (10.3°N-17.6°N) that allowed us to test the hypothesis presuming the Caribbean influenced by the ORP to exhibit net autotrophic balance. Metabolic activity estimates are based on measurements of PP (O2 evolution and 14C techniques) and R (O2 evolution and potential respiration-ETS activity). Carbon stock assessments are based on historic data and measurements of phytoplankton biomass.

Brock, D. A., The College of William & Mary/VIMS, Gloucester Point, USA, brock@vims.edu

Frischer, M. E., Skidaway Institute of Oceanography, Savannah, USA, Marc.Frischer@skio.usg.edu

Bradley, R. B., NOAA, Washington, USA, paul.bradley@noaa.gov

Sanderson, M. P., The College of William & Mary/VIMS, Gloucester Point, USA, mp@vims.edu

Roberts, Q., The College of William & Mary/VIMS, Gloucester Point, USA, qroberts@vims.edu

Booth, M. G., University of Georgia, Sapelo Island, USA, booth@uga.edu

THE QUEST TO DEFINE WHAT IS DOING WHAT IN PLANKTONIC COMMUNITIES - PHYTOPLANKTON

During our fifteen-year collaboration with Peter Verity, there was one consistent theme – quantifying what different members of the plankton were doing. Through a combination of small volume shipboard incubations and large volume mesocosms, in a number of environments, the team of Verity, Frischer, and Bronk et al. tried a suite of approaches to define who was doing what with respect to nitrogen and carbon rates. One approach that worked was the merging of flow cytometric sorting with N15 tracer techniques. Flow cytometry was used to sort autotrophs from heterotrophs at the end of N15 tracer incubations to produce true phytoplankton-specific uptake rates. In a comparison of phytoplankton-specific uptake rates across systems, ammonium was the largest contributor to phytoplankton nitrogen nutrition (~55%), followed by urea (~30%), nitrate (~15%), and dissolved free amino acids (~5%). Estimates of heterotrophic nitrogen uptake indicate that at times over half of the total uptake of each substrate was by bacteria. This approach holds great promise to provide the group-specific nitrogen and carbon uptake rates needed to model elemental flow through aquatic systems.

Bromk, C., Lund University, Lund, Sweden, christo.bromkark@linnol.lu.se

Lakowitz, T., Lund University, Lund, Sweden, thomas.lakowitz@linnol.lu.se

DO CHEMICAL CUES FROM FISH AFFECT GROWTH OF FRESHWATER MACROPHYTES?

To test the importance of lethal and trait-mediated effects of molluscivorous fish on snails, periphyton and macrophytes we performed a long-term experiment with control (no fish), non-lethal (caged fish) and lethal (fish) treatments. Predation had a strong effect on snail density, whereas there was no difference in snail density between the control and the non-lethal treatment. The biomass of periphytic algae was significantly higher in the lethal than in the control and non-lethal treatment. A high biomass of periphytic algae resulted in a reduced growth of submerged macrophytes in the lethal treatment due to competition for light and nutrients. Further, the biomass of periphyton and macrophytes were negatively respectively positively correlated to snail density across all treatments. The results show that fish predation can have a strong, indirect effect on growth of both periphyton and macrophytes mediated by a lethal, direct effect on snails. However, chemical cues from fish had no effect on algal or macrophyte growth and, thus, trait-mediated indirect effects of predation are not important for periphyton and macrophytes in this system.

Brooks, G. R., Eckerd College, St. Petersburg, USA, brooksg@eckerd.edu

Larson, R. A., USF/Eckerd College, St. Petersburg, USA, larsonra@eckerd.edu

Devine, B., Tropical Ecosystems Consulting, Coral Bay, U.S. Virgin Islands, bddevine3485@gmail.com

NATURAL AND ANTHROPOGENIC INFLUENCES ON COASTAL SEDIMENTATION IN THE USVI

Coastal sediment input and accumulation rates in the US Virgin Islands (USVI) have increased by up to 10x since the 1980s in response to increases in anthropogenic development in the contributing watershed. Once entering the marine environment, however, accumulation rates are also influenced by the ability of oceanographic processes (waves, currents) to export sediments. In the USVI the ability to export sediments is further controlled by island geology, which dictates coastal configuration. For example, St. Thomas and St. John are volcanic in origin creating an irregular coastline with numerous embayments. Most sediment input is deposited along the coast as the sluggish circulation inhibits sediment export. St. Croix, on the other hand, is a sedimentary island with a straighter coastline and fewer restricted embayments. Coastal circulation is greater and much of the sediment entering the system is exported, regardless of the input rate. Thus, the rate of sediment accumulation in coastal environments is not only a function of input rates, but also the ability of the system to export sediments, which must be considered when planning for future island development.

Brooks, M. L., Southern Illinois University, Carbondale, USA, mbrooks@siu.edu

Lovvorn, J. R., Southern Illinois University, Carbondale, USA, lovvorn@siu.edu

Cooper, L. W., University of Maryland Center for Environmental Science, Solomons, USA, cooper@umces.edu

CDOM PHOTOOXIDATION IN THE ARCTIC: IMPLICATIONS FOR CLIMATE CHANGE EFFECTS ON FOODWEBS

Climate change is decreasing the extent of arctic sea ice and increasing exposure of surface waters to both PAR and biologically damaging UV. Penetration of UV depends mainly on chromophoric dissolved organic matter (CDOM) excreted by plankton. To investigate spectral qualities and photooxidation of CDOM, we incubated seawater on deck during Icebreaker cruises in spring 2009 and fall 2009. CDOM absorption of UV-B (~280-320 nm) increased >10-fold after ~30 h. Zooplankton biomass and chlorophyll a covaried directly with UV-B absorption. CDOM from laboratory cultures of Tigriopus californicus fed Dunaliella spp. also increased absorption after full-spectrum irradiation. The apparent post-irradiation enhancement of UV absorption suggests that global warming might trigger greater primary production without detriment from UV. Conversely, without freshwater from melting sea ice, seas may not stratify, limiting phytoplankton residence in the euphotic zone, and diminishing the spring bloom. Finally, we model arctic production from contrasting sea ice scenarios.

Brotz, L., Sea Around Us Project, Fisheries Centre, University of British Columbia, Vancouver, Canada, lcasbroitz@gmail.com

Pauly, D., Sea Around Us Project, Fisheries Centre, University of British Columbia, Vancouver, Canada

Cheung, W. L., University of East Anglia, Norwich, United Kingdom

Pakhomov, E., Earth and Ocean Sciences, University of British Columbia, Vancouver, Canada

CHANGING JELLYFISH POPULATIONS – TRENDS IN LARGE MARINE ECOSYSTEMS

While many jellyfish populations fluctuate with climatic cycles, there is recent evidence suggesting increases in both native and invasive jellyfish species from several locations around the globe. To understand the scope of these changes, jellyfish abundance data was collected and analyzed from over 40 Large Marine Ecosystems. Due to the dearth of scientific datasets, anecdotal information from marine scientists must be considered when planning for future island development.
and fishes was also included. All information was weighted to reflect spatial and temporal coverage, as well as apparent confidence. Possible anthropogenic causes of changes in jellyfish populations were also investigated, including effects from fishing and coastal development. While many populations show high variability, signs of increasing jellyfish blooms and invasions on a global scale were found to be both numerous and widespread.

**Brouillet-Gauthier, G., Université du Québec à Rimouski et Centre d’étude Nordique, Rimouski, Canada, genevieve_bg@hotmail.com**

Nozais, C., Université du Québec à Rimouski et Centre d’étude Nordique, Rimouski, Canada, christian_nozais@uqar.ca

**DIET OF THE AMPHIPOD HYALELLA AZTECA (AMPHIPODA) IN THE LITTORAL ZONE OF BOREAL LAKES: INSIGHTS FROM STABLE ISOTOPE ANALYSIS**

Littoral habitats represent a key component of the functioning of lake ecosystems. However, most current studies have focused on the pelagic food webs and very few on their benthic counterparts. The objective of this study was therefore to assess the diet of amphipods of the *Hyalella azteca* species complex, a major component of benthic communities in the littoral zone of lakes, using carbon and nitrogen stable isotopes. *H. azteca* is considered to be an omnivorous detritivore living in macrophyte communities, on sediments and organic debris. Preliminary stable isotope analyses and mixing models on samples originating from seven lakes showed that *H. azteca* fed primarily on terrestrial detritus with contribution ranging from 21 to 53% to amphipod diet. Macrophytes and periphyton did not appear to represent a significant food source for *H. azteca* with contribution ranging from 13 to 23% and 12 to 25%, respectively. Overall, the results show the importance of terrestrial detritus for the littoral benthic food web and highlight the tight nature of the coupling between lakes and their surrounding terrestrial habitats.

**Brown, A. S., University of California, Santa Cruz, Santa Cruz, USA, abrown@ucsc.edu**

Fredrickson, K., Shannon Point Marine Center, Anacortes, USA, kerri.Fredrickson@wwu.edu

Strom, S., Shannon Point Marine Center, Anacortes, USA, Suzanne.Strom@wwu.edu

**EXAMINING HYDROGEN PEROXIDE AS THE AGENT OF TOXICITY OF HETEROSIGMA AKASHIWO IN THE PRESENCE OF CATALASE**

Heterosigma akashiwo (Raphidiophyceae) can form dense blooms that are toxic to fish. These red tide phytoplankton generate the reactive oxygen species superoxide (*O*₂⁻) and hydrogen peroxide (*H*₂*O*₂), and hydroxyl radical (OH), which can damage the gills of fish, blocking the exchange of O₂ and resulting in asphyxiation. Our research sought to examine hydrogen peroxide as the agent of toxicity of *H. akashiwo*. We used the enzyme catalase to convert *H*₂*O*₂ metabolically produced by *H. akashiwo*, into *H*₂*O*₃ and *O*₂ (gas). We introduced *H. akashiwo* to the ciliate *Favella ehrenbergii* with and without catalase present to see if the enzyme would eliminate the toxicity produced by *H. akashiwo*. After an 8 hour exposure, there were indications that hydrogen peroxide was the agent of toxicity; however, the effect had disappeared by 24 hours. Based on our data, it is unclear whether hydrogen peroxide was the indication of toxicity for *Heterosigma akashiwo*. There are signs that catalase could be a contributor of toxicity based on its negative effects on *Favella ehrenbergii* and *Heterosigma akashiwo*.

**Brown, C. W., NOAA, College Park, USA, Christopher.W.Brown@noaa.gov**

Hood, R. R., University of Maryland Center for Environmental Science - Horn Point Laboratory, Cambridge, USA, rhood@umces.edu

Long, W., University of Maryland Center for Environmental Science - Horn Point Laboratory, Cambridge, USA, wenlong@umces.edu

Ramers, D. L., Naval Surface Warfare Center Dahlgren, USA, douglas.ramers@navy.mil

Wazia, C., Maryland Department of Natural Resources, Annapolis, USA, cwazia@dnr.state.md.us

Wiggett, J., University of Southern Mississippi, Stennis Space Center, USA, jerry.wiggett@usm.edu

Murtugudde, R., University of Maryland, College Park, USA, ragu@esri.com

Decker, M. B., Yale University, New Haven, USA, marybeth.decker@yale.edu

Wilson, D., NOAA, Annapolis, USA, doug.wilson@noaa.gov

**DEVELOPMENT OF A CHESAPEAKE BAY ECOLOGICAL PREDICTION SYSTEM**

A system was developed to routinely provide short-term predictions of hydrodynamic and biogeochemical parameters in the Chesapeake Bay to monitor its ecological condition. The system generates daily nowcasts and three-day forecasts of several water quality variables, such as sea-surface temperature, salinity, and chlorophyll concentration, and the likelihood of encountering several noxious organisms, such as the scyphomedusa *Chrysaora quinquecirrha* and several harmful algal bloom species. The biological predictions are generated by driving multi-variante empirical habitat suitability models with real-time and forecast data acquired and derived from an implementation of the Regional Ocean Modeling System configured for Chesapeake Bay. The forecasts, in the form of digital images, are available via the internet to guide research, recreational and management activities. All components of the infrastructure to the predictions are integrated into a forecasting system that is housed and operated by the NOAA Chesapeake Bay Office. The system can be modified to predict the probability of other important target species, and the ecological approach can be transported to any location were sufficient data to define the habitat of the species in question exists.

**Brown, E. E., Stony Brook University, Stony Brook, USA, elbrown@ic.sunysb.edu**

Baumann, H., Stony Brook University, Stony Brook, USA, hbaumann@ms.cc.sunysb.edu

Conover, D. O., National Science Foundation, USA, dconover@nsf.gov

**TESTING FOR ADAPTATION TO CLIMATE CHANGE IN AN OCEANIC SPECIES, THE CALIFORNIA GRUNION (LEURESTHES TENUIS)**

Understanding how species adapt to spatial climate gradients can provide clues to the potential for evolutionary responses to temporal environmental change. Adaptive genetic variation in multiple traits has been found in eastern fishes on the east and west coasts of North America. Common garden experiments and studies of wild fish were used to test for local adaption among several traits (growth, sex ratios, and vertebral number) of California grunion across three latitudinal populations: Monterey, CA (36.6°N), Malibu, CA (34.0°N), and Ensenada, MX (31.9°N) in 2009 and 2010. We did not find any consistent differences in growth rates between populations. Temperature significantly affected sex ratios (*p* < .001), indicating grunion have environmental-dependent sex determination (ESD); however the level of ESD did not differ among populations. Mean vertebral number in wild grunion was nearly identical for all populations. Failure to observe latitudinal variation in these traits, unlike other coastal fishes, may be due to the more oceanic habitat of grunion, which provides a greater opportunity for broad-scale gene flow. Oceanic life-history strategies may be less suited to adapt to climate change than estuarine strategies.

**Brown, J. M., Cornell University, Ithaca, USA, jmb636@cornell.edu**

Hewson, I., Cornell University, Ithaca, USA, hewson@cornell.edu

**INSIGHTS INTO PHAGE ECOLOGY OF A TRICHODESMIUM SPP. LYSIS EVENT USING METAVIROMICS**

The marine diazotrophic cyanobacterium *Trichodesmium* spp. plays a crucial role in the marine nitrogen cycle in oligotrophic waters. *Trichodesmium* aggregations are known to undergo lysis events causing them to disappear rapidly in both culture and field settings. Viruses are important players in the marine microbial loop, lysing up to 50% bacteria day⁻¹. Viral lysis of hosts may satisfy the elemental demands of co-occurring microorganisms. Previous studies observed virus-like particle emission from *Trichodesmium* spp. suggesting that cyanophages (potentially in concert with apoptosis) are the agents of its mortality. We have constructed a metavirome of a lysed *Trichodesmium* community. Several viral sequences were identified within the metavirome which are most similar to genes from known cyanophage, but are not present in other metaviromes. Quantification of one of these genes by qPCR verified its presence in higher abundance within viral size fractions of samples where *Trichodesmium* was present. The metavirome also contained numerous temperate phage genes of putatively heterotrophic bacteria. The abundance of bacteriophage sequences within the metavirome suggests that *Trichodesmium* lysis contributes to phage activity within the associated microbial community.

**Brown, M. K., University of Minnesota, Minneapolis, USA, brow2113@umn.edu**

Aguilar, C., Great Lakes WATER Institute, Milwaukee, USA, aguilarc@uwm.edu

Cahel, R., Great Lakes WATER Institute, Milwaukee, USA, rcbel@uwm.edu

**PARTICULATE PHOSPHORUS CONTENT IN THE TISSUE OF QUAGGA MUSSELS AND WATER COLUMN BIOMASS IN DISTINCT AREAS OF LAKE MICHIGAN**

Quagga mussels were collected from nearshore and offshore locations of western Lake Michigan and analyzed morphometrically and chemically. A strong correlation exists between morphometric parameters and phosphorus (P) content in the mussel body tissue. Body tissue phosphorus can be accurately modeled as a function of the non-destructive length measurement. With further analysis, morphometric data measurements can conceivably calculate the phosphorus inventory of Lake Michi-
gan, which has significant food web implications. Length and phosphorus content in the body tissue from all stations sampled exhibited a very strong correlation regardless of depth (inshore versus offshore). The particulate P fraction in the surface water contained a higher percent of small phytoplankton (<3μm), whereas the deep chlorophyll maximum (DCM) consisted of a higher percent of larger phytoplankton (>10μm). We can infer that the guagua mussel populations constitute a significant portion (near 2/3) of the phosphorus inventory of Lake Michigan.

Brown, R. W. University of South Florida, Tampa, USA, twbrown@mail.usf.edu

FRESHWATER BENTHIC ALGAL RESPONSE TO ELEVATED CARBON DIOXIDE
The effects of elevated atmospheric carbon dioxide on freshwater algae are relatively understudied, though terrestrial plants grown under elevated atmospheric carbon dioxide concentrations have been shown to produce increased biomass, structural compounds and chemical defenses. If similar effects occur for freshwater algae, impacts would propagate through other trophic levels of aquatic ecosystems. In this study, flow-through systems were used to simulate a temperate stream. Benthic algae were grown under ambient (380 ppm CO2) and elevated (1,000 ppm CO2, a worst-case scenario under a fossil fuel-intensive future world) CO2 conditions. Biomass differences, shifts in species dominance, changes in pigment production, and changes in chemical defenses were quantified. The study improves understanding of elevated CO2 effects on a freshwater ecosystem and contributes towards understanding the role of freshwater algae in carbon capture and storage and in the future global carbon cycle.

Bruno, L. P. NOAA, Washington D.C., USA, lia.bruno@noaa.gov

A BASELINE ASSESSMENT OF CORAL CONTAMINATION NEAR GUÁNICA BAY, PUERTO RICO IN SUPPORT OF WATERSHED RESTORATION
This paper presents a baseline assessment of the magnitude and spatial distribution of contaminants in the coral species Porites astreoides near Guánica Bay Puerto Rico. The baseline will be used to help measure the effectiveness of planned watershed restoration activities targeting land-based sources of pollution. The direct discharge of agricultural runoff and sediment into the bay along with wastewater effluent and storm water runoff from coastal communities are the primary anthropogenic sources of pollutants in the area. Although pollution is a known cause of the decline of coral reefs, knowledge of the relationship between contaminants and corals is not well understood. A suite of 150 contaminants, including 14 major and trace metals as well as organics, was quantified. The measured contaminant concentrations were consistent with those quantified in other coral reefs around Puerto Rico. Elevated metal concentrations were detected near the Cayos de Caña Gorda and elevated concentrations of PCB and DDT were quantified west of the mouth of Guánica Bay. Spatial distributions of organic contaminants suggest a potential downstream concentration gradient may be present in the region.

Bruno, B. C. University of Hawaii, Honolulu, USA, barb@hawaii.edu

PROFESSIONAL DEVELOPMENT AT THE CENTER FOR MICROBIAL OCEANOGRAPHY: RESEARCH AND EDUCATION
The Center for Microbial Oceanography: Research and Education (C-MORE) is a NSF-funded Science and Technology Center comprised of six partner institutions in Hawaii and on the U.S. Mainland. One of C-MORE’s key goals is to produce leaders from coastal upwelling and anthropogenic nutrient loading impact the estuarine ecosystem is unknown. A study was initiated in May 2010 to measure seasonal and spatial variations in concentrations of nutrients and chlorophyll, enumerate phytoplankton species, and obtain rates of primary production and nutrient uptake. The interplay between physics and variation in the supply of different forms of nitrogen, both from natural and anthropogenic sources, are hypothesized to lead to seasonal shifts in primary production.

Buccarelly, E., Université Européenne de Bretagne, UMR 6539 LEMAR, IUEM, PLOUZANCE, France, Eva.Buccarelly@univ-brest.fr

HYDROGEN PEROXIDE DISTRIBUTIONS IN THE ATLANTIC SECTOR OF THE SOUTHERN OCEAN, ALONG A TRANSIENT FROM THE SUBTROPICAL DOMAIN TO THE WEDDELL SEA CYRE
Hydrogen peroxide (H2O2) is one of the most powerful oxidants in marine waters, and it is also a strong reductant. It affects the marine cycles of organic compounds and the redox state of trace metals, e.g. iron. Vertical dissolved and particulate H2O2 distributions were investigated in the Southern Atlantic from 34 to 57°S during the BONUS-GoodHope cruise (February-March 2008). We observed a north-south gradient in the surface concentrations of dissolved H2O2 from 60 nM in the subtropical domain to 9 nM in the Southern Ocean. They generally decreased rapidly with depth to less than 1 nM below 500 m. Dissolved H2O2 half-life times increased from 1.97 d (subantarctic waters). Two unusual features were the measurements of high values of dissolved H2O2 (12 nM) at 1000 m in the Weddell Gyre, and the existence of a pool of particulate H2O2 in the surface layer, with concentrations as high as 23 nM in the subtropical domain. These results are discussed by considering different parameters that may affect oceanic H2O2 dynamics (e.g. irradiance, phytoplankton composition, iron concentrations...).

Buck, C. Romberg Tiburon Center / San Francisco State University, San Francisco, USA, cbuck@sfsu.edu

THE INFLUENCE OF MARICULTURE AND UPWELLING ON SEASONAL VARIATIONS OF NUTRIENTS, PHYTOPLANKTON COMMUNITIES AND PRIMARY PRODUCTIVITY WITHIN A LOW-INFLOW ESTUARY
Drakes Estero Marine Conservation Area, Point Reyes National Seashore, CA is the only designated marine coastal wilderness on the west coast of the United States. The shallow low-inflow estuary is surrounded by wilderness and cattle farms, and is the site of an oyster aquaculture facility where Harmful Algal Bloom (HAB) species have been observed. How nutrient enrichment from coastal upwelling and anthropogenic nutrient loading impact the estuarine ecosystem is unknown. A study was initiated in May 2010 to measure seasonal and spatial variations in concentrations of nutrients and chlorophyll, enumerate phytoplankton species, and obtain rates of primary production and nutrient uptake. The interplay between physics and variation in the supply of different forms of nitrogen, both from natural and anthropogenic sources, are hypothesized to lead to seasonal shifts in primary production.
and dominant phytoplankton species, including HAB dinoflagellates. This study will be of use to water resource managers by providing a mechanistic look at the consequences of different nitrogen sources on the phytoplankton community and ecology of Drakes Estero.

Bulleri, G. S., Bowling Green State University, Bowling Green, OH, USA, buller@bgsu.edu

McKay, R. M., Bowling Green State University, Bowling Green, OH, USA, rmcmckay@bgsu.edu

Kane, D., Defiance College, Defiance, OH, USA, dkane@defiance.edu

Struger, S., Environment Canada, Burlington, ON, Canada

Richardson, V., Environment Canada, Burlington, ON, Canada

Watson, S. B., Environment Canada, Burlington, ON, Canada, Sue.Watson@ec.gc.ca

GLYPHOSATE AS A SOURCE OF DIFFUSE PHOSPHORUS LOADING IN LAKE ERIE

Application of the phosphate herbicide glyphosate (GLY) has escalated over the past decade. Evidence now suggests that GLY and its derivative aminoethylphosphonic acid (AMPA) may have insidious effects on receiving waters. Bacteria and many cyanobacteria harbor genes for transformation of phosphate-P as an alternative P supply. We tested whether GLY application may be linked to the resurgence in cyanobacteria blooms in Lake Erie that receives significant agricultural loading to the western basin. Between 2008-10 GLY was traced downriver and into the western basin, indicating that herbicide is not completely transformed to phosphate P in the watershed. Periodically elevated levels of GLY and AMPA were detected at inshore sites, in tributary mouths and upstream near agricultural drainage. Peak concentrations up to 70 nM corresponded with herbicide application periods. The levels of phosphonates detected in this study were within ranges reported by other authors in streams throughout southern Ontario. We conclude that this overlooked form of P may represent a cumulative source that may play a role in the initiation of cyanobacterial blooms.

Bulleri, G. S., Bowling Green State University, Bowling Green, OH, USA, buller@bgsu.edu

Woitra, W. C., USCGC NEAH BAY, Cleveland, USA

Beall, B. F., Bowling Green State University, Bowling Green, USA

McKay, R. M., Bowling Green State University, Bowling Green, USA

CREDIBLE DATA COLLECTION BY THE US COAST GUARD

One approach to mitigating the declining role of the state in environmental monitoring is the use of ships of opportunity to collect data. Here we describe a partnership with the US Coast Guard Cutter Neah Bay that has allowed us to overcome logistical obstacles to sampling and collecting data during the Great Lakes during winter. To promote collection of data in compliance with GLACIER’s Credible Data Program, crew members were enrolled in a BGSU course, Great Lakes Ecosystems. In some ways, this approach parallels the successful community-based monitoring programs that have arisen in recent decades. Although lead by volunteers, water quality data produced by these efforts are routinely of high quality, reflecting the role of these volunteers as stakeholders in the community. Likewise, while assigned to Neah Bay, the Great Lakes serve as “home” to the crew members. By coupling the monitoring program with a course in which they learned about the many challenges faced by the Great Lakes, they too became invested in the project and are helping to address the void in our understanding of the winter ecosystem in Lake Erie.

BULLUSI, S., UNIVERSITY OF SOUTH CAROLINA, COLUMBIA, USA, sbullo@geol.sc.edu

NYADJRO, E. S., University of South Carolina, Columbia, USA, enyadjro@geol.sc.edu

Murty, V. S., National Institute of Oceanography, Visakhapatnam, India, vsmurty@nio.org

NEAR SURFACE SALT TRANSPORT IN THE INDIAN OCEAN USING HYCOM

The seasonal and interannual variability of salinity transport in the Indian Ocean is investigated using HYCOM simulated Sea Surface Salinity (SSS). Mechanisms and physical parameters that control the salinity budget are examined. The effects that these have on mixed layer depth, nutrient availability and distribution of marine productivity are also studied. Results show that the influence of freshwater forcing and zonal advection as dominating mechanisms of SSS interannual variability. Ekman drift is more important in the transport of SSS than geostrophy while meridional salt transport dominates the zonal salt transport. During the SW monsoon, the Somali Current transports nutrient rich, high saline upwelled water northwards. SSS transport shows the strongest variation in the Bay of Bengal where it is positive during the NE monsoon and negative during SW monsoon with peaks occurring towards the end of the monsoon. We hope that in future we could use SMOS and Aquarius salinity missions data for this study.

Bundy, R. M., Scripps Institution of Oceanography, La Jolla, USA, mbundy@ucsd.edu

Barbeau, K., Scripps Institution of Oceanography, La Jolla, USA, kbbarbeau@ucsd.edu

Biller, D., University of California, Santa Cruz, Santa Cruz, USA, dbiller@ucsc.edu

Bruland, K., University of California, Santa Cruz, Santa Cruz, USA, bru@ucsc.edu

IRON COMPLEXATION IN COASTAL UPWELLING SYSTEMS USING MULTIPLE ANALYTICAL WINDOWS

Dissolved iron speciation in the ocean is dominated by organic iron chelates. Despite their ubiquitous nature, little is known about the cycling of ligands, especially in dynamic coastal regions. Using current analytical methods, research is focused on strong ligands while weaker ligands are generally undetected. Iron-speciation was investigated in the California Current at varying analytical windows (a) using competitive ligand-exchange adsorptive cathodic stripping voltammetry (CLE-ACSV) in the surface and bottom boundary layer during a spring upwelling event. Samples were analyzed at multiple to a survey a continuum of iron-ligand complexes. Surface and bottom boundary layer samples showed systematic differences in strong ligands detected at each a. Surface samples were dominated by strong ligands, while bottom boundary layer samples consisted primarily of weaker ligands, which were only detected at the lowest a. This reveals qualitative differences in the surface and boundary layer ligand pools, and emphasizes the importance of varying analytical windows in electrochemical methods. Slight differences in iron complexation may have important implications for iron uptake by phytoplankton, especially in coastal upwelling regions with high primary productivity.

Bunting, L., University of Regina, Regina, Canada, Lynda.Bunting@uregina.ca

Leavitt, P. R., University of Regina, Regina, Canada, Peter.Leavitt@uregina.ca

Schindler, D. E., University of Washington, Seattle, USA, deschind@uwashington.edu

Hampton, S. E., NCEAS, Santa Barbara, USA, hampton@nceas.ucsb.edu

REGULATION OF LAKE EUTROPHICATION AND RECOVERY BY PHOSPHORUS FLUX ALONE: INSIGHTS FROM LAKES WASHINGTON AND SAMMAMISH, USA.

Eutrophication and its subsequent reversal are caused primarily by changes in nutrient influx to lakes. Despite this generalization, little agreement exists on the relative role of phosphorus (P) and nitrogen (N), mainly because fluxes of these elements co-vary, particularly after nutrient diversion (e.g., wastewater treatment), and because unique effects of N and P vary with total nutrient content. Historical records of plankton and nutrient concentrations (1949–2002) were compared with fossil time series of plankton (algal pigments, Cladocera) and nutrient flux (stable isotopes of C and N) in Lake Washington and upstream Lake Sammamish, USA (1800–2000). Both lakes exhibited eutrophication starting ca. 1940; however, L. Washington alone recovered after its wastewater was diverted in 1969. Comparison of N isotope time series in the lakes suggested that these findings are specific only to moderately eutrophied lakes.

Burkett, H. L., University of Glasgow, Glasgow, United Kingdom, heidi.burkett@glas.gla.ac.uk

Aloisio, E., University of Plymouth, Plymouth, United Kingdom, elena.aloisio@plymouth.ac.uk

Calosi, P., University of Plymouth, Plymouth, United Kingdom, pietro.calosi@plymouth.ac.uk

Widdicombe, S., Plymouth Marine Laboratory, Plymouth, United Kingdom, swi@pml.ac.uk

Findlay, H., Plymouth Marine Laboratory, Plymouth, United Kingdom, hefi@pml.ac.uk

Hatton, A., Scottish Association for Marine Science, Oban, United Kingdom, angela.hatton@sams.ac.uk

Kamenos, N. A., University of Glasgow, Glasgow, United Kingdom, nick.kamenos@glasgow.ac.uk

HIGH CO2 INDUCES A NEW PATHWAY FOR THE RELEASE OF DMSP FROM CORALLINE ALGAE

The effect of two high CO2 scenarios (projected 2100 ocean acidification [OA] and natural CO2 vent systems) on intracellular dimethylsulphoniopropionate (DMSP)
production and the surface structure of the free-living coralline alga Lithothamnion glaciale was investigated. Thalli were maintained in a closed microcosm system with three pCO2 treatments: control (498 ppm, pH 8.1), high CO2 (2100 OA, 1081 ppm, pH 7.9) and high, spiked CO2 (CO2 vents, mean 2778 ppm, pH 6.6 – 8.1). Intracellular DMSP concentrations were significantly higher than the control only in the high, spiked CO2 treatment. Dissolved DMSP [DMSPd] followed a similar pattern; DMSPd concentrations in the high, spiked CO2 treatment were 120% greater than the control. Using secondary electron imaging, cracks were observed between the calcite cell walls of healthy epithelial cells from thalli in both high CO2 treatments. It is proposed that, under high CO2 conditions, damage to the structure of live epithelial cells may represent a new pathway for cellular DMSP release into the surrounding water column.

Burge, C. A., Cornell University, Ithaca, USA, cab43@cornell.edu
Douglas, N. L., Cornell University, Ithaca, USA, nldd@cornell.edu
Conti-Jerpe, L., Cornell University, Ithaca, USA, iec@cornell.edu
Weil, E., University of Puerto Rico, Mayaguez, USA, eweil@caribe.net
Mydlarz, L. D., University of Texas at Arlington, Arlington, USA, mydlarz@uta.edu
Harvell, C. D., Cornell University, Ithaca, USA, cdh5@cornell.edu

SMALL PURPLE SPOTS MAY REVEAL NEW PATHOGEN: CHARACTERIZATION AND HOST RESPONSE TO A Labyrinthulomycota ISOLATED FROM GORGONIA VENTALINA

Visual observations of small purple spots on the surface of the sea fan Gorgonia ventalina led to the histological identification of a potential new pathogen, named Sea Fan Parasite unknown (SPX), a member of the Phylum Labyrinthulomycota. Other Labyrinthulomycota are pathogens in marine organisms including eel grass and hard clams. To better understand the affect of SPX on sea fan health, we isolated the microorganism from these sea fan spots. Visual observations of cultured SPX indicate growth is greatest between 25-28 ºC and a quantitative growth assay is being designed to validate these observations. Sequence information obtained from the 18S ribosomal RNA gene indicates SPX (both cultured and detected in sea fans) is similar to the Labyrinthulomycota genus Aplanochytrium. Using the Differentially Expressed Gene kit (Seegene) we are comparing experimentally SPX exposed sea fans with controls. This analysis has revealed several genes that are up or down regulated in response to SPX. As part of a larger goal to build a sea fan transcriptome, we have also begun an Illumina sequencing project with these samples.

Burgos, A. K., Western Washington University, Bellingham, USA, burgesa@students.wwu.edu

VECTORING ALGAL TOXIN IN MARINE PLANKTONIC FOOD WEBS: SORTING OUT NUTRITIONAL DEFICIENCY FROM TOXICITY EFFECTS

HABs may play a role in affecting coastal system productivity, but a better understanding of the dynamics of algal toxin transfer among components of the food web is needed. This research determined whether the reduction in larval crab survival due to Alexandrium is a function of algal toxin transfer or a consequence of reduced nutritional value of the rotifer. Two rotifer diets were created, one fed Alexandrium andersoni (toxic alga); the other students.wwu.edu

exp-versus-rotifer. Zinc and vitamin A concentrations of the rotifer-fed toxic algal diet are significantly lower than controls. This reduction in essential nutrients is needed. This research determined whether the reduction in larval crab survival due to Alexandrium is a function of algal toxin transfer or a consequence of reduced nutritional value of the rotifer. Two rotifer diets were created, one fed Alexandrium andersoni (toxic alga); the other

Burke, R. A., USEPA/NERL, Athens, GA, USA, burke.roger@epa.gov
McCranie, M. B., USEPA/NERL, Athens, GA, USA, mathlmac@gmail.com
Stanley, M. S., USEPA/NERL, Athens, GA, USA, standog8@uga.edu

INFLUENCE OF LAND USE AND IN-STREAM PARAMETERS ON DENITRIFICATION ENZYME ACTIVITY IN SOUTHEASTERN US PIEDMONT HEADWATER STREAMS

Sediment denitriﬁcation enzyme activity (DEA) was measured monthly over a period of two years in 15 headwater streams from an area with extensive poultry and cattle production and a rapidly growing human population. Linear regression techniques were used to evaluate the inﬂuence of land cover and various in-stream parameters on DEA. Results indicate that: (1) mean DEA and % sedimentary organic matter (SOM) range from 0.38 to 4.8 &microgN/g/d and from 0.49 to 3.83 %, respectively, among study streams; (2) DEA exhibited considerable temporal variability, ranging over more than two orders of magnitude in some streams; (3) % SOM also varied temporally, varying by a factor of 5 to 10 in some streams (4); (3) mean DEA was not significantly related to watershed or buffer land use; and (5) mean DEA was signiﬁcantly related to mean % SOM (adj r² = 0.32; p = 0.017). Periodic pulses of stream flow that result from storms that produce greater than 5 cm of rain likely contribute to the temporal variability in DEA and SOM by flushing SOM-rich particles from stream beds.

Burkhart, B. G., Oregon State University, Corvallis, USA, bburkhart@coas. oregonstate.edu
White, A. E., Oregon State University, Corvallis, USA, awhite@coas.oregonstate.edu
Watkins-Brandt, K., Oregon State University, Corvallis, USA, kwatkins@coas. oregonstate.edu
Paytan, A., University of California Santa Cruz, Santa Cruz, USA, apaytan@ucsc.edu

MICROBIALY MEDIATED PHOSPHORUS REMINERALIZATION RATES VIA CONTINUOUS FLOW ANALYSIS

In the marine environment, microorganisms consume and degrade phosphorus (P) leading to a steady cycling of P between living and detrital particle-bound forms and inorganic and organic P compounds dissolved in seawater. A fundamental step in stock.
the marine P cycle is the enzymatic hydrolysis of a wide range of dissolved organic P (DOP) compounds and the subsequent liberation of the more bioavailable dissolved inorganic P (DIP). The rate of P remineralization controls the supply rate of DIP ultimately available to support phytoplankton growth, thus affecting the carrying capacity and productivity of the photosynthetic community. This study will examine the microbial remineralization rates of select classes of DOP compounds including polyphosphates, mono- and di-esters and phosphonates. The activity of heterotrophic bacterial communities isolated from a nutrient rich upwelling regime (Oregon) the oligotrophic central gyre of the Pacific (near Hawaii) will be assessed. Continuous analysis of DIP and discrete measurements of DOP; bacterial P and bacterial abundance are paired to provide high resolution kinetics of DOP remineralization.

Burmeister, V., Leibniz-Institut für Gewässerökologie und Binnenfischerei, Berlin, Germany, burmeister@igb-berlin.de

Müller-Navarra, D. C., Universität Hamburg, Hamburg, Germany, doerthe.mueller-navarra@uni-hamburg.de

FATTY ACIDS OF TWO SYMPATRIC FISH LARVAE, ALOSA FALLAX AND OSMERUS EPERLANUS. DO THEY EXPLAIN OBSERVED DIFFERENCES IN GROWTH POTENTIAL?

During spring and early summer we sampled larvae of two fishes caught for human consumption, Osmerus eperlanus and Alosa fallax, in the Elbe estuary and analyzed them for increase in length and for their fatty acids contents. Although Osmerus eperlanus larvae were larger at the beginning (mid of May), larvae of Alosa fallax caught up to be even slightly larger than Osmerus eperlanus in early July. Thus as usually observed, Alosa fallax larvae grew faster than larvae from Osmerus eperlanus. We could detect differences in their fatty acid composition, especially in respect to the nutritionally important (n-3) poly unsaturated fatty acids, EPA and DHA, and compared those to their natural prey (Daphnia and the copepod Eurytemora affinis). Differences in feeding mode and fatty acid dynamics for observed growth differences will be discussed.

Burns, J. H., University of Hawaii at Hilo, Hilo, USA, jburns@gmail.com

Rozet, N. K., University of Hawaii at Hilo, USA

Greeg, T. M., University of Hawaii at Hilo, USA

Takahayashi, M., University of Hawaii at Hilo, Hilo, USA

IMPACTS OF SKELETAL GROWTH ANOMALY ON ORGANISMAL AND POPULATION VIABILITY OF THE CORAL MONTIPORA CAPITATA IN HAWAII

Montipora capitata corals inhabiting the Waiʻōpae tide pools, southeast Hawaiʻi Island, display abnormally high prevalence levels of skeletal growth anomaly (SGA) compared to other surveyed sites throughout the Hawaiian Archipelago. Micromorphological analysis suggests the SGA pathogenesis progresses from diagnostically distinct Type A to B, with Type B exhibiting more detrimental signs of morphological changes induced by the disease. Exhaustive prevalence surveys produced epizootiological data that determined cofactors such as colony size, colony orientation, and levels of water circulation associated with high disease prevalence. Furthermore, histopathological analysis revealed SGA tissue undergoes changes in cellular morphology which compromise physiological functions such as defense, digestion, and reproduction. Both types of SGA tissue suffered significant reductions (<0.05) in abundance of gonads, symbionts, mesenterial filaments, and nematocytes along measured contour lengths of tissue. Comparing photophysiology between healthy and afflicted tissue showed endosymbionts within SGA-afflicted tissue suffer from reduced photochemical efficiency. Values of both Fv/Fm and ΔF/ΔF’o were significantly lower (<0.01) in SGA tissue. Combining fine-scale physiological analyses with population-scale epizootiological data allowed for quantifying the threat this disease poses to organismal and population viability.

Burrell, C. T., University of South Carolina, Columbia, USA, cburrell@geol.sc.edu

Anderson, C., University of California, Santa Cruz, Santa Cruz, USA, monkey-fringe@gmail.com

Benitez-Nelson, C. R., University of South Carolina, Columbia, USA, cbnelson@geol.sc.edu

Thunell, P., University of South Carolina, Columbia, USA, thunell@geol.sc.edu

Tappa, E., University of South Carolina, Columbia, USA, tappa@geol.sc.edu

DEGRADATION OF THE MARINE TOXIN DOMOIC ACID IN COASTAL SYSTEMS

Domoic acid is a neurotoxin produced by a common genus of diatoms, Pseudo-nitzschia. With Pseudo-nitzschia blooms increasing in frequency and intensity in coastal areas, significant transport of particulate domoic acid (DA) to depth is of concern for benthic food webs. This study focuses on the 1) remineralization of sinking particles and partitioning of DA to aqueous, and 2) integrity of sediment trap samples used to quantify the timing and magnitude of DA fluxes to the seafloor. Samples were collected from the Santa Barbara Basin (SSB), a region known to have seasonal blooms of toxin producing Pseudo-nitzschia. Pseudo-nitzschia cell number and DA concentrations were collected from the upper 150 m of the water column on monthly cruises from March 2009 to December 2010. Sinking material was concurrently collected for two-week intervals using two, moored sediment traps located in the center of the basin at depths of 150 and 540 m. Our results suggest that even though significant quantities of DA are found within the deepest 540 m trap (>6 g DA m⁻² d⁻¹), only ~3% of the DA produced in the upper waters is actually collected at depth, indicating rapid degradation or particle loss during transport. Thus, sediment traps, while providing a valuable tool for examining potential impacts of DA on the seafloor, may consistently underestimate the impact of DA on benthic food webs.

Burton, G. A., University of Michigan, Ann Arbor, USA, burtonal@umich.edu

Costello, D., University of Michigan, Ann Arbor, USA, dcostello@umich.edu

Taulbee, K., Great Lakes Environmental Center, Columbus, USA, ktaulbee@glec.com

Custer, K., Wright State University, Dayton, USA, k.custer@wright.edu

Burmester, V., Leibniz-Institut für Gewässerökologie und Binnenfischerei, Berlin, Germany, burmester@igb-berlin.de

Müller-Navarra, D. C., Universität Hamburg, Hamburg, Germany, doerthe.mueller-navarra@uni-hamburg.de

Taulbee, K., Great Lakes Environmental Center, Columbus, USA, ktaulbee@glec.com

Custer, K., Wright State University, Dayton, USA, k.custer@wright.edu

BIODEGRADATION OF TOXICANT AND COPPER IN SULFIDIC AND NON-SULFIDIC FRESHWATER SEDIMENTS

The AVS-SEM model of metal bioavailability predicts that acid volatile sulfide (AVS) in sediments reacts with simultaneously extracted metals (SEM) to form metal sulfides that are effectively not bioavailable to living organisms. We compared the performance of the AVS-SEM bioavailability model to direct measurements of metal flux using diffusive gradients in thin films (DGTs). DGTs were deployed during a series of field experiments that evaluated Cu and Ni, both alone and together, across experimental metal concentrations in both high and low AVS freshwater sediments. Bioavailability measured with DGTs and AVS-SEM was used to predict in situ toxicity responses of caged organisms and the changes in the extant macro-invertebrate community. In general, the fluxes of metals were positively correlated with total metal concentrations and decreased over time as metals effluxed from the sediments. This pattern persisted even within sulfidic sediments where AVS exceeded SEM, and metals were theoretically not bioavailable. The AVS-SEM model outperformed the DGT-based models in predicting benthic community response. These results suggest that for sulfidic freshwater sediment DGTs may not be the best tool for measuring bioavailability.

Butler, M. J., Old Dominion University, Norfolk, VA, USA, mbutler@odu.edu

Behringer, D. C., University of Florida, Gainesville, FL, USA, behringer@gflue.edu

Shields, J. D., Virginia Institute of Marine Science, Gloucester Pt, VA, USA, jeff@vims.edu

Paris, C. B., RSMAS - University of Miami, Miami, FL, USA, cparris@rsmas.miami.edu

Moss, J. A., Virginia Institute of Marine Science, Gloucester Pt, VA, USA, jamoss@vims.edu

Dolan, T. W., Old Dominion University, Norfolk, VA, USA, twdolan@verizon.net

Cowen, R. K., RSMAS - University of Miami, Miami, FL, USA, rcowen@rsmas.miami.edu

BEHAVIOR INFLUENCES VIRAL DISEASE DYNAMICS IN CARIBBEAN SPINY LOBSTER

The spiny lobster Panulirus argus is an iconic species in the Caribbean, where it supports the region’s most valuable fishery. Lobsters are susceptible to a lethal, pathogenic virus (PaV1) and we have been studying lobster-PaV1 disease dynamics since we discovered the disease over a decade ago. An important consideration in our research is the role of host behavior in altering the spread of disease, which is particularly relevant in species such as spiny lobsters that are social. We discovered that ontogenetic changes in lobster susceptibility to disease and in aversion of diseased lobsters by healthy conspecifics limits the spread of PaV1 in the wild, even when environmental degradation crowds lobsters into the remaining available habitat. Recently, we found that infected postlarvae may act as “vectors”, potentially enhancing the spread of PaV1 among host populations. However, modeling results suggest that this unusual mechanism by which marine pathogens may spread is counter-balanced in part by larval behavior, which limits larval dispersal. Our findings thus highlight the subtle ways in which host behavior may influence the spread of disease in marine ecosystems.
two aquatic habitats and the organisms that inhabit them. In the course of presenting the students with more hands on activities, they will gain more knowledge in everyday science going on around them and how to be part of conservation efforts happening in the island.

Caddie, J. A. University of Maryland Eastern Shore, Department of Natural Sciences, Princess Anne, USA, joellea.caddie@yahoo.com
Johnson, A. K., University of Maryland Eastern Shore, Department of Natural Sciences, Princess Anne, USA, akjohnson@umes.edu
Brill, R. W., National Marine Fisheries Service, NOAA, Woods Hole, USA, rbrill@nms.noaa.gov
Crawford, K. C., Hampton University, Department of Marine and Environmental Science, Hampton, USA, kendyl.crawleycrawford@my.hamptonu.edu
Horodysky, A. Z., Hampton University, Department of Marine and Environmental Science, Hampton, USA, andrij.horodysky@hamptonu.edu

ONTOGENY OF AUDITORY AND VISUAL ECOPHYSIOLOGY IN BLACK SEA BASS (CENTROPRISTIS STRIATA)

The ability of coastal fishes that settle in inshore nurseries and migrate to offshore habitats as adults to cope with environmental variability and anthropogenic stressors has not received much attention. We therefore used electrophysiological techniques to examine the ontogeny of auditory and visual systems of black sea bass (Centropristis striata), a protogynous serranid that supports substantial commercial and recreational fisheries from Cape Cod to Florida. The auditory performance of sea bass, assessed via auditory brainstem response (ABR) experiments, did not differ between juveniles and adults and was consistent with a low-frequency hearing generalist system presumably most attuned to the vector (i.e. particle motion) components of sound. Electroretinographic (ERG) assessment of visual function demonstrated that the luminous sensitivity, chromatic sensitivity, and temporal properties of juvenile and adult black sea bass eyes correlate with the phototaxis experienced by each respective life stage. Collectively, such research exemplifies physiology in the service of fisheries science and promotes multidisciplinary syntheses that can mechanistically link processes from the cellular to the individual to the population level in support of sage management of living marine resources.

Cade-Menun, B. J. Agriculture & Agri-Food Canada, Swift Current, SK, Canada, Barbara.Cade-Menun@agr.gc.ca

PHOSPHORUS FORMS IN TERRESTRIAL AND AQUATIC ECOSYSTEMS

Researchers in aquatic ecosystems often measure only soluble reactive phosphorus (P) or total P; while researchers in terrestrial ecosystems often focus only on measures of plant-available P. However, P in both terrestrial and aquatic ecosystems exists in a wide range of organic and inorganic forms. Inorganic P forms include orthophosphate, pyrophosphate and polyphosphate; organic P forms can be grouped into phosphonates, orthophosphate monoesters (e.g. inositol phosphates, sugar phosphates) and orthophosphate diesters (e.g. phospholipids, DNA). Because these P forms vary in their environmental reactivity and bioavailability, knowledge of P forms in different environments is essential for understanding P dynamics. This presentation will discuss P forms in freshwater, marine, soils and other environmental samples, highlighting similarities and differences. It will also discuss potential concerns as P forms are transported from terrestrial to aquatic environments.

Cady-Pereira, K. E., AER, Inc, Lexington, USA, cadyp@aar.com
Snell, H. E., AER, Inc., Lexington, USA, hsnell@aer.com
Gioioso, M., AER, Inc, Lexington, USA, mgioioso@aer.com
Chase, A., AER, Inc., Lexington, USA, achase@aer.com
Petroy, S., Ball Aerospace, Boulder USA, spetroy@ball.com

A NEW APPROACH FOR OBTAINING WATER LEAVING RADIANCE FROM AIRCRAFT AND SATELLITE MEASUREMENTS

Accurate water leaving radiance (WLR) estimates are fundamental for determining phytoplankton concentrations and dissolved organic matter (DOM) from remote sensing observations. In order to obtain WLR values the interfering effects of the atmosphere must be removed. The algorithm currently in place to provide WLR from MODIS measurements is a direct descendant of the original atmospheric correction procedures developed first for the Coastal Zone Color Scanner (CZCS) and then for SeaWiFS. While the MODIS WLR algorithm includes significantly more physics than the original CZCS algorithm (e.g., multiple scattering, the effect of whitecaps), it ultimately consists of a number of separate modules, each of which attempts to estimate one physical effect. We have developed a new algorithm, based on

Byars, N. L., Florida State University, Tallahassee, FL, USA, nataliebyars@gmail.com
Wetz, M. S., Texas A&M University- Corpus Christi, Corpus Christi, TX, USA, Michael.Wetz@tamucc.edu

HOW DOES RIVER FLOW VARIABILITY AFFECT THE SPATIAL AND TEMPORAL DISTRIBUTION OF PHYTOPLANKTON IN APALACHICOLA BAY, FLORIDA?

Long-term reductions in freshwater delivery to Apalachicola Bay, Florida, threaten its biological integrity and ability to support commercially-important fisheries. Changes in river flow are expected to cause shifts in the spatial structure of estuarine phytoplankton populations, which could have cascading effects on higher trophic levels such as commercially-important oysters. To better predict how flow-induced changes may affect Apalachicola Bay ecosystem dynamics, we mapped the spatial distribution of phytoplankton in response to varying freshwater input at orders-of-magnitude finer resolution than has been previously recorded. Geo-oriented measurements were collected at 50 m resolution throughout Apalachicola Bay every two weeks beginning in May 2009. To supplement this high spatial resolution data, discrete samples were collected to measure nutrients, particulate organic matter, and phytoplankton taxonomic composition/biomass. High-resolution temporal data was also obtained from in situ chlorophyll and water quality sensors deployed at a major oyster reef. Statistical and spatial analyses were conducted to assess the effects of river flow and water properties on phytoplankton community characteristics.

Byrne, M., University of Sydney, Sydney, Australia, mbyrne@anatomy.usyd.edu.au

IMPACT OF OCEAN WARMING AND OCEAN ACIDIFICATION ON MARINE INVERTEBRATE LIFE HISTORY STAGES: VULNERABILITIES AND POTENTIAL FOR PERSISTENCE IN A CHANGING OCEAN

Global warming and increased atmospheric CO2 cause the oceans to warm, decrease in pH and become hypercapnic. These stresses have deleterious impacts on marine invertebrates. Increasing temperature stimulates metabolism until lethal levels are reached while hypercapnia has a narcotic effect. Ocean acidification threatens calcifying larvae, decreasing availability of CaCO3 ions for skeletogenensis and exerting a pH effect on physiology. Marine invertebrate propagules live in a multistressor world and climate change stressors are adding to the mix. Ocean pH, pCO2 and CaCO3 covyary and change with temperature, challenging our ability to predict outcomes for marine biota. To address questions on future vulnerabilities, the thermo- and pH-pCO2 tolerance of fertilisation and development is investigated in the context of the change forecast for the next 100-200 years. Effects of climate change stressors and their interaction differs among life history stages and species. Fertilisation is generally tolerant to warming and acidification beyond conditions predicted for 2100. Pre-larval stages may be sensitive to warming but larvae may be more sensitive to acidification/hypercapnia. Early juveniles may be vulnerable to skeletal dissolution, although this may be diminished by warming. Although climate change is potentially dire for development some species will be more resilient. This has implications for persistence, faunal shifts, species invasions and community function.

Cáceres-Charanco, R. L. University of Puerto Rico - Río Piedras Campus, San Juan, Puerto Rico, rtinerin@hotmail.com
Ortiz-Zayas, J., Institute for Tropical Ecosystem Studies, San Juan, Puerto Rico, jorgeortiz.ites@gmail.com
Thiele, M., Escuela Intermedia Manuel Martín Monserrat, Santa Isabel, Puerto Rico, methiele@yahoo.com

THE PUERTO RICAN CRESTED TOAD TADPOLE RELEASE SITE IN GABIA, PUERTO RICO: AN OUTSIDE CLASSROOM FOR TEACHING LIMNINOLOGY TO MIDDLE SCHOOL STUDENTS

An education and outreach program called “Protecting the Puerto Rican Crested Toad” has been developed in Gabia, Coamo, Puerto Rico. Gabia, Coamo is a release site for tadpoles of the Puerto Rican crested toad (PRCT), the only endemic toad of Puerto Rico, which are part of a reintroduction program in order to establish new populations in the island. Part of this program includes education related activities in order to involve the general public in the conservation of the PRCT. Middle school students from the Escuela Intermedia Manuel Martin Monserrat in Santa Isabel have been collecting and analyzing aquatic and terrestrial habitat data since 2009. Data collected in the field has been used by the students to understand math and science topics taught in school. Last year, students analyzed the terrestrial habitat characteristics. This year, the students will be using the aquatic habitat data to better understand the water cycle and different types of aquatic habitats. Through this activity students are expected to understand processes that drive the water cycle and its importance in our daily lives. Students are expected to be able to name more than 42 (~) represents Tutorial presentations
Caffrey, M. A., University of Tennessee, Knoxville, Knoxville, USA, mcaffrey@utk.edu
Horn, S. P., University of Tennessee, Knoxville, Knoxville, USA, shorn@utk.edu
Haberyan, K. A., Northwest Missouri State University, Maryville, USA, khaber@nwmissouri.edu

Sullivan, D. G., University of Denver, Denver, USA, dsulliva@du.edu

PALEOLIMNOLOGY OF LAGUNA SALADILLA, DOMINICAN REPUBLIC INFERRRED FROM DIATOMS AND OTHER PALEOENVIRONMENTAL PROXIES
Laguna Saladilla is a large (ca. 200 ha), freshwater coastal lake (pH 7.7) located approximately 5 km inland from the Atlantic coast of the Dominican Republic, near the border with Haiti. Surface sediment diatoms from across the modern lake were compared to water chemistry (e.g. pH and alkalinity) and physical parameters (e.g. temperature, clarity, and depth). Diatoms and other geochemical data from an 8.5 m sediment core were used to produce a record of changes in lake conditions, particularly lake depth and paleosalinity. Geochemical data suggest that salinity was high from ca. 8031 to 3650 cal yr BP, possibly with greater stratification of the water column. Salinity gradually decreased until ca. 2500 cal yr BP, when a large increase in freshwater diatom species was followed by a greater abundance of freshwater diatom species.

Callieri, C., CNR - Institute of Ecosystem Study, Verbania, Italy, c.callieri@ise.cnr.it
Bertoni, R., CNR - Institute of Ecosystem Study, Verbania, Italy, r.bertoni@ise.cnr.it
Lami, A., CNR - Institute of Ecosystem Study, Verbania, Italy, a.lami@ise.cnr.it

MICROCOLONY FORMATION FROM SINGLE CELL. SYNECHOC OCCUS STRAINS: A PROTECTIVE STRATEGY AGAINST UVR
UVR have different effects on prokaryotic cells as, for instance, filamentation and aggregation in bacteria. We studied the effect of UVR on microcolony formation in two freshwater picocyanobacterial strains from different ribotypes (Group B and Group I) and pigment composition (phycocerythrin, PE-rich and phycocyanin, PC-rich). The cultures were photoacclimated at low (LL, 10 µmol m⁻²s⁻¹) and medium (ML, 100 µmol m⁻²s⁻¹) light for two months and then exposed to UVR (Q-Panel) for 7 days. We observed the higher percentage of cells in microcolonies in PE-rich strain and then exposed to UVR. Conversely, PE acclimated to ML and PC did not aggregate significantly. We identified and measured the specific carotenoids by HPLC at the different times of the experiment. We suggest that the induction of protective pigments during ML acclimation enables single-cell survival during UVR irradiation and that the strategy of microcolony formation is a protective response of LL acclimated cells. The extent to which the microcolony formation from single cell Synechococcus is related to pigment type, phylogenetic position or photoacclimation is discussed.

Camilli, R., Woods Hole Oceanographic Institution, Woods Hole, USA, rcamilli@whoi.edu
Yoeger, D. R., Woods Hole Oceanographic Institution, Woods Hole, USA, dyoeger@whoi.edu
German, C. R., Woods Hole Oceanographic Institution, Woods Hole, USA, cgerman@whoi.edu
Boetius, A., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, antje.boetius@awi.de
Kinsey, J., Woods Hole Oceanographic Institution, Woods Hole, USA, jkinsey@whoi.edu
de Beer, D., Max Planck Institute for Marine Microbiology, Bremen, Germany, dbeer@mpi-bremen.de

THE HAAKON MOSBY MUD VOLCANO, A CARBON DIOXIDE POINT SOURCE
The Haakon Mosby Mud Volcano (HMMV) is located within the Arctic Circle at 72°0’N 14°7’E and approximately 1250 m depth. Although the ambient water column temperature at this depth is ~1°C, the HMMV hosts sediment temperatures in excess of 40°C and actively expels methane-rich fluids from within its warm, central region. An October 2010 survey of the HMMV site using a TETHYS in-situ mass spectrometer operating as payload aboard the Sentry autonomous underwater vehicle (AUV) detected highly localized carbon dioxide anomalies in the water column. Most of these carbon dioxide anomalies correlate spatially with methane expulsion sites located at the HMMV’s hydrate-bearing hummocky region enclosing the warm muds. Analysis of gases evolved from sediments collected in this region also revealed substantially elevated methane and carbon dioxide concentrations. A pH logger deployed for a year prior to the AUV survey recorded periods of extremely low pH values at the seafloor of the most active area, suggesting intermittent carbon dioxide release. The coupled seawater carbonate chemistry and depth of release make carbon dioxide transport to the atmosphere unlikely. Carbon dioxide input into the benthiic water column may, however, represent a considerable fraction of the region’s dissolved inorganic carbon inventory and preclude certain types of organisms from living within close proximity to these sources.

Campbell, J. R., The University of Texas Marine Science Institute, Port Aransas, USA, jena23@mail.utexas.edu
Buskey, E. J., The University of Texas Marine Science Institute, Port Aransas, USA, ed.buskey@mail.utexas.edu

IMAGING TECHNOLOGY AND MICROPLANKTON MONITORING IN THE MISSION-ARANSAS NATIONAL ESTUARINE RESEARCH RESERVE
The FlowCAM and microscope counts have been used to monitor microplankton in the Mission-Aransas National Estuarine Research Reserve (MANERR) since 2007. The FlowCAM has provided a less time consuming characterization of the microplankton communities at each of the reserve’s System Wide Monitoring Program (SWMP) sites. We have seen seasonal patterns and drought effects at all SWMP sites. Dinoflagellate blooms have been observed entering the Aransas Ship Channel from the Gulf of Mexico and in Aransas Bay, and ciliate blooms have been found in Copano Bay. However, there are limitations to using the FlowCAM for analyzing whole water samples in an estuarine and coastal environment. Because of the wide range of organism size, high water column biomass in the spring and summer, and lower biomass in the winter months, quantitative measurements are not always accurate. Microscope counts of the same water samples generally show diatoms, dinoflagellate, and ciliate abundances in higher concentrations than the FlowCAM analyses; however, the archival record of microplankton images and automated measurements make this a useful tool in long-term microplankton monitoring.

Campbell, L., Texas A&M University, College Station, USA, lcampbell@ocean.tamu.edu
Henrichs, D. W., Texas A&M University, College Station, USA, dhernichs@mail.bio.tamu.edu
Renshaw, M. A., Texas A&M University, College Station, USA, mrenshaw@ag.tamu.edu
Gold, J. R., Texas A&M University, College Station, USA, goldfish@tamu.edu

GENETIC DIVERSITY AND POPULATION STRUCTURE OF KARENIA BREVIS BLOOMS IN THE GULF OF MEXICO: SUGGEST A COMMON SOURCE POPULATION
Karenia brevis is the major HAB in the Gulf of Mexico (GOM), yet the source of bloom populations is not well known. Microsatellite markers were developed to assess genetic diversity within and among blooms and to ask: Are blooms of K. brevis genetically homogeneous within a given bloom and/or across years? and What is the source population of K. brevis blooms in Texas? Samples from recent blooms in Texas and Florida were collected and single cells genotyped at five microsatellite loci. The number of alleles per microsatellite ranged from 9-23. The extremely high gene diversity estimates are similar to results for other phytoplankton. C₆ gene values indicated low to moderate genetic differentiation among samples. Year-to-year variation between bloom samples does not support local populations as the source. When grouped according to geographic location (TX vs. FL), no significant genetic differentiation was found between the two groups. The majority of variation was found within-samples. This supports the idea that blooms of K. brevis in the Western GOM may originate from, or have a common source with, blooms in the Eastern GOM off Florida.

Campbell, R. R., Bigelow Laboratory for Ocean Sciences REU, West Boothbay Harbor, USA, rachellerampbell@gmail.com
McClenan, D. A., Bigelow Laboratory for Ocean Sciences REU, West Boothbay Harbor, USA

WHAT FREED WILLY: ANCIENT RESPIRATORY ADAPTATIONS IN WHALES
Rapid changes in habitat (terrestrial to aquatic), morphology (e.g., location of nasal openings, presence of hind limbs, development of fusiform body shape), and behavior (e.g., mode of locomotion, extended submersion) in cetacean ancestors over just 30 million years most likely necessitated several molecular adaptations, especially among the proteins integral to cellular respiration. Cytochrome b is the central catalytic enzyme of the cytochrome bc₁ complex and is fundamental to the electron transfer chain of cellular respiration. 79 cetacean and artiodactyl cytochrome b gene
sequences were used to estimate the effects of natural selection on the cytochrome b protein among ancestral cetacean lineages. Statistically significant results that identify protein sites and affected amino acid properties were mapped onto three-dimensional protein structures in an attempt to associate sites with protein structure and function. Overall conclusions included [1] structural protein adaptations preceded fine-tuned chemical adaptation; [2] adaptive sites cluster around home-groups and proton input sites, suggesting that selection likely affected proton pump function; and [3] protein adaptation paralleled morphological adaptation, with both rates of change reaching a peak in the 55-25 mya range.

Canady, C. S., University of Maryland Center for Environmental Science REU, Solomons, USA, cscanady8073@muleriders.saumag.edu

kilbourne, K. H., University of Maryland Center for Environmental Science REU, Solomons, USA

Replicating surprisingly cool coral geochemistry-based paleotemperatures in the Caribbean at the end of the Little Ice Age. Replicating paleoclimate records is necessary to distinguish between climate and non-climatic signals in proxy-based climate reconstructions. This study reproduced a coral δ18O record from southwestern Puerto Rico using a Montastrea favolata collected at the same location and time as the OLPFA specimen reported by Kilbourne et al. (2008). The new record extends from 1906-2004 and consists of 13.4mm subsamples representing ~1.8yrs each. The data have a mean δ18O value of -4.15±0.08% and a -0.002%/yr decreasing trend, indicating about 1°C warming and/or ~1psu freshening over the nearly hundred year record. A mean offset of 0.19±0.05‰ between the two cores for the years 1906-2004, is consistent with the inter-annual δ18O variability found in previous studies. The δ18O variability within the two cores is similar, especially at the decadal scale. The Pearson’s correlation coefficient for the 2-year resolution record is 0.52, whereas that of the 10-year smoothed data is 0.9. The results indicate that the coral δ18O from the previous study are reproducible within the expected error and that the Caribbean Sea can experience relatively large climate fluctuations.

Canals, M. F., University of Puerto Rico at Mayaguez, Mayaguez, Puerto Rico, miguel.canals@upr.edu

FIELD OBSERVATIONS AND NUMERICAL SIMULATIONS OF THE HYDRO-DYNAMICS OF GUÁNICA BAY: IMPLICATIONS FOR WATER QUALITY AND CORAL REEF MANAGEMENT

Coral reefs in the vicinity of Guánica Bay are some of the most degraded reefs in Puerto Rico due to an increase in sediment and nutrient load caused by anthropogenic modifications to the Guánica Bay Watershed. The loss of the Guánica Lagoon is believed to be the main factor leading to this degradation (Warne et al. 2005). Since the Lagoon acted as a filter of nutrients and sediments before being drained for agricultural purposes in the 1950’s. In an effort to improve coral reef ecosystems near Guánica, the Guánica Bay Watershed Management Plan seeks to improve water quality within the system by reducing pollution sources. To successfully improve water quality, it is necessary to understand the spatial structure of the velocity field, which is responsible for the vertical and horizontal mixing of these pollutants in the Bay. In this presentation we will show preliminary results from the first Lagrangian velocity measurements and numerical simulations of the hydrodynamics of Guánica Bay. GPS-tracked Lagrangian drifters were released at three locations: the Río Loco rivermouth, the Guánica treatment plant and the Bay entrance. This first set of observations and simulations focuses on low river flow conditions to examine the background current patterns which exist in the absence of high-momentum river plumes. The implications of the observed velocity structure on the system’s water quality and flushing characteristics will be discussed.

Canin, N. E., Woods Hole Oceanographic Institution, Woods Hole, USA, ncanin@whoi.edu

Cohen, A. L., Woods Hole Oceanographic Institution, Woods Hole, USA, acohen@whoi.edu

Tarrant, A. M., Woods Hole Oceanographic Institution, Woods Hole, USA, atarrant@whoi.edu

INTERSPECIFIC VARIABILITY IN THE CORAL RESPONSE TO RISING SEA SURFACE TEMPERATURES ON A CENTRAL RED SEA REEF

Summer sea surface temperatures (SSTs) in the central Red Sea have increased by 0.8°C since 1990, repeatedly exceeding the historical summertime maximum SST by more than 1°C. We investigated the impact of this warming on coral calcification within a single forereef community. Variability in skeletal growth over a thirty year period (1978-2008) was quantified in Diploria strigosa, Montastraea annularis and Cyphastrea serailia using Computed-Tomography (CT) scanning. Three coral species exhibited different responses to the same thermal anomalies of the last decade: negative, positive and neutral. D. heliopora annual calcification declined by 18%; conversely, P. tenua calcification increased by 8% over the same period; for C. serai- lia, calcification showed no trend. Our data show that species responses to thermal anomalies capable of causing bleaching, can be highly variable within a single reef community. Apparently tolerant coral species continue to grow at normal or higher rates, whereas growth by sensitive species continues to decline. One possible outcome could be shifts in species composition as temperatures continue to rise over this century. By analyzing calcification responses to past and increasingly frequent stress events, across a range of species and reef sites, we can greatly improve our understanding of how coral reef communities are responding to a changing climate.

Capec, M. R., Scripps Institution of Oceanography, UCSD, La Jolla, USA, mattias@spg.ucsd.edu

Vernet, M., Scripps Institution of Oceanography, UCSD, La Jolla, USA, mvernet@ucsd.edu

Kahru, M., Scripps Institution of Oceanography, UCSD, La Jolla, USA, m.kahru@ucsd.edu

sebestyen, S. D., USDA Forest Service, Grand Rapids, MN, USA, ssebestyen@fs.fed.us del Giorgio, P., Université de Québec à Montréal (UQAM), Montreal, Canada, del_giorgio.paul@uqam.ca

Seguraj, J. R., Université de Montréal and UQAM, Montreal, Canada, jh.legendue@gmail.com

REFINING SATELLITE-DERIVED ESTIMATES OF DOC IN LIGHT OF NEW EVIDENCE

As increasing attention is paid to the storage and flux of carbon in and around boreal lakes, strategies to make credible region-wide estimates of stocks and fluxes will be increasingly important. Given that there are perhaps millions of lakes in lake-rich regions like Quebec, however, concerted field campaigns can reach only a minuscule fraction of the lakes. In a given lake that has not been visited, evidence about carbon content might come from a variety of sources having differing amounts of credi-
tibility: lake color from a high-quality satellite image; lake color from a cloudy image; GIS-based regressions, and simulation models. The challenge of updating estimates will be increasingly important as a new Landsat-class satellite is prepared for launch: a prototype (the Advanced Land Imager) produces images that correlate well with field studies in boreal lakes in northern Europe and Quebec. After launch, this satellite will produce a stream of images of varying quality. This research explores ways of automatically incorporating such new evidence about carbon content from a variety of sources, in order to improve estimates of important lake attributes.

Carlson, B., Gustavus Adolphus College, Saint Peter, MN, USA, bcarlso4@gustavus.edu

Jeremiasson, J. D., Gustavus Adolphus College, Saint Peter, MN, USA, jjeremia@gustavus.edu

Sebestyen, S. D., USDA Forest Service, Grand Rapids, MN, USA, sebestyen@fs.fed.us

Kolka, R. K., USDA Forest Service, Grand Rapids, MN, USA, rkolka@fs.fed.us

TRACE METAL AND DISSOLVED ORGANIC MATTER (DOM) CYCLING IN AN OMBROTROPHIC BOG

The transport and biogeochemical cycling of trace metals in peatland systems is often related to the type and amount of dissolved organic matter present. Trace metals,
dissolved organic carbon (DOC), and other parameters were measured monthly from June to October 2010 in porewaters of an ombrotrophic bog to assess movement of trace metals from the upland towards the center of the bog. Significant gradients in pH, DOC, and other parameters were observed in the porewater transects extending from the upland towards the center of the bog, although these varied monthly. Some trace metal concentrations were correlated with DOC (e.g. Pb) and generally increased in concentration moving from the upland towards the center of the bog. This behavior suggests a central role for DOC in controlling speciation and transport of these metals. Others metals (e.g. Ca) decreased in concentration towards the center of the bog, suggesting runoff from the upland as a major source and potentially less interaction with DOC. A redox model will be presented to help explain trace metal speciation and elucidate potential transport mechanisms in the bog.

Carlson, C. A., University of California, Santa Barbara, USA, carolson@lifesci.ucsb.edu
Hansell, D. A., University of Miami, Miami, USA, dhansell@rsmas.miami.edu
Goldberg, S. J., Scripps Institution of Oceanography, San Diego, USA, sigoldberg@mail.ucsd.edu

Dissolved Organic Matter Accumulation, Transformation and Export in the North Atlantic Basin

DOC is produced daily with primary production. Most of this DOC is remineralized rapidly, however, an amount equal to about 20% of net community production is resistant to microbial degradation for periods of months to years. It is this semi-labile DOC pool that accumulates in the surface layer until it is mixed into the ocean interior, thus contributing to the biological pump. In the North Atlantic, there are latitudinal gradients in both the quantity and quality of this DOC. Prevailing surface currents redistribute accumulated DOC to high latitudes where it is exported, representing 10 – 20% of export production in the North Atlantic Basin. Here we present the basin scale DOC distribution to describe where DOC accumulates and where it is exported. Also presented are time-series data of annual build up and export in the north Atlantic subtropical gyre. Characterization of the combined carbohydrate pool will be presented to illustrate how DOM character is altered in time and space within the surface layer of the subtropical gyre.

Carrijoan, A. D., University of Wollongong, Wollongong, Australia, aadc401@uow.edu.au
Puotinen, M. L., University of Wollongong, Wollongong, Australia, marji@uow.edu.au

To What Extent Do Tropical Cyclone ‘Cool Wakes’ Create Thermal Refugia for Coral Reefs?

Tropical cyclones (TC) reduce sea surface temperature (SST) in the upper ocean, producing a ‘cool wake’. Recent evidence shows that if a reef is located within a cool wake at a time when corals are thermally stressed, bleaching severity may be reduced. As the timing and location of both high SST and TC tracks varies, some reefs that frequently get relief from cool wake(s) during periods of thermal stress may represent thermal refugia (especially under future climates). To identify these potential refugia first requires the creation of a global database of TC cool wakes. As ocean cooling has multiple causes (upwelling, currents), we assumed that TC cool wakes existed on a given day only in pixels where TC winds exceeded 17 m/s (using a TC wind database we generated). We validated our techniques with in situ data (e.g., Hurricane Earl, 9/2010, North Atlantic, n = ~30 buoy). Subsequently, we reconstructed cool wakes daily for every TC from 1985-2007 (25 km resolution). From this data, we will examine the extent to which cool wakes coincide with thermal stress events to potentially reduce bleaching.

Casey, B. J., QinetiQ, NA, Stennis Space Center, USA, casey@nrlssc.navy.mil
deRada, S., Naval Research Laboratory, Stennis Space Center, USA, Sergio.Derada@nrlssc.navy.mil
Ko, D. S., Naval Research Laboratory, Stennis Space Center, USA, ko@nrlssc.navy.mil
Ladner, S. D., Naval Research Laboratory, Stennis Space Center, USA, ladner@nrlssc.navy.mil
Aronne, R. A., Naval Research Laboratory, Stennis Space Center, USA, aronne@nrlssc.navy.mil

Using a Bio-Optical Model as a Proxy for Surface Satellite Optical Measurements in an Eulerian Advection Forecast Model

The OpCast system can produce a 24-hour forecast of satellite-measured optical products such as chlorophyll-a, back-scatter, etc. OpCast works by coupling the satellite surface optical measurements with currents from a physical ocean model into an Eulerian advection process. Since satellite imagery is inherently unreliable due to contamination by cloud coverage and atmospheric correction, the system employs a “fill” process to replace these missing areas of the 2D optical field before the advection process begins. The “fill” process may introduce large errors which increase the difficulty of validating a complex model. By using a bio-optical model as a proxy for the 2D satellite optical field, we can avoid the fill process entirely and focus solely on the errors introduced by the Eulerian advection scheme. We extract a synthetic 2D satellite surface field of chlorophyll-a concentration from a 4km resolution Gulf of Mexico bio-optical model and used it in place of satellite imagery to produce a forecast. We then compare this forecast with the coincident surface field produced by the bio-optical model and discuss the results.

Casey, J. R., University of Hawaii, Honolulu, USA, jrcasey@hawaii.edu
Lomas, M. W., Bermuda Institute of Ocean Sciences, St. Georges, Bermuda, michael.lomas@bios.edu
Aucan, J., Bermuda Institute of Ocean Sciences, St. Georges, Bermuda, Jerome.aucan@bios.edu

Interannual Dynamics of Carbon Partitioning within the Sargasso Sea Picoplankton Assemblage

Bacteria and picophytoplankton dominate the living particulate carbon pool in oligotrophic subtropical gyres, however time-variability of these pools remains poorly defined. Flow cytometry was used to directly estimate cellular carbon quotas of the microbial community at the RATS site from 2004 to 2010. During this period, shifts in population-specific POC pools were observed which were not apparent from numerical abundance alone. Increasing stratification from 2004-2009 led to ~15% reduction in bulk POC within the upper 60m at the expense of both autotrophic (27% reduction) and heterotrophic (21% reduction) POC, while detrital POC (DNA negative particles) remained a constant proportion of living POC. Within the autotrophic POC pool, Prochlorococcus and Synechococcus POC doubled while eukaryotic POC was reduced by half. An especially deep winter mixed layer (420m) in 2010 ‘reset’ the POC reservoirs, with eukaryotic algae POC again exceeding cyanobacterial POC. Up to 80% of POC variability within each microbial community was due to changes in cellular carbon quotas rather than abundance. This dataset demonstrates the direct impact of physical variability on microbial POC quotas and differential responses of planktonic groups.

Casillas-Maldonado, J. J., University of Puerto Rico/Sea Grant College Program, Mayaguez, Puerto Rico, casillas_jorge_i@yahoo.com
Soto-Santiago, F. J., University of Puerto Rico/Sea Grant College Program, Mayaguez, Puerto Rico, coralero@gmail.com

Guardarenas Project: Working for a Sustainable Development

Guardarenas (Sandwatch) project began in 1998 in Trinidad & Tobago as part of the United Nations Educational, Scientific and Cultural Organization (UNESCO). It started in Puerto Rico in 2008, with the support of the local Sea Grant Program in an environmental education workshop in Southwest, Puerto Rico. It currently encompasses 10-15 schools throughout the main island. Guardarenas aims to engage schools and communities in the better management of beaches with hands on experience. Moreover, it integrates the learning experience as a model for the UNESCO Decade of Education for Sustainable Development (2005-2014). Guardarenas activities include beach clean ups, beach profiling, measurements of coastal currents and waves, water quality monitoring and classification of different types of sands. These activities are important because they provide long term data about the dynamic processes that take place in these coastal environments. In Puerto Rico, Guardarenas is needed because of the archipelago's long history of excessive coastal development that affects not only the natural resources but human beings as well. Puerto Ricans need to be part of the decision making regarding their coastal environments.

Casillas-Martinez, L., University of Puerto Rico-Mayaguez, Mayaguez, Puerto Rico, lcasillas@gmail.com
Rios-Velazquez, C., University of Puerto Rico-Mayaguez, Mayaguez, Puerto Rico, visscher.p.t@connectivity.usct.edu
HYPERsaline Microbial Mats as QUINTESSENTIAL TOOLS FOR TEACHING GEOMICROBIOLOGY

Hyersaline microbial mats are one of the best suited laminar organo- sedimentary ecosystems on Earth. We have used these mats as educational tools to promote active learning of geomicrobiology introductory concepts for undergraduate students organized in multidisciplinary teams with biological and geological backgrounds. The main educational activities of our Research at Undergraduate Institutions---
Microbial Observatory (RUI-MO) program are field trips and independent research projects focused on microbial mats, intensive workshops and one capstone activity designed to expose students to the different geomicrobiology subdisciplines (microbiology, molecular biology, geology, and geochemistry). The teaching-learning process of our undergraduate students was assessed using pre- and post-tests, group discussions, activities including Gallery Walks and the capstone activities demonstrated an increase in the depth, coherence, and thoughtfulness in answering questions, including a clear integration of the different sub-disciplines during their presentations. To our knowledge this is the first educational initiative that uses tropical hypersaline microbial mats to effectively teach geomicrobiology in a multidisciplinary fashion to undergraduate students from different disciplines.

**Casini, M.,** Swedish Board of Fisheries, Lysekil, Sweden, michelle.casini@fiskerverket.se

Loven, N., Stockholm University, Stockholm, Sweden, tblen@nmbu.no

Müller-Karulis, B., Latvian Institute of Aquatic Ecology, Riga, Latvia, baierbel@latnet.lv

Möllmann, C., University of Hamburg, Hamburg, Germany, christian.moellmann@uni-hamburg.de

Lindegren, M., Technical University of Denmark, Copenhagen, Denmark, ml@knu.dk

Gårdenmark, A., Swedish Board of Fisheries, Oresund, Sweden, anna.gardmark@fiskerverket.se

Bergström, L., Swedish Board of Fisheries, Oresund, Sweden, lena.bergstrom@fiskerverket.se

Llope, M., Instituto Español de Oceanografía, Cádiz, Spain, marcos.llope@bio.unican.es

Kornilovs, G., Institute of Food Safety, Department of Fish Resources Research, Riga, Latvia, Georgs.kornilovs@fishmet.gov.lv

Stenseth, N. C., University of Oslo, Oslo, Norway, n.c.stenseth@bio.unican.es

Diekmann, R., University of Hamburg, Institute of Hydrobiology and Fisheries Sciences, Hamburg, Germany, rabea.diekmann@uni-hamburg.de

Pikss, M., Institute of Food Safety, Department of Fish Resources Research, Riga, Latvia, Marii.pikss@bio.gov_lv

**Spatial Connectivity and Predator Spillover Affect Food-Web Structure in Ecological Sinks: The Baltic Sea Case**

Resolving ecological connectivity, spatio-temporal linkages among habitats and the interactions between regional and local processes is fundamental in community ecology. Here we show, using 35-year data from the Baltic Sea that the spillover of the predator cod from its main distribution area of the central Baltic Sea produces cascading effects on the whole food-web of the adjacent and semi-isolated Gulf of Riga. At high cod stock size and favourable hydrological conditions, cod increase its geographical distribution and invade the Gulf of Riga decreasing in this area the population of its main prey, the herring. When cod disappear from the Gulf of Riga, due to climate changes and potentially fishing pressure, the herring population recovers affecting summer zooplankton and phytoplankton biomasses via top-down control. The Gulf of Riga can be considered as a "true sink", where in absence of immigration from the source areas of the central Baltic Sea the cod population goes extinct due to the absence of spawning. The integration of landscape and food-web ecology is central to predict species and ecosystems’ responses to environmental changes and fisheries pressure.

**Cattani, L.,** Università Cattolica del Sacro Cuore, Cremona, Italy, ilenia.cattani@unicatt.it

Beone, , Università Cattolica del Sacro Cuore, Cremona, Italy, ilenia.cattani@unicatt.it

De Santis, , Università degli Studi di Napoli “Federico II”, Portici (NA), Italy

Cozzolino, , Università degli Studi di Napoli “Federico II”, Portici (NA), Italy

Boccelli, , Università Cattolica del Sacro Cuore, Cremona, Italy

Pigna, , Università degli Studi di Napoli “Federico II”, Portici (NA), Italy

**Effect of Arbuscular Mycorrhiza and Phosphorus Application on As and P Availability in a Contaminated Soil: Comparison between DGT Estimation and Maize Uptake**

In both terrestrial plants and soils, As occurs mostly in inorganic forms. Arbuscular mycorrhiza (AM) inoculation may enhance the tolerance to soil contamination whereas phosphorus application can effectively reduce plant uptake of As(V), which is transported across the plasma membrane as a phosphate analogue. In this study we tested the effect of AM and P addition on As and P availability in a contaminated soil: As availability was detected by DGT, whereas speciation of As, uptake and translocation of As and P by HPLC-ICP-MS, after maize cultivation in a rhizobox system. Speciation and DGT analysis suggest that arsenic availability is low and that it moderately increases in the rhizosphere. Inoculation of AM was not sufficient to influence the tolerance to arsenic, even if they increased accumulation of As(V) in root, translocation of As(III) to shoot and P/As ratio in leaves. Phosphorus application at agronomic rate effectively improved the biomass production and reduced As sensitivity in plants. Ultimately, DGT measurements reflected the balance between the soil resupply and the root uptake, and they were able to predict plant accumulation of As.
Catton, K. B., Colorado State University, Fort Collins, USA, kimberly.catton@colostate.edu

ZOOPLANKTON COMMUNITY STRUCTURE IN URBAN LAKES UNDERGOING RESTORATION

Aeration systems are commonly used in small, urban lakes to improve water quality and lake odors. Aerators alter the natural stratification regime and increase small-scale mixing in these lakes. Different zooplankton groups may respond differently to fluid cues, which could lead to differences in community structure. Zooplankton samples were taken in three lakes with different aeration levels to examine the effect of aeration on the zooplankton community. Initial observations indicate that Cladocerans are more abundant in lakes that are aerated. Additionally, Cladocerans were more abundant in areas near aerators, whereas copepods not more abundant near aerators.

Cermeño, P., Universidad de Vigo, Vigo, Spain, pedro@uvigo.es

EXTINCTION OF MICROBIAL PLANKTON IN THE SEA

Life on Earth is microbe dependent, yet, little is known about the mechanisms that control their evolutionary dynamics and, in particular, the causes that drive microbial species to extinction. Historical contingencies such as climatic variations or tectonic processes alter local environmental conditions, cause habitat fragmentation and threaten the survival of species. However, owing to their huge population densities and broad dispersal, free-living microbes track changes in global environmental conditions, shift their biogeographic distribution ranges, and hence escape extinction. Here I show that two estimates of extinction intensity support the hypothesis of nearly constant extinction rates for marine planktonic diatoms and coccolithophores across the Cenozoic, and concur with the predictions of a time-homogeneous speciation-extinction model. To the extent that microbial plankton dispersal reduces the importance of biotic interactions, my results link the extinction of these marine microbes to the failure of species to adapt to a progressively changing physical/chemical environment. This finding has implications for our understanding of microbial plankton diversity in the sea.

Cesarz, J., University of Cologne, Biocenter, Cologne, Germany, jcesarz@smail.uni-koeln.de

Scherwass, A., University of Cologne, Biocenter, Cologne, Germany, anja.scherwass@uni-koeln.de

Wilen, C., University of Cologne, Biocenter, Cologne, Germany

Arndt, H., University of Cologne, Biocenter, Cologne, Germany

CHANGE OF BACTERIAL ACTIVITY AS RESPONSE TO INTENSIVE PROTOZOA GRAZING

Grazing of protozoans on bacteria is known to shape the morphology of bacteria in a distinctive way (e.g. Hahn & Hofle, 2001) which leads to formation of filaments, colonies etc. The present study we measured the change of bacterial activity as response to protozoan grazing in a chemostat system. The system contained two species: the ciliate (Tetrahymena pyriformis) and the bacterium Acinetobacter johnsonii, which revealed a strong morphological change from small morphotypes to colonies etc. In the present study we measured the change of bacterial activity as response to intensive protozoan grazing.

Chan, F. T., Great Lakes Institute for Environmental Research, University of Windsor, Windsor, ON, Canada, chan.f@guelph.ca

Bailey, S. A., Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, ON, Canada, Sarah.Bailey@dfo-mpo.gc.ca

Wiley, C. J., Fisheries and Oceans Canada/Transport Canada Marine Safety, Sarnia, ON, Canada, Chris.Wiley@dfo-mpo.gc.ca

MacKee, H. J., Great Lakes Institute for Environmental Research, University of Windsor, Windsor, ON, Canada, humphg@uwindsor.ca

FIRST VECTOR-BASED RISK ASSESSMENT FOR SHIP-MEDIATED BIOLOGICAL INVASIONS IN THE CANADIAN ARCTIC

Global warming is reducing Arctic sea ice, and may provide additional navigation routes and a prolonged shipping season in the future. Therefore, the Arctic may be exposed to greater ship traffic and thus greater risk for ship-mediated invasions. We used a two-step model to identify high risk ports in the Canadian Arctic based on ship traffic and environmental suitability. First, we summarized 2005-2008 shipping data from the Canadian Coast Guard and Transport Canada, and used vessel arrivals and ballast water discharge volume as proxy measures for propagation pressure. We estimated 541 arrivals discharging 233,165 m3 of ballast water annually. We then compared the environmental conditions of the recipient ports with those of the connected bioregions to estimate establishment probability for potential ANS. Churchill, MB and Iqaluit, NU were identified as high risk ports with Port Alford, QC and Montreal, QC as their respective potential ANS sources. These results can be used to develop early detection programs at high risk ports and as a baseline for long-term monitoring of biological invasions as climate conditions and shipping activities in the region change.

Chan, F., Oregon State University, Corvallis, USA, chanf@science.oregonstate.edu

Menge, B. A., Oregon State University, Corvallis, USA, bmenge@science.oregonstate.edu

Hales, B., Oregon State University, Corvallis, USA, bhales@coas.oregonstate.edu

Barth, J. A., Oregon State University, Corvallis, USA, barth@coas.oregonstate.edu

HYPOXIA AND OCEAN ACIDIFICATION AS COUPLED ECOSYSTEM STRESSORS: INSIGHTS FROM TIME-SERIES OBSERVATIONS ON THE OR- EGON UPWELLING SHELF

Temporal and spatial changes in oxygen availability represent dominant gradients for organizing biogeochemical cycles and ecological interactions in the sea. Because the cycling of oxygen and carbon are tightly coupled, the onset of hypoxia can be accompanied by increased ecosystem vulnerability to ocean acidification (OA). While OA can further impact biogeochemical processes and organismal biology in hypoxia-prone systems, the dynamics that govern OA variability in time and space and its interaction with oxygen stress remains poorly characterized. We will present results of a time-series effort to characterize the temporal dynamics of hypoxia and ocean acidification in the Oregon seasonal upwelling shelf system. Ship- and mooring-based observations indicate the potential for rapid seasonal onset and marked interannual variability in hypoxia and OA stress in response to upwelling wind forcing. In addition, inner-shelf in-situ sensors reveal extreme diurnal fluctuations in pCO2 and oxygen concentrations. Together, these observations highlight the sensitivity of upwelling ecosystems to OA and reveal important considerations for defining present and predicting future biological exposure regimes to ecosystem change.

Chandler, C. L., Woods Hole Oceanographic Institution, Woods Hole, MA, USA, cchandle@whoi.edu

Allison, M. D., Woods Hole Oceanographic Institution, Woods Hole, MA, USA

Groman, R. C., Woods Hole Oceanographic Institution, Woods Hole, MA, USA

Gegg, S. R., Woods Hole Oceanographic Institution, Woods Hole, MA, USA

Wiebe, P. W., Woods Hole Oceanographic Institution, Woods Hole, MA, USA

Glover, D. M., Woods Hole Oceanographic Institution, Woods Hole, MA, USA

CARICO TIME-SERIES DATA MANAGEMENT

The Carbon Retention in a Colored Ocean (CARICO) Time Series site, located off the coast of Venezuela, has been conducting monthly ship-based data collection since November 1995. Because it is impossible to resample environmental data, assessed every 3 weeks. After 101 days of exposure, body component indices (gut, gonad, Aristotle’s lantern, and test with spines) were obtained and strength of the test was measured. Test strength (via penetrometry) was significantly greater at reduced pH, indicative of compensatory calcification. However, by day 84 the mean whole animal wet weight at reduced pH was significantly less than at ambient pH. This reduction in body weight (15.39%) appears to be the outcome of a reduction in feeding.
proper management of those data sets is especially important to realize their full potential, to enable data re-use and facilitate integration of data from multiple disciplines and the synthesis of time-series collections. In recognition of this, in 2006 the US National Science Foundation funded the Biological and Chemical Oceanography Data Management Office (BCO-DMO) to serve the data management requirements of investigators funded by the NSF’s Biological and Chemical Oceanography Sections. BCO-DMO staff members collaborate with investigators ensuring that data are documented, stored, disseminated, and protected long after the research is completed. Highlighting the available CARICO project data and related biogeochemical data, we describe the capabilities of the BCO-DMO data system: geospatial and text-based data discovery and access systems; recent enhancements to data search tools; data export and download utilities; and strategic use of controlled vocabularies to facilitate data integration and improve interoperability.

Chappell, P. D., University of Puerto Rico-Mayagüez Campus, Mayagüez, Puerto Rico, jeschappell@upr.edu

Whitmire, S., University of Puerto Rico-Mayagüez Campus, Mayagüez, Puerto Rico, stefanie.whitmire@upr.edu

Martínez, G. A., University of Puerto Rico-Mayagüez Campus, Mayagüez, Puerto Rico, tavomart@hotmail.com

Sotomayor-Ramírez, D., University of Puerto Rico-Mayagüez Campus, Mayagüez, Puerto Rico, david.sotomayor@upr.edu

THE PHYTOPLANKTON COMMUNITY STRUCTURE IN TWO PUERTO RICAN RESERVOIRS OF CONTRASTING NUTRIENT STATUS

Reservoirs in Puerto Rico are the main source of drinking water and their eutrophication is a concern from both an ecological and public health perspective. Two reservoirs in Puerto Rico were studied to explore the relationships between nutrient concentrations and phytoplankton community structure. Lago Guajataca is mesotrophic, while Lago La Plata is eutrophic. As part of a larger project, we evaluated the spatial variability in water quality parameters, chlorophyll A, and the phytoplankton community structure of each reservoir. La Plata had a higher abundance of phytoplankton, which was reflected in higher chlorophyll A concentrations and a larger amount of green algae genera. Centric diatoms were the major phytoplankton group in the eutrophic system, while pennate diatoms dominated the mesotrophic reservoir. Additionally, the eutrophic system had a larger number of dinoflagellates and cyanobacteria colonies. The evidence of different phytoplankton communities between reservoirs with a high and low nutrient concentration demonstrates how the phytoplankton community can be altered once a system becomes eutrophic.

Chappell, P. D., University of Rhode Island, Kingston, USA, dreux@mail.uri.edu

Jenkins, B. D., University of Rhode Island, Kingston, USA, bjenkins@uri.edu

THALASSIOSIRID BARCODING METHOD REVEALS COASTAL DIVERSITY AND REGIONS OF SINGLE SPECIES DOMINANCE IN THE EASTERN SUBARCTIC PACIFIC OCEAN

Diatoms are a genetically diverse group of unicellular photosynthetic eukaryotes that are significant primary producers in the ocean. There are over 200,000 extant diatom species found in marine and freshwater environments from polar to tropical regions. Despite rapidly advancing methodologies for genome sequencing, there is complete genome data for only a few species, including one representative of the Thalassiosirid genus. To expand this database, we are sequencing libraries of expressed genes for coastal and oceanic Thalassiosirids. To link the comprehensive information from genomic studies with field populations, we are developing methods to genotype Thalassiosirids from a wide variety of habitats including estuarine, coastal and oceanic environments. We have developed a Thalassiosira-specific barcoding method using 5.8s rRNA and internal transcribed spacer region 2 (ITS2) to identify Thalassiosira species in field samples from a cruise to the eastern subarctic Pacific Ocean. This method revealed considerable diversity in Thalassiosira species present in coastal regions and two distinct populations of a single species, one associated with the HNLC Ocean Station PAPA and another associated with a Haida eddy that was encountered in the region.

Chatellain, M., CNRS, Banyuls-sur-Mer, France, chatellain@obs-banyuls.fr

Guizien, K., CNRS, Banyuls-sur-Mer, France, guizien@obs-banyuls.fr

OXYGEN DYNAMICS NEAR THE SEDIMENT-WATER INTERFACE UNDER LOW-FREQUENCY FLOWS

Diffusional mass transfers between bottom sediments and overlying water constitute an essential coupling of benthic and pelagic ecosystems. These transfers are controlled by the thickness of the diffusive boundary layer in the water column, which display periodic changes under oscillatory flows. A numerical diffusion-reaction model describing oxygen dynamics under wind waves and sea swell (Chatellain and Guizien, 2010) was extended to low-frequency flows (seiche, inertial wave, tide, etc.). For these flows, diffusion time across the diffusive boundary layer, time granted to this diffusion during a wave cycle, and oxygen consumption time in the sediment have similar order of magnitudes. Simulations show that unsteady properties of the flow are transmitted to the oxygen concentration inside the sediment: diffusive flux, concentration at the interface, and oxic layer thickness exhibit strong fluctuations. Moreover, maximum oxic layer thickness is phase-lagged with the maximum outer flow velocity. Ecological relevancy of these results will be discussed as oxygen dynamics regulates important biological and geochemical processes of organic matter degradation in the upper sediment, and in situ measurements may be required to validate the modeling predictions.

Chavez, F. P., Monterey Bay Aquarium Research Institute, Moss Landing, USA, chl@nbear.org

Messé, M., Monterey Bay Aquarium Research Institute, Moss Landing, USA, monique@nbear.org

Marinovic, B., University of California Santa Cruz, Santa Cruz, USA, marinovic@ucsc.edu

Pennington, J. T., Monterey Bay Aquarium Research Institute, Moss Landing, USA, peti@nbear.org

SALINITY AS AN INDICATOR OF ECOLOGICAL PROCESSES IN THE EASTERN NORTH PACIFIC

Salinity has long been used as a tracer for water masses and to estimate transport by ocean currents. Here we show how salinity is also an excellent proxy for ecological provinces in the eastern North Pacific. The primary data set was collected on a transect from the site of a 20 year time series in Monterey Bay, California to station Aloha where the Hawaii Ocean Timeseries (HOT) has operated for a similar time period. At the surface the transect cut through the intermediate salinity coastal upwelling waters, into the fresher waters brought southward from the Pacific Northwest by the California Current, and finally into the high salinity waters of the subtropical gyre. The relative abundance of fauna (micro and meso zooplankton) and flora (pico to large phytoplankton) sampled during the transect was intimately related to salinity. The processes responsible for the different biogeochemical provinces are discussed.

Cheah, W., University of Tasmania, Hobart, Australia, wee.cheah@utas.edu.au

McMinn, A., University of Tasmania, Hobart, Australia, andrew.mcminn@utas.edu.au

 Griffiths, F. B., Commonwealth Scientific and Industrial Research Organisation, Hobart, Australia, brian.griffiths@csiro.au

Westwood, K. J., Australian Antarctic Division, Hobart, Australia, karen.westwood@aad.gov.au

Wright, S. W., Australian Antarctic Division, Hobart, Australia, simon.wright@aad.gov.au

Clementson, L. A., Commonwealth Scientific and Industrial Research Organisation, Hobart, Australia, lesley.clementson@csiro.au

PHOTOSYNTHETIC RESPONSE OF SUBANTARCTIC AND POLAR FRONTAL ZONES PHYTOPLANKTON TO LIGHT AND NUTRIENTS

The extension of the subtropical East Australian Current to the subantarctic zone (SAZ) south of Australia is expected to affect the biogeochemistry of this region. To better understand the response of phytoplankton to different environmental variables in this region, we measured photosynthetic performance of natural phytoplankton communities in the SAZ and polar frontal zone (PFZ) during the SAZ-Sense (Sub-Antarctic Zone Sensitivity to environmental change) survey in Jan-Feb 2007. Under iron replete conditions, phytoplankton were found to be adapted to higher light levels combined with higher biomass, productivity, photosynthetic performance, and lower photoprotective pigment concentrations as recorded in the SAZ. In contrast, phytoplankton communities sampled in the iron depleted PFZ exhibited lower biomass and production but higher photoprotective pigment concentrations under the relatively low light environment. Our results highlight the dynamic interaction of light and nutrients in the control of phytoplankton growth in the SAZ and PFZ.
concentrations and thus cause or contribute to hypoxic/anoxic events. These events consequently dying and decomposing jellyfish populations could deplete dissolved O₂.

Baudoux, A. C., Université Européenne de Bretagne, UMR 6539 LEMAR, IUEM, Plouzané, France, anne-claire.baudoux@univ-brest.fr

Development of a Voltammetric Method to Measure Iron Organic Speciation in Rainwater

Atmospheric dust deposition (wet and dry) is one of the main inputs of Fe to the surface open ocean. Although organic Fe in rainwater may be an important source of soluble Fe to surface seawater and for phytoplankton, it has not been measured. We have developed a new method based on Competitive Ligand Exchange Cathodic Stripping Voltammetry (CLE-CSV) to measure the organic speciation of Fe (binding capacity of organic natural ligands with Fe and conditional stability constants) in rainwater. Different competing ligands have been tested at low rainwater pH (4.7-6) and at low ionic strength. Potential interferences (e.g., other metals, oxalate, etc.) were also tested. This method was applied to rainwater samples collected at a coastal site (Brest, France) and over the open ocean during the AMT 19 (Oct. 2009). We will present the results of this analytical development as well as the Brest and AMT site (Brest, France) and over the open ocean during the AMT 19 (Oct. 2009). We will present the results of this analytical development as well as the Brest and AMT data, which constitute the first data set of Fe organic speciation measurements in rainwater.

Chen, C. A., National Sun Yat-sen University / Institute of Marine Geology and Chemistry, Kaohsiung, Taiwan ROC, cchen@mail.nsysu.edu.tw

Export of Dissolved Organic Carbon from the Northern South China Sea

In general, the South China Sea surface waters and waters in the Taiwan Strait are higher in DOC concentrations than the surface waters in the West Philippine Sea (WPS), whereas waters below 1000 m have the same concentrations. As waters around 2000 m in depth flow into the SCS year-round, these waters bring in relatively smaller amount of DOC compared to waters flowing in and out of the SCS at shallower depths. In the wet and dry seasons, the SCS has net fluxes of -4.68 ± 2.40 × 10^12 (export) and 1.45 ± 0.59 × 10^12 (import) moles of DOC, respectively, through the Luzon Channel and the Taiwan Strait, showing that the SCS exports 3.18 ± 2.47 × 10^12 moles DOC to the East China Sea and the WPS in a year.

Chen, C., National Taiwan Normal University, Taipei, Taiwan ROC, cchen@ntnu.edu.tw

Effects of the Changjiang River Discharge on Planktonic Community Respiration in Spring in the East China Sea

The Changjiang (a.k.a. Yangtze) River is the fifth largest river in the world in terms of volume discharge, and its freshwater input has significant impact on the ecosystem of the East China Sea (ECS), one of the largest continental shelves in the world. Its effects on planktonic community respiration (i.e., CR) has been evidenced in summer, however, there is rare data on this related issue in other seasons. To evaluate and understand the potential controlling mechanism of organic carbon consumption (e.g., CR) in spring in the ECS, study with stations covering almost the entire ECS shelf were conducted in April 2009. Results showed that concentrations of nitrate and Chl a in the surface water and averaged values over the euphotic zone were all negatively correlated with sea surface salinity, reflecting the strong influence of river discharge on the ECS shelf ecosystem. As for CR, its averaged values over the euphotic zone ranged from 15.2 to 264.9 mg C m⁻² d⁻¹, with mean (± SE) values (mg C m⁻² d⁻¹) of 108.0 ± 69.7. As expected, the higher CR values were observed in the inner shelf with area of higher planktonic growth. Interestingly, in addition to the coastal region, the highest CR was measured in the outer shelf. This result suggests that heterotrophic processes regulating CR in spring in the ECS was support materials discharged by the Changjiang River and other factors which needed to be further explored.

Chen, F., National Taiwan Normal University, Keelung, Taiwan ROC, gcgong@mail.ntou.edu.tw

Determination of Karenia Brevis Bloom Source Area along the Texas Coast

The surface distribution of Karenia brevis, a dominant harmful algal bloom dinoflagellate along the Texas coast, is investigated using a numerical hydrodynamic model. The conceptual model for plankton distribution is that plankton remain near the surface, and changes in concentration are influenced by convergence and divergence in the surface flow field. The basis for this idea is that measured growth rates for K. brevis are insufficient to create observed blooms along the Texas coast and that blooms occur only sporadically, in contrast to blooms in Florida that occur every year. We use hindcast numerical simulations of surface currents to quantify convergence. Surface currents are used to advect tracers representing K. brevis concentrations and these concentration change in proportion to flow divergence. The simulated K. brevis concentrations are compared against observations between 2000 and 2009. Intensity and spatial extent of known blooms are estimated using in situ sampling and satellite images. The possible source regions are identified by advecting known blooms ‘backward’ through the numerical simulation by integrating these patches backward in time using the negative of the velocity field.
Chen, G. L., McGill University/Yunnan Normal University, Montreal, Canada/Kuming, China, Canada, guangjiecheng@gmail.com
Selbie, D. T., McGill University, Montreal, Canada
Saulnier-Talbot, E., McGill University, Montreal, Canada
Schindler, D. E., University of Washington, Seattle, USA
Bunting, L., University of Regina, Regina, Canada
Leavitt, P. R., University of Regina, Regina, Canada
Finney, B. P., Idaho State University, Pocatello, USA
Gregory-Eaves, L., McGill University, Montreal, Canada

PACIFIC SALMON DRIVE DIATOM BETA-DIVERSITY PATTERNS IN FRESH-WATER ECOSYSTEMS

It is well recognized that Pacific salmon (Oncorhynchus spp.) play an important role in maintaining the structure and functioning of freshwater ecosystems due to their anadromous and semelparous life histories. However, few studies have examined their impact on freshwater biodiversity. Here we employ paleolimnological methods to test whether salmon-derived nutrients (SDN) have shaped diatom beta-diversity patterns. Based on sedimentary 615N records from six Alaskan lakes, SDN derived from salmon was calculated to represent SDN loadings using an isotopic mixing model. SDN loadings were found to regulate diatom community composition within and across the study lakes over the past 500 years. Diatom beta-diversity was also significantly and positively related to differences (or variance) in SDN among lakes – 1950 AD, within a lake with strong variation in SDN during 1700-1950 AD, and among lakes over 1700-1950 AD. However, mean SDN showed either non-significant or negative correlations with diatom beta-diversity in similar analyses. These suggest that diatom species turnover was driven by the magnitude of variability in SDN, highlighting the presence and variability of SDN in maintaining freshwater biodiversity in Pacific Northwest.

Chen, R. F., UMassBoston, Boston, USA, bob.chen@umb.edu
Gardner, G. B., UMassBoston, Boston, USA, bernie.gardner@umb.edu
Cherrier, J., Florida A&M University, Tallahassee, USA, jennifer.cherrier@famu.edu

OUTWELLING OF CHROMOPHORIC DISSOLVED ORGANIC MATTER (CDOM) FROM TROPICAL SALT MARSHES

The Gulf of Mexico is characterized by a significant land-ocean boundary, coastal wetlands, shallow estuaries and dynamic carbon exchange across short distances. Of particular interest is the 14,500 km2 of estuarine wetlands that border the Gulf of Mexico, about 2/3 of which are intertidal salt marshes. Very little is known about the magnitude and fate of organic matter that originates in coastal marshes and enters the coastal ocean, even as over half of the US coastal wetlands have been destroyed in the last 50 years. While “outwelling” of significant amounts of organic carbon was hypothesized over 25 years ago, little progress has been made in quantifying this potentially significant flux due to the complexity of the tidal creek-marsh system and the dynamic nature of intertidal and freshwater-driven fluxes. We are combining high spatial (towed vehicle) and temporal (wells, buoys and drifters) resolution observations with discrete biogeochemical sampling in the salt marsh, estuary and coastal waters and spatially explicit modeling to attempt to quantify this important chromophoric dissolved organic matter (CDOM) flux in the Florida Big Bend region.

Chen, R. F., University of Massachusetts Boston, Boston, USA, Bob.Chen@umb.edu

BROADER IMPACTS OF CARBON CYCLE RESEARCH: TEACHING LARGE UNDERGRADUATE COURSES AND PROVIDING PROFESSIONAL DEVELOPMENT FOR TEACHERS

Studies of chromophoric dissolved organic matter (CDOM) in coastal waters are relevant to the global carbon cycle, and as such belong in large introductory environmental and/or ocean science courses for undergraduates. Discussions of my own research with a growing number (from 50 to 280) of major and non-major students within the context of the global carbon cycle has inspired undergraduates to join our research efforts as independent study and work-study students. Stories of field work, role models of graduate students, and opportunities for hands-on research engages an increasing number of diverse students in authentic research. In an attempt to inspire larger numbers of K-12 students, I am involved in several teach-the-teacher activities. Through summer and evening courses offering teacher professional development, I can integrate my carbon cycle research into courses on Energy and Environmental Science that can engage 10s of teachers and, over the years, thousands of K-12 students to conduct authentic inquiry inside and outside of their classrooms. This paper will present two successful models of broader impacts at the university and their impacts on students and science.

Chen, X., Stony Brook University, Stony Brook, USA, xichen2@ic.sunysb.edu
Baines, S. B., Stony Brook University, Stony Brook, USA, sbaines@ms.cc.sunysb.edu
Fisher, N. S., Stony Brook University, Stony Brook, USA, nfsbarker@notes.cc.sunysb.edu

A VIOUS CYCLE. A NON-HOMEOSTATIC REGULATION OF IRON BY A MARINE COPEPOD

Consumers confronted with variable C, N and P in their diet maintain stoichiometric homeostasis by minimizing loss of the limiting nutrient element and excreting more of the nutrient elements in excess. To determine if this paradigm applies to Fe, the copepod Acartia tonsa was exposed to three food species of algae grown under an Fe-replete and an Fe-limited condition. Respiration was 24-40% greater for copepods fed Fe-limited diets, as would be expected given excess dietary organic C. Differences in C and Fe assimilation efficiency and excretion were measured using radiotracer pulse chase techniques. Assimilation efficiencies of C and Fe varied among food algae but were not related to Fe status of food. Contrary to expectation, excretion of Fe was 2-fold faster for copepods fed Fe-limited diets than those fed Fe-replete diets. This pattern suggests that Fe limitation enhances the remineralization of particulate Fe by copepods. The inability of copepods to regulate Fe homeostatically according to imbalances in the diet may increase the likelihood and severity of Fe limitation of these organisms and influence the biogeochemical consequences of such limitation.

Cherrier, J., Florida A&M University, Tallahassee, USA, jennifer.cherrier@famu.edu
Owens, H., Concordia College Selma, Selma, USA, howens@concordiasselma.edu
Morton, S., NOAA-CEHBR, Charleston, USA, steve.morton@noaa.gov

THE EFFECTS OF DISSOLVED ORGANIC MATTER (DOM) ON KARENIABREVIS GROWTH AND TOXIN PRODUCTION

Two sets of time series incubation studies were carried out to evaluate the effect of DOM quality and supply on K. brevis growth and toxin production: a natural 14C uptake tracer study using two isotopically distinct DOM amendments, and a dose-response study using sewage DOM. Increased K. brevis abundances and toxin production were observed in both the sewage and peat moss DOM amendments with toxin production approximately 50% greater in DOM amended vs. control (inorganic nutrients only) cultures. Maximum growth rates were observed in sewage DOM amended incubations. K. brevis cell 14C signatures in sewage and peat moss DOM amendments became depleted over time relative to controls indicating DOM assimilation by K. brevis and/or their cell surface associated bacteria. A positive correlation between toxin production and DOM concentration was observed in dose-response incubations with significantly greater toxin production at higher DOM concentrations. Collectively these results demonstrate that DOM uptake by K. brevis cultures significantly impacts its growth and toxin production and suggests that
DOM supply to coastal systems should be considered when evaluating the potential toxicity associated with HAB outbreaks.

Chiver, E., UBO-IUEM, PLOUZANE, France, Fanny.Chever@univ-brest.fr
Rouxel, O. J., UBO-IUEM-IFREMER, PLOUZANE, France, orouxel@whoelu.gov
Ponzeveera, E., IFREMER, PLOUZANE, France, Emmanuel.Ponzeveera@ifremer.fr

SOURCES AND BIOGEOCHEMICAL CYCLING OF IRON ISOTOPES IN MA- RINE ENVIRONMENTS
Iron (Fe) is now recognized as a limiting nutrient in large regions of world's ocean. Changes in Fe supply to the upper ocean may affect biological productivity and alter rates of carbon sequestration. However, there is a continuing debate over the main sources of dissolved Fe to the global ocean. Fe isotopes are a promising tool to quantify and characterise the various Fe sources to the ocean. Vertical profiles of δ56Fe were obtained, using MC-ICP/MS, in two areas of the oxygen minimum zone in the Pacific affected by contrasted inputs: (1) hydrothermal input from Loih Seamount and (2) shelf input from the Peru Margin. At the coastal Peru margin area, values in the dissolved pool ranged from -0.6 to -0.9‰ in surface waters and from -1.0 to -1.2‰ at the bottom. These values could reflect riverine and diagenetic pore fluids from shelf sediment sources respectively. Hydrothermal plume originating from Loih is characterized by variable and overall negative Fe isotope signatures (values from -0.3‰ to -0.8‰) due to the slow rate of Fe(II) oxidation in the near-field plume.

Chia-Te Chien, C., Research Center for Environment Changes, Taipei, Taiwan ROC, ctcchen1@gate.sinica.edu.tw
Cheng-Ling Hu, C., National Chung Hsing University, Taichung, Taiwan ROC, linghua@gate.sinica.edu.tw
Tse-Hua Chu, T., National Taiwan Normal University, Taipei, Taiwan ROC, th91134@gmail.com
Tung-Yuan Ho, T., Research Center for Environment Changes, Taipei, Taiwan ROC, tyho@gate.sinica.edu.tw

NICKEL LIMITATION OF NITROGEN FIXATION BY TRICHODESMIUM
Oceanic diazotrophic phytoplankton transform dinitrogen to ammonia and impact global nitrogen and carbon cycles. Decoded genome sequences show that oceanic nitrogen fixers contain Ni superoxide dismutase (SOD) and suggest that the nitrogen fixers may partially depend upon Ni for growth. However, the importance of Ni for the growth of nitrogen fixers is not understood. By growing Trichodesmium (Tricho) under trace metal controlled culture media in artificial seawater without adding nitrate and ammonium, we show that the growth of Tricho is strongly limited under Ni depleted condition. In addition, the growth rates are much slower in the South China Sea surface water, in which original Ni concentration is 2 nM, than the natural seawater enriched with 10 nM Ni. The cellular SOD activities of Tricho are positively associated with bioavailable Ni concentrations in ambient seawater and estimated Ni demands for SOD account for at least 20-45% of its intracellular Ni quotas.

Childers, D. L., Arizona State University, Tempe, USA, dan.childers@asu.edu
Turnbull, L., Arizona State University, Tempe, USA, laura.turnbull@asu.edu
Earl, S., Arizona State University, Tempe, USA, steve.earl@asu.edu
Grimm, N. B., Arizona State University, Tempe, USA, nrbgrim@asu.edu

1. MULTI-SCALAR EFFECTS OF URBAN STORMWATER INFRASTRUCTURE IN A SEMI-ARID URBAN CATCHMENT: HYDROLOGIC RESPONSES
Urban ecosystem heterogeneity results from natural and engineered landscape features as well as institutional behaviors. The spatial configuration of urban patch mosaics controls hydrologic responses at all scales. We are investigating how infrastructure type and ecohydrologic connectivity interact to control stormwater runoff characteristics in the Phoenix metropolitan area using several nested watersheds. Previous work comparing desert stream and urban stormwater responses to rain events suggests that urbanization in Phoenix may not lead to flashier discharge, as has been repeatedly demonstrated in wetter cities. In fact, during several Summer 2010 monsoon storm events we found that hydrographs from a large (15500 ha) urban stormwater catchment more closely resembled those of non-urbanized mesic streams than of the desert streams they replaced. Within this large catchment, runoff from small (5 ha) basins was characteristically flashy while hydrographs from medium-sized watersheds (∼100 ha) were more sensitive to stormwater infrastructure type (‘harder’ infrastructure produced markedly flashier discharge than ‘softer’ stormwater features). Ultimately, hydrologic connectivity at larger (>1000 ha) scales significantly dampened stormwater hydrographs, even though a wide mix of infrastructure types characterize this urban watershed.

Chin, J. P., Queen's University Belfast, Belfast, United Kingdom, jchin02@qub.ac.uk
Villarreal-Chiu, J. F., Queen's University Belfast, Belfast, United Kingdom, JVillarreal-Chiu1@qub.ac.uk
Kukalova, A. N., Queen's University Belfast, Belfast, United Kingdom, a.kukalova@qub.ac.uk
Kukalov, L. A., Queen's University Belfast, Belfast, United Kingdom, L.Kukalov@qub.ac.uk
Gilbert, J. A., Argonne National Laboratory, Argonne, USA, jgilbert@jack@gmail.com
Quinn, J. P., Queen's University Belfast, Belfast, United Kingdom, j.quinn@qub.ac.uk
McGrath, J. W., Queen's University Belfast, Belfast, United Kingdom, jm McGrath@qub.ac.uk

PHOSPHONATE METABOLISM IN MARINE BACTERIA
Phosphorus plays a key role in the biochemistry of all life forms and is often a limiting nutrient in the biosphere. As a result, microorganisms possess a series of mechanisms to utilize a variety of sources of phosphorus in addition to its most bioavailable form, inorganic phosphate. Phosphonates contain a stable carbon-phosphorus bond and comprise some 25% of the dissolved organic phosphorus pool in the oceans. Our main aim was to determine the importance of their metabolism by marine bacteria and its contribution to biogeochemical nutrient cycling. We studied the distribution of phosphonate catabolic genes amongst sequenced marine microorganisms and in metagenomic data from the GOS Expedition. Selected strains identified during bioinformatic analysis were found to utilize 2-aminoethylphosphonate, aminoethylphosphonate, methylphosphonate, phenylphosphonate, phosphonacetate and glycolphosphate. Although all strains predicted in silico to metabolize phosphonates utilized these as a phosphorus source only, enrichment culture from N. Ireland coastal waters yielded bacterial isolates with novel, phosphate-insensitive pathways of phosphonate utilization. Their importance will be discussed.

Chislock, M. E., Auburn University, Auburn, USA, mcf0002@auburn.edu
Kaul, R. B., Auburn University, Auburn, USA, rzk0010@auburn.edu
Jernigan, L. M., Auburn University, Auburn, USA, lm0001@auburn.edu
Sarnelle, O., Michigan State University, East Lansing, USA, sarnelle@msu.edu
Wilson, A. E., Auburn University, Auburn, USA, wilson@auburn.edu

IS GRAZER TOLERANCE TO TOXIC CYANOBACTERIA A GENERAL PHE- NOMENON?
While cyanobacteria are typically regarded as poor quality food for zooplankton, recent laboratory studies have revealed that Daphnia may adapt to tolerate toxic cyanobacteria in the diet. Evolution of tolerance to cyanobacteria may have important consequences for food web interactions, but the role of these adaptations in nature is unexplored. Using an 8-week limnocoral experiment, we tested the hypotheses that nitrogen-fixing to phosphorus (N:P) ratios and Daphnia tolerance to toxic cyanobacteria would mediate effects on phytoplankton. Nitrogen-fixing cyanobacteria became dominant in the low N:P (4:1, by atoms) treatment, and Microcystis became domi- nant in the high N:P (28:1) treatment. We subsequently stocked equal densities of six genotypes of Daphnia that vary in tolerance to toxic Microcystis into half of the enclosures. After 8 weeks, all six Daphnia genotypes were equally represented under low N:P (microcystin = 0.04 µg/L) and had no effect on cyanobacteria. In contrast, Daphnia most tolerant of toxic Microcystis dominated under high N:P (microcystin = 0.12 µg/L) and suppressed cyanobacterial biomass. Given that Daphnia suppression of cyanobacteria depended on the dominant phytoplankton in each N:P treatment, our results suggest that Daphnia tolerance of toxic Microcystis does not translate into Daphnia tolerance and control of all cyano bacteria in nature.

Cho, W. W., Woods Hole Oceanographic Institution, Woods Hole, USA, wcho@ whoi.edu
Shank, T. M., Woods Hole Oceanographic Institution, Woods Hole, USA, tshan@ whoi.edu

ASSESSING THE IMPACT OF THE DEEPWATER HORIZON OIL SPILL ON INVERTEBRATES ASSOCIATED WITH DEEPWATER CORAL COMMUNITIES IN THE GULF OF MEXICO
Deep-water coral communities are thought to be vulnerable to disturbance due to their low rates of colonization, growth, and the high levels of host-specificity for associated invertebrates. A major concern resulting from the Deepwater Horizon oil spill is the vulnerability of these deep-water coral communities to the oil spill. Research cruises in 2008 and 2009 established a comparative baseline for changes in benthic community structure. A research cruise in October 2010 will return to some of the sites visited prior to the Deepwater Horizon oil spill. We will assess changes
in community structure, including the impact of the Deepwater Horizon oil spill on coral-associated invertebrates (including ophiuroids, crabs, shrimp, barnacles), and the level of genetic connectivity between populations in the Gulf of Mexico, the Caribbean, and the North Atlantic.

Christian, A. D.; University of Massachusetts Boston, Boston, USA, alan.christian@umb.edu

Dorval, E.; Dorval Initiative de Recherche Ecologique & Consultation, Port-au-Prince, Haiti, emmanis.dorval@gmail.com

Hannigan, R. E.; University of Massachusetts Boston, Boston, USA, robyn.hannigan@umb.edu

PHYSICAL AND CHEMICAL ANALYSIS AND CLASSIFICATION OF LAKE AZUEI, HAITI.

Lake Azuei is Haiti's largest lake, is brackish, is located east of Port Au Prince along the Dominican Republic border, and was considered a productive fishery in the past. The goal of this study is to obtain physical and chemical water column and sediment data from 3 seasons to classify Lake Azuei. In May 2010, we collected water samples at 3 stations, representing the western (A), central (B) and eastern (C) basins, at 2 m depth profile intervals. Basin depths ranged from 10 to 18 m and showed deep stratification based on D.O. and temperature profiles. Average Secchi depth, chlorophyll, nitrogen, and phosphorus were 3.25 m, 2.39 (± 0.39 SD) ug/L, 419.02 (±19.31 SD) ug/L, and 10.58 (± 13.82) ug/L, respectively. Based on the OECD fixed boundary classification scheme, we classified Lake Azuei as mesotrophic. Secchi depth indicated euphotic; chlorophyll indicated oligotrophic; and phosphorus and nitrogen indicated mesotrophic. Additional sampling will be conducted this year. We hypothesize the change in fisheries production is due to a change in trophic status as a result of Lake Azuei being an evaporative lake.

Chu, P. C.; Naval Postgraduate School, Monterey, USA, pchu@nps.edu

MULTI-TIME SCALE ANALYSIS AMONG OCEAN BIOGEOCHEMISTRY TIME SERIES USING EMPIRICAL MODE DECOMPOSITION

Classical techniques for time-series analysis on ocean biogeochemical data rely too strongly on having a constant sampling rate, which poorly adapts to the uneven time recording of biogeochemistry variables; new, more flexible methods issued from Non-Linear Physics are hence required. In this paper, Huang's Empirical Mode Decomposition (EMD) (Huang et al., 1998) was used for the analysis of biogeochemical time series (1996-2006) obtained from the Carbon Retention in A Colored Ocean Project (CARIACO). The main idea of EMD is to estimate a signal as a sum of a trend and superposed oscillations. When this is done for all the oscillations composing a signal, the high frequency time series is called an Intrinsic Mode Function (IMF) and the low frequency part is called the residual. The procedure is then applied again to the residual, considered as a new time series, extracting a new IMF using a spline function, and obtaining a new residual. After the decomposition process is terminated, the EMD method expresses a time series as the sum of a finite number of IMFs and a residual. To measure the degree of temporal correlation of two variables, a method was used to relate couples of modes from different series by calculating the instantaneous phase differences and correlations among the associated modes. The correlation coefficients among the trends of various variables show the long-term linkages and feedbacks in ocean biogeochemical processes.

Church, M. J.; University of Hawaii, Honolulu, USA, mchurch@hawaii.edu

Bottjer, D.; University of Hawaii, Honolulu, USA, dbottjer@hawaii.edu

Karl, D. M.; University of Hawaii, Honolulu, USA, dkarl@hawaii.edu

Letelier, R. M.; Oregon State University, Corvallis, USA, letelier@coas.oregonstate.edu

Viviani, D. A.; University of Hawaii, Honolulu, USA, viviani@hawaii.edu

Zehr, J. P.; University California Santa Cruz, Santa Cruz, USA, zehr@ucsc.edu

NITROGEN FIXATION IN THE NORTH PACIFIC SUBTROPICAL GYRE

Owing to intensive efforts to quantify the roles that nitrogen fixing microorganisms (termed diazotrophs) play in ocean biogeochemistry and ecology, nitrogen fixing organisms have been identified as pivotal components of planktonic food webs and major contributors to net organic matter productivity and carbon export in the open ocean. Merger of field-based measurements on rates of nitrogen fixation with physiological and metabolic underpinnings of these microorganisms. This studies also provide clues into how changes in ocean habitat influence the distributions and activities of nitrogen fixing microorganisms in the sea. In this context, ongoing time-series sampling and analyses of diazotroph abundances and rates of nitrogen fixation have highlighted the importance of seasonal to event scale habitat variability in driving the ecological dynamics of these microorganisms. This presentation will review new research aimed at understanding processes controlling the time and space dynamics associated with ocean diazotrophs, with emphasis on field work being conducted in the North Pacific Subtropical Gyre.

Churchill, J. J.; Hamline University, St. Paul, MN, USA, jchurchill801@hamline.edu

Hembre, L. K.; Hamline University, St. Paul, MN, USA, lhembre@hamline.edu

DO PREY FEAR UNFAMILIAR PREDATORS?: PHYSIOLOGICAL RESPONSES OF DAPHNIA TO NATIVE AND INVASIVE PREDATORS

Studies examining the impact of nonindigenous species often focus on food web or ecosystem effects of the invader. However, few studies have investigated how individual naive populations respond to the presence of a nonindigenous species. This study employs a heart rate (HR) bioassay to assess whether naive prey (Daphnia) exhibit an increase in HR (a fright response) after exposure to kairomones from the spiny waterflea (Bythotrephes longimanus), an invasive zooplankton predator. HR responses of Daphnia from three lakes that differ in predator composition were assayed after exposure to kairomones of three predators (Bythotrephes, fish, and Chaoborus). One of the lakes has been invaded by Bythotrephes and also contains fish and Chaoborus. The other two lakes have not been invaded: one contains fish and Chaoborus, and the other only has Chaoborus. Daphnia from the invaded lake exhibited an elevated HR after exposure to Bythotrephes kairomones while Daphnia from the uninvaded lakes did not. This implies that Daphnia in the invaded lake have adapted to recognize the presence of Bythotrephes, while Daphnia from the uninvaded lakes are naive to this unfamiliar predator.

Cisternas-Novoa, C. A.; Stony Brook University, Stony Brook, USA, cistern@c. sunysb.edu

Lee, C.; Stony Brook University, Stony Brook, USA, Cindy.Lee@sunysb.edu

Engel, A.; Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, Anja.Engel@awi.de

MEASUREMENT OF PROTEINACEOUS AND POLYSACCHARIDE-RICH PARTICLES PRODUCED BY BUBBLING PHYTOPLANKTON EXUDATES

Transparent stainable particles (TSP) were produced in the laboratory by bubbling dissolved exudates released by the diatom Thalassiosira pseudonana. We developed a method to quantify proteinaceous TSP, identified by staining with Coomassie Brilliant Blue and called Coomassie stainable particles (CSP). This method is similar to that used to quantify polysaccharide-rich TSP, identified by staining with Alcian Blue and known as transparent exopolymeric particles (TEP). Measurement of CSP is colorimetric and is quantified relative to a particulate bovine serum albumin standard (in a manner similar to how TEP is quantified relative to xanthan gum). Although this research demonstrates that coagulation of dissolved xyloglucan exudate produces TSP that contain both polysaccharides and proteins, but leaves open the question of whether protein is absorbed onto TEP (as suggested previously) or forms discrete particles. Understanding the chemical composition of TSP would aid in determining sources of these particles in the ocean and their role in biogeochemical processes like aggregation. A colorimetric method to quantify CSP allows faster and more quantitative measurements, providing an efficient tool to investigate their role in seawater.

Claquin, P.; University of Caen Basse-Normandie / PE2M UMR 100 IFREMER, Caen, France, pascal.claquin@unicaen.fr

Napoleon, C.; University of Caen Basse-Normandie / PE2M UMR 100 IFREMER, Caen, France, camille.napoleon@unicaen.fr

Raimbault, V.; University of Caen Basse-Normandie / PE2M UMR 100 IFREMER, Caen, France, virginie.raimbault@unicaen.fr

Assam, H.; University of Caen Basse-Normandie / PE2M UMR 100 IFREMER, Caen, France

Fauchot, J.; University of Caen Basse-Normandie / PE2M UMR 100 IFREMER, Caen, France, juliette.fauchot@unicaen.fr

RELATIONSHIPS BETWEEN NUTRIENT LIMITATIONS, PHOTOSYNTHESIS AND TEP EXCRETIONS: FROM CULTURE STUDIES TO ENVIRONMENTAL IMPLICATIONS

Transparent exopolymeric particles (TEP) can represent large carbon flux and are involved in aggregation mechanisms which can influence sedimentation of phytoplankton blooms. In order to evaluate the impact of nutrient variations on TEP production in coastal ecosystem, the effects of N, P or Si limitations on TEP production and photosynthesis for six coastal planktonic species belonging to three microalgal
phylla (Heteronkontophyta, Dinophyta and Haptophyta) were investigated. Species specific answers were observed which revealed no common regulations of cellular carbon flux from photosynthesis to TEP excretion. In literature, in situ or on cultures studies, increases of TEP production expressed by chlorophyll unit are frequently reported or considered to be associated to nutrient stress. These excretions would reveal an overflow of cellular carbon flux. In our study we showed, in many examples, that the increase of TEPs production per chlorophyll unit was mainly the result of significant decreases of chlorophyll per cell while the TEP production per cell was not always significantly affected. These experimental data were then confronted to field data obtained in the English Channel.

Clardy, T. R., Virginia Institute of Marine Science, Gloucester Point, USA, tclaridy@vims.edu

TERRESTRIAL AND AQUATIC LOCOMOTION IN THE ROCK PRICKLEBACK, XIPHISTER MUCOSUS (COTTIFORMES: ZOARCOIDEI: STICHAEDAE)

Several prickleback species are capable of both aquatic and terrestrial locomotion, which they utilize as an escape response in rocky intertidal habitats. In this study, high-speed video was used to compare the mechanics of aquatic and terrestrial locomotion of Xiphister mucosus. While swimming, tailbeats occur much faster (0.17 sec/beat and 0.53 sec/beat; p = 0.001) and the velocities of the head (11.51 cm/sec and 4.07 cm/sec; p = 0.006) and tail (18.71 cm/sec and 11.18 cm/sec; p = 0.021) are greater than on land. Froude efficiencies during swimming average 0.7536 (+/- 0.0105). On land, tailbeats take much longer and cover a greater distance (4.07 cm/beat and 2.83 cm/beat; p = 0.003), yet the distance traveled by the head (1.72 cm/beat and 1.94 cm/beat; p = 0.246) are similar to aquatic locomotion. Overall, no major mechanical differences in locomotion in Xiphister mucosus are apparent between aquatic and terrestrial locomotion. Terrestrial locomotion appears to be an exaggeration of swimming mechanics.

Cleary, A. C., University of Rhode Island Graduate School of Oceanography, Narragansett, USA, aclerey@gso.uri.edu

Durbin, E. G., University of Rhode Island Graduate School of Oceanography, Narragansett, USA, edurbin@gso.uri.edu

Rynearson, T. A., University of Rhode Island Graduate School of Oceanography, Narragansett, USA, ryneerson@gso.uri.edu

NORTHERN KRILL BRING SEDIMENT CARBON BACK TO THE PELAGIC: DNA IN MEGANYCTIPHANES NORVEGICA GUT CONTENTS SHOWS BENTHIC FEEDING

Krill are key members of many marine ecosystems, as a trophic link between microscopic plankton and large predators such as fish, whales and seabirds. Krill in-situ diet, currently considered mainly planktivorous, is thus important to coral cycling through the ecosystem. We took a novel DNA based approach to measure Northern krill, Meganyctiphanes norvegica, in-situ feeding in the Gulf of Maine. 185 clone libraries were constructed from a PCR with universal primers and a krill-specific Peptide Nucleic Acid blocking probe. The most common prey items were then quantified in individual krill guts with prey species-specific quantitative PCR. We identified an unknown benthic microeukaryote that comprised approximately half of krill diets in the Gulf of Maine. Krill feeding on the sediment is a new pathway for carbon flow from the sediments to the pelagic, opposite to classical carbon flows from surface waters to the sediment. We estimate that over 100,000 tons of carbon are brought back into the Gulf of Maine pelagic ecosystem annually by krill benthic feeding, more than that required by the region's entire fish population.

Chuck, R. E., Department of the Interior, Herndon, USA, Rodney.E.Chuck@boemre.gov

Rassier, M. K., Department of the Interior, Herndon, USA, Michael.Rassier@boemre.gov

Dhanju, A., Department of the Interior, Herndon, USA, Aamardeep.Dhanju@boemre.gov

THE ROLE OF THE UNITED STATES DEPARTMENT OF INTERIOR IN COASTAL AND MARINE SPATIAL PLANNING

Coastal and Marine Spatial Planning is an integral part of the Department of the Interior's (DOI) stewardship responsibilities that extend nearly seamlessly from upland areas to the ocean waters of the outer continental shelf. An overview will be provided of DOI involvement with the Ocean Policy Task Force in the development of the National Policy for the Stewardship of the Ocean, Coasts, and Great Lakes (Executive Order 13547). This policy calls for the creation of a National Ocean Council (NOC), Regional Planning Bodies and the development of the Interagency Information Management System (IMS) and CMSP Data Portal. The creation of a national CMSP process provides a framework to create regional marine spatial plans that are approved by the National Ocean Council. One of the challenges of implementing this new process is that it utilizes existing legal authorities. As a result, governmental agencies such as the DOI will be intricately involved in the implementation of CMSP.

Cobb, R. M., University of Alabama, Tuscaloosa, USA, rncobb@ crimson.ua.edu

Andrus, C. F., University of Alabama, Tuscaloosa, USA, fandrus@geo.ua.edu

Perez-Huerta, A., University of Alabama, Tuscaloosa, USA, aphuerta@as.ua.edu

STRUCTURAL DIFFERENCES IN GROWTH FEATURES OF DEEP-WATER CORALS

Deep-sea and tropical hydrocorals have not been extensively studied as to their use as environmental proxies. Growth rate, skeletal structure, and other fundamental properties have not been measured in most taxa. This research will present data from two species of the family Stylasteridae: Specimens of Stylaster enebeci, a deep-water hydrocoral, were collected off the Charleston Bump (North Atlantic, Blake Plateau) at depths between 400-600m. Stylaster museus, a shallow water species; our samples were collected near the Cayman Islands at 30m depth. During this study both sample sets were examined to determine internal growth features in the carbonate skeleton. SEM imaging was used to characterize and map internal skeletal features, as some apparent growth structures are less than 10µm in size. Ramen spectroscopy, XRD, and geochemical data are used to assess structural properties and variability in different growth features of the colonies. A better understanding of these structures may help determine if skeletal banding indicates growth history, differentiate primary and secondary carbonate growth, and lead to environmental proxy development. XRD was also used to determine the mineral make of the colonies.

Cohen, A., Woods Hole Oceanographic Institution, Woods Hole, USA, acohen@whoi.edu

Bedoya, L., University of Mexico, Puerto Morelos, Mexico, luisc@whoi.edu

Oppo, D., Woods Hole Oceanographic Institution, Woods Hole, USA, doppo@whoi.edu

DECLINING GROWTH RATES OF ATLANTIC CORALS AND THE LINK TO BASIN-SCALE CLIMATE VARIABILITY

An important concern about CO2-induced global climate change is the potential effects on coral reefs and the diversity of ocean life they support. Evidence suggests that ocean warming and acidification could have significant negative impacts on coral reefs. Shifts in basin-scale modes of Atlantic climate variability are also predicted over this century but lack of definitive links to coral reef health make the full impact of global climate change much more difficult to predict. We show that the skeletal growth of important Atlantic reef-building corals in the western tropical and subtropical Atlantic is significantly inversely correlated with AMO and NAO respectively, on multianual timescales. During past negative phases (cool, high productivity), coral growth rates were between 30% and 50% higher than they were during recent positive phases (warm, low productivity). Over much of the 20th century, AMO and NAO accounted for up to 86% of the variability in coral growth. IPCC-AR4 coupled GCM's predict shifts in both the NAO and AMO mean state over this century. These predictions, if realized, could have enormous implications for the future of Atlantic reefs.

Colbert, A., University of Miami - RSMAS, Miami, USA, acolbert@rsmas.miami.edu

Soden, B. J., University of Miami - RSMAS, Miami, USA, bsoden@rsmas.miami.edu

SENSITIVITY OF NORTH ATLANTIC TROPICAL CYCLONE TRACKS TO CLIMATE VARIABILITY AND CLIMATE CHANGE

We examine the relationship between North Atlantic tropical cyclone (TC) tracks and the large-scale steering flow using best-track data for the 1950 to 2007 hurricane seasons. We categorize each cyclone into one of three groups according to their track type. Using NCEP-NCAR Reanalysis data, a westward extension and strengthening of the subtropical high is observed for straight-moving (SM) cyclones, and a recession and weakening of the subtropical high occurs for recurving ocean (RCO) cyclones. When examining the influence of climatological events, a weakening in the subtropical high during El Nino, when compared to La Nina, results in more RCO cyclones. When examining the influence of basin-scale modes of Atlantic climate variability, shifts in basin-scale modes of Atlantic climate variability are also predicted over this century but lack of definitive links to coral reef health make the full impact of global climate change much more difficult to predict. We show that the skeletal growth of important Atlantic reef-building corals in the western tropical and subtropical Atlantic is significantly inversely correlated with AMO and NAO respectively, on multianual timescales. During past negative phases (cool, high productivity), coral growth rates were between 30% and 50% higher than they were during recent positive phases (warm, low productivity). Over much of the 20th century, AMO and NAO accounted for up to 86% of the variability in coral growth. IPCC-AR4 coupled GCM's predict shifts in both the NAO and AMO mean state over this century. These predictions, if realized, could have enormous implications for the future of Atlantic reefs.
Monitoring of outer reef slope thermal profiles by thermograph arrays to 90 m depth in Palau, western Caroline Islands over a decade has revealed highly variable daily water temperatures at mesophotic reef depths. Internal waves produced rapid (0.5-3 hr) temperature changes of 4-10°C while monthly-yearly mean temperatures ranged from 16-29°C at 90 m depths. These monthly-yearly changes were associated with ENSO conditions at depths below about 30 m. During periods with coral bleaching the reef water column was nearly unithermal with little prospect of vertical mixing providing any lowering of shallow water temperatures. A positive correlation between monthly mean sea level and mean water temperatures at depth allows estimation of historic water column thermal structure from tide gauge data. In Palau the deeper reaches of photic reef environments are unlikely to serve as refugia insulated from coral bleaching conditions. The intermittently low temperatures will also limit reef growth to less than 60 m depth despite high light penetration to depth.

**CONCLUSIONS**

Polychlorinated Biphenyls (PCBs), once used in industry, were banned in the U.S. for their adverse health effects; however, due to their chemical properties, PCBs persist in the environment and continue to impact aquatic ecosystems. Our goal was to address the relative influence of sediment vs. aqueous exposure of PCBs to benthic and planktonic fauna. Sediment and water was collected from seven locations with known elevated levels of PCBs in St. Clair Shores, MI, USA. First we evaluated the effects of site-water on Daphnia pulex survival, then we exposed D. pulex to sediment plus PCB-free water, and finally we assessed sediment toxicity (96 hrs) of PCB-contaminated sediments. Site water had no effect on Daphnia survival. Conversely, Daphnia exposed to sediment plus PCB-free water had significantly higher mortality (p < 0.05) compared to contaminated sediments. Remediation efforts focusing on sediment will likely minimize impacts to both benthic and planktonic fauna.

**ACKNOWLEDGEMENTS**

The SaFA is being developed using coastal waters from Puerto Rico where we have shown that we can stabilize samples for up to 3 days without appreciable DNA degradation. The SaFA system is being designed to collect and filter 24 user defined time-stamped water samples of between ~200-500 ml. The filters will be stabilized with a DNA preserving buffer, and following retrieval will be available for downstream laboratory processing. The SaFA is being developed using coastal waters from Puerto Rico where we have shown that we can stabilize samples for up to 3 days without appreciable DNA degradation. The system will enable increased in situ sampling regimes without the need for personnel to be deployed in the field, particularly during dangerous or inconvenient sampling periods. To facilitate adoption by end users, the SaFA is being constructed using predominately commercially available parts, and all information relating to its construction and operation will be downloadable under an open source license. The open source nature of the SaFA will enable end users to evolve the instrument by providing feedback on new designs or applications.
Conley, D. J., Lund University, Lund, Sweden, daniel.conley@geol.lu.se
Dalsgaard, T., Aarhus University, Silkeborg, Denmark, tda@bm.dk
Gustafsson, B., Stockholm University, Stockholm, Sweden, bogen@nex.nu
Hietanen, S., Helsinki University, Helsinki, Finland, susanna.hietanen@helsinki.fi
Jilbert, T., Utrecht University, Utrecht, Netherlands, t.jilbert@geo.uu.nl
Reed, D., Utrecht University, Utrecht, Netherlands, d.reed@geo.uu.nl
Slomp, C., d.reed@geo.uu.nl, Utrecht, Netherlands, slomp@geo.uu.nl
Voss, M., Leibnitz Institute for Baltic Sea Research, Warnemuende, Germany, maren.voss@io-warnemuende.de
Frey, C., Leibnitz Institute for Baltic Sea Research, Warnemuende, Germany, claudia.frey@io-warnemuende.de
Zillen, L., Lund University, Lund, Sweden, Lovisa.Zillen@geol.lu.se

EFFECTS OF HYPOXIA ON NUTRIENT BIOGEOCHEMISTRY IN THE BALTIC SEA

Hypoxia has been intermittently present in the Baltic Sea over the last 8000 years driven by morphometric changes, changes in climate and anthropogenic activities. Hypoxia regulates the biogeochemical cycles of both phosphorus and nitrogen in the water column and sediments. These feedbacks can regulate productivity in the Baltic with benthic fauna playing a significant role in biogeochemistry. Significant amounts of P are currently released from sediments, an order of magnitude larger than annual anthropogenic inputs. Simulations with a reactive-reactive transport model demonstrate that forced reoxygenation of hypoxic deep waters – a suggested engineering solution – has little impact on sedentary P retention, but results in the conversion of organic phosphorus to redox-sensitive iron-bound species. A relapse into hypoxia would release this P to overlying waters, potentially exacerbating hypoxic conditions. The Baltic Sea is unique for coastal marine ecosystems experiencing N losses in hypoxic waters below the halocline and in sediments – both not yet well quantified. We will discuss some of our recent findings from the EU funded BONUS HYPER (Hypoxia mitigation for Baltic Sea Ecosystem Restoration) project.

Cook, A. B., Virginia Institute of Marine Science, The College of William & Mary, Gloucester Point, USA, acok@vims.edu
Sutton, T. T., Virginia Institute of Marine Science, The College of William & Mary, Gloucester Point, USA, tsutton@vims.edu
Galbraith, J. K., NOAA Northeast Fisheries Science Center, Woods Hole, USA, john.galbraith@noaa.gov
Vecchione, M., NOAA National Systematics Lab, Washington D.C., USA, vecchiom@si.edu

VERTICAL DISTRIBUTION OF DEEP-PELAGIC (0-3000 M) FISHES OVER THE CHARLIE-GIBBS FRACTURE ZONE REGION OF THE NORTHERN MID-ATLANTIC RIDGE

Only a tiny fraction of the world’s largest volume of living space, the ocean’s mid-water biome, has ever been sampled. As part of the International Census of Marine Life field project, MAR-ECO; a discrete-depth trawling survey was conducted in 2009 aboard the NOAA ship Henry B. Bigelow to examine pelagic assemblage structure and distribution over the Charlie-Gibbs Fracture Zone of the northern Mid-Atlantic Ridge. The bottom topography in this region ranges from 4500 m in the channel to 700-800 m on top of adjacent seamounts. Sampling was conducted at 11 stations from 0-3000 m using a Norwegian “Krill” trawl with five codends that were collected, with a maximum species diversity and biomass being observed between 700-1900 m. Other key features observed were a strong diel migrating component and frequent captures of putative bathyplagic fishes, shrimps, and cephalopods in the epipelagic zone (0-200 m). The results of MAR-ECO sampling show patterns unlike those previously reported for open ocean ecosystems.

Cooke, S. L., Duke University, Durham, USA, s.cooke@duke.edu

SEASONAL AND SPATIAL DYNAMICS OF NON-INDIGENOUS DAPHNIA LUMHOLTZI IN TWO NUTRIENT-SENSITIVE RESERVOIRS AFFECTED BY MULTIPLE STRESSORS

I recently discovered exotic Daphnia lumholtzi in two water supply reservoirs in North Carolina. Falls Lake and Jordan Lake, deemed “nutrient-sensitive waters”, frequently experience multiple stressors, including excess nutrient and chlorophyll levels. My objectives were to determine (1) if and under what conditions this non-indigenous species may be considered invasive; and (2) if D. lumholtzi dynamics correlate to seasonal and spatial variations in chlorophyll and other water quality parameters in Falls Lake. I sampled zooplankton in Falls Lake over 20 months and nine different sites, concurrent with routine water quality sampling conducted by state officials. Jordan Lake zooplankton were sampled over seven months. D. lumholtzi density and dominance varied widely across sites and season in Falls Lake, and preliminary results suggest that its abundance increases with turbidity. In most sites, D. lumholtzi was present, but copepods were often the dominant group. In contrast, D. lumholtzi was consistently dominant in Jordan Lake, often comprising 95% of the crustacean zooplankton. Further analysis is needed to determine the effects of D. lumholtzi in each reservoir, including its response to algal bloom events.

Conley, S. R., WHOI, Woods Hole, USA, scooley@whoi.edu
Lacey, N., WHOI, Woods Hole, USA, nlacey@whoi.edu
Kite-Powell, H. L., WHOI, Woods Hole, USA, hauke@whoi.edu
Doney, S. C., WHOI, Woods Hole, USA, sdoney@whoi.edu

COULD TODAY’S MOLLUSK HARVESTS SUGGEST TOMORROW'S VULNERABILITY TO OCEAN ACIDIFICATION?

We examine the possible implications of ocean acidification on worldwide mollusk harvests by examining present production, consumption, and export and by relating those data to present and future surface ocean chemistry forecast by a coupled-climate ocean model (Community Climate System 3.1; CCSM3). We identify the “threshold date” when future ocean chemistry will distinctly differ from that of today (2010), and when mollusk harvest levels similar to those of the present cannot be guaranteed. We assess nations’ susceptibilities to ocean acidification-driven decreases in mollusk harvests by comparing their nutritional and economic dependencies on mollusk harvests, overall societal adaptability, and the amount of time until the threshold date. Projected threshold dates for individual countries will occur 14-46 years after 2010. Countries with low adaptability, high nutritional or economic dependence on mollusks, rapidly approaching threshold dates, or rapidly growing populations will therefore be most vulnerable to ocean acidification-driven mollusk harvest decreases. These threshold dates suggest how soon nations should implement strategies, such as increased aquaculture of resilient species, to help maintain current per capita mollusk harvests.

Cooley, S. R., Woods Hole Oceanographic Institution, Woods Hole, USA, scooley@whoi.edu
Benway, H., Woods Hole Oceanographic Institution, Woods Hole, USA, H.Benway@whoi.edu

EDUCATING NON-SCIENTISTS ABOUT OCEAN ACIDIFICATION

As ocean acidification research has exploded worldwide in the past five years, the demand for educational materials explaining this subdiscipline has also rapidly increased. Media attention and public interest have created a need for educational materials targeting a range of ages and backgrounds. As part of the U.S. Ocean Carbon and Biogeochemistry Project’s (OCB’s) mission to support scientific research and provide education and outreach materials, the OCB Project Office has developed and distributed several types of materials intended to teach non-specialists about the state of ocean acidification knowledge. In addition, we cooperated with other organizations to develop and distribute other materials. We will review the ocean acidification outreach materials available for different target audiences developed by OCB and others, we will discuss forthcoming efforts, and we will review opportunities to close existing gaps.

Cooper, L. A., University of Colorado at Boulder, Boulder, USA, leigh.a.cooper@colorado.edu
McCutchan, Jr., J. H., University of Colorado at Boulder, Boulder, USA, jhmcch@colorado.edu
Detmer, T. M., University of Colorado at Boulder, Boulder, USA, thomas.detmer@colorado.edu
Lewis, Jr., W. M., University of Colorado at Boulder, Boulder, USA, lue@spot.colorado.edu

EFFECTS OF LIMESTONE PINE MORTALITY DUE TO MOUNTAIN PINE BEETLE INFESTATION ON STREAM CHEMISTRY

Recently, bark beetles have caused widespread tree mortality across approximately 50 million hectares of coniferous forests from Alaska to Mexico. This study documents effects of tree mortality caused by the mountain pine beetle (Dendroctonus ponderosae) on stream chemistry. Samples were analyzed for carbon, nitrogen, and phosphorus fractions across the Colorado Rockies (54 watersheds) on a single date in Rocky Mountain National Park (185 watersheds). In the 54-watershed study, sites with the highest tree mortality showed a slight but significant increase (approximately 7 ppb) in TDP but no significant changes in nitrogen or carbon fractions.
The 185-watershed study showed a small but significant decrease in phosphorus concentrations. Stepwise multiple regressions showed that elevation, slope, and aspect often affected water chemistry more than tree mortality. Tree mortality equaled approximately 6% of variation in phosphorus for the 54-watershed study and 2% for the 185-watershed study. In contrast to the large effects documented for other types of forest disturbance, tree mortality due to mountain pine beetle infestation has minimal effects on stream chemistry in the Colorado Rockies.

Cordes, E. E., Temple University, Philadelphia, USA, ecordes@temple.edu
Lunden, J. J., Temple University, Philadelphia, USA, jlunden@temple.edu
Roberts, H. H., Louisiana State University, Baton Rouge, USA, hrober3@lsu.edu

ROBERTS REEF: A NATURAL LABORATORY FOR THE EXAMINATION OF THE EFFECTS OF OCEAN ACIDIFICATION ON THE DEEP-WATER CORAL LOPHELIA PERTUSA

Deep-water corals will be among the first to feel the effects of ocean acidification. The continued shoaling of the aragonite saturation horizon will place deep-water coral reefs at risk in the near future. The deep-water coral Lophelia pertusa creates extensive reef-like structures between 300 and 600 m depth in the Gulf of Mexico. Recent data indicate that the majority of these reefs occur below the aragonite saturation horizon. An exception to these findings was a site in Viosca Knoll 906 where we discovered a large L. pertusa reef overlying a cold-water coral carbonate mound. Water samples taken at this site revealed high alkalinity and aragonite saturation state values, as compared to the generally low saturation state of the waters of the deep Gulf of Mexico. These anomalous alkalinity measurements may be attributed to the dissolution of the carbonate cap rock on top of the shallow salt structure below the mound. This apparent alkaline seep in a relatively acidic body of water provides the opportunity for a unique natural experiment on the effects of ocean acidification on scleractinian corals.

Corell, H., Stockholm University, Stockholm, Sweden, hanna@misu.su.se
Moksnes, P. O., University of Gothenburg, Gothenburg, Sweden, per.moksnes@marecol.gu.se
Engqvist, A., Stockholm University, Stockholm, Sweden
Jonsson, P. R., University of Gothenburg, Gothenburg, Sweden, per.jonsson@marecol.gu.se

MODEL SIMULATION OF MARINE LARVAL DISPERSAL DISTANCE AS A FUNCTION OF SPawning TIME, PELAGIC LARVAL DURATION AND VERTICAL POSITION

In this study a hydrodynamic 3D circulation model of the Baltic Sea was used to investigate the influence of life-history characteristics and larval behaviour on the dispersal distance of virtual larvae. The Baltic is a shallow brackish sea with a distinct gradient in salinity and a large longitudinal extension. Numerical experiments were made in three connected basins with different salinity and oceanographic features at four spawning seasons during 2 separate years. In the experiments the different larval swimming depths and three larval duration times were assessed in an orthogonal design, and the dispersal distance and pattern was examined for a total of 3.2 million trajectories. The results show that dispersal distance was mainly determined by larval swimming depth and, to a lesser degree, by the pelagic larval duration, whereas the spawning season, ocean basin and the year simulated had little effects. New empirical data from the Baltic Sea shows that larvae of different species display distinct vertical patterns. Thus, the vertical distribution of the larvae must be understood to properly predict dispersal in marine larvae.

Corinaldesi, C., Polytechnic University of Marche, Department of Marine Science, Ancona, Italy, c.corinaldesi@univpm.it
Dell’Anno, A., Polytechnic University of Marche, Department of Marine Science, Ancona, Italy, a.dellanno@univpm.it
Luna, G. M., Polytechnic University of Marche, Department of Marine Science, Ancona, Italy, g.luna@univpm.it
Danovaro, R., Polytechnic University of Marche, Department of Marine Science, Ancona, Italy, r.danovaro@univpm.it

VIRAL INFECTION AND DECAY IN DEEP-SEA SEDIMENTS

Viral dynamics are the result of the balance between the rates of viral production and decay. To explore the viral balance we have carried out syoptic measurements of viral production and decay rates in over 50 stations in deep-sea benthic ecosystems worldwide spanning a broad range of bottom-water temperatures and trophic conditions. The net viral production and decay rates were significantly correlated, but viral decay did not balance viral production at any of the sites investigated. We estimate that the carbon released by viral decay significantly contributed to the total C released by the viral shunt. Viruses non-infecting prokaryotes can also remain as a potential food source for benthic consumers suggesting that viral decay can play an important role in biogeochemical cycles and benthic trophodynamics.

Cornwell, J. C., UMCES Horn Point Laboratory, Cambridge MD, USA, cornwell@umces.edu
O’Keefe, J., UMCES Horn Point Laboratory, Cambridge MD, USA
Owens, M. S., UMCES Horn Point Laboratory, Cambridge MD, USA, owens@umces.edu
Jordan, T. E., Smithsonian Environmental Research Center, Edgewater MD, USA, jordanth@si.edu
Bailey, E. M., UMCES Chesapeake Biological Laboratory, Solomons MD, USA, bailey@umces.edu
Boynton, W. R., UMCES Chesapeake Biological Laboratory, Solomons MD, USA, boynton@umces.edu

SEDIMENTARY PHOSPHORUS AND NITROGEN FLUXES CHANGE WITH SEASONAL INCREASES IN ESTUARINE SALINITY

Seasonal changes in freshwater discharge results in temporal changes to estuarine salinity distribution. In Maryland coastal plain subestuaries, low warm-season discharge can result in large reaches of the estuary changing from freshwater to oligohaline conditions. In the tidal Patuxent and Potomac Rivers, a diminishment of coupled nitrification-denitrification occurred when saline water intruded into previously freshwater sedimentary environments. The efflux of soluble reactive phosphorus (SRP) from sediments under hypoxic conditions was high due to conversion of iron oxide to iron sulfide minerals. However, elevated fluxes of SRP under aerobic conditions were observed as the salinity “front” moved upriver. Salinity-driven desorption of SRP from iron oxides did not appear to control these higher SRP fluxes; we hypothesize that enhancement of iron sulfide mineral formation with higher sulfite concentrations can rapidly lead to increased SRP fluxes. The intrusion of salinity appeared to increase the supply of both SRP and ammonium from the sediment, resulting in elevated water column inorganic nutrient concentrations, possibly leading to the initiation of cyanobacterial blooms in the Potomac River.

Costas, B. A., University of Connecticut, Groton, USA, barbara.costas@uconn.edu
McManus, G. B., University of Connecticut, Groton, USA, george.mcmanus@uconn.edu

USE OF SPECIES-SPECIFIC PRIMERS TO UNDERSTAND TOP-DOWN CONTROL OF MICROZOOPLANKTON BY MESOZOOPLANKTON

Trophic cascade experiments have shown significant grazing pressure by copepods on ciliates, and high copepod abundance can decimate ciliate populations in many cases. However, these studies are limited to identifying overall grazing pressure – not who is eating whom or the dynamics of these interactions. We have been using species-specific primers (ITS region of the ribosomal genes) and PCR to identify ingested ciliates (Laboea strobilia, Favella sp., Strombidinopsis sp.) in the guts of the abundant copepod Acartia tonsa. Gut transit time is similar to that of phytoplankton-only diets, but the fecal pellets of ciliate-fed copepods are amorphous and disintegrate, making collected pellets of limited use to quantify gut passage. Laboratory experiments show that a single ingested ciliate is detectable, due to the highly amplified nature of the ciliate genome, a phenomenon that likely extends how long DNA is recoverable from copepods post grazing. Our preliminary observations indicate that variation in copy number limits quantification of grazing with this method, but estimates can be made using presence-absence statistics.

Coiter, J. B., University of Minnesota, Saint Paul, USA, cotnez002@umn.edu
Godwin, C. M., University of Minnesota, Saint Paul, USA, ggodwi018@umn.edu
Scott, J. T., University of Arkansas, Fayetteville, USA, jts004@uark.edu

TRADE-OFFS WITH PHOSPHORUS AND CARBON AMONG BACTERIA AND WINNIE-THE-POOH

What are the implications of phosphorus limitation to the carbon cycle? It is well-known that a large fraction of the aquatic ecosystems on the Earth, from freshwater lakes and streams to regions of the open ocean, are limited by the availability of phosphorus (P). Yet little is known about how the availability of P affects the composition and liability of the organic matter produced and decomposed by various biological communities. Most evidence suggests that in oxic waters, organic P-containing compounds are more labile than those containing either nitrogen (N)
or carbon (C) alone, but little is understood about how communities and strains adapt to various levels of P-limitation. How much can they adjust how P is allocated internally and how does allocation into nucleic acids, phospholipids and poly-P affect P-availability to the rest of the ecosystem? Little is known about how bacterial allocation of P into various P-pools affects the production and subsequent degradation of organic matter (OM). We will explore this idea for chemostats, a Great Lake (Superior), and small lakes in Minnesota.

Cotner, S. H., University of Minnesota, Saint Paul, USA, cote002@umn.edu
Cotner, J. B., University of Minnesota, Saint Paul, USA, cote002@umn.edu

STUDENT PARTICIPATION IN RESEARCH EXPERIENCES FOR UNDERGRADUATES

Students participating in the Research Experiences for Undergraduates (REU) site at the University of Minnesota’s Itasca Biological Station and Laboratories (IBSL) conducts research on issues relevant to global change and the hydrologic cycle. Recruitment of students emphasizes diversity, allowing us to build intellectual capital among future scientists from extremely broad perspectives. Through our new “Hip 2 Outreach” (H2O) program, participating students will spend some of their time in the Twin Cities (Minneapolis/St. Paul) and at their home institutions extending the results of their research into K-12 schools. The University’s new Science, Technology, Engineering, and Math (STEM) Education Center will facilitate this effort. As REU participants develop on-site modules to enrich the existing curriculum of area summer programs. Targeted K-12 programs include ethnically diverse area school populations engaged directly in studies of water quality in the Mississippi River. Through an emphasis on how science is communicated to non-scientists, the societal implications of each student’s work will be highlighted. Past program successes (in terms of recruitment, mentoring, and student performance) will be discussed, as well as plans for the new H2O program.

Couse, E., University of Bristol, Bristol, United Kingdom, E.Couse.07@bristol.ac.uk
Ridgwell, A., University of Bristol, Bristol, United Kingdom, andy@sse2.org
Hendy, E., University of Bristol, Bristol, United Kingdom, E.Hendy@bristol.ac.uk

MODELLING THE DECAHAL TO CENTENNIAL IMPACT OF CLIMATE CHANGE ON THE GLOBAL DISTRIBUTION OF CORAL REEF ECOSYSTEMS

Recent advances in Species Distribution Modelling (SDM) techniques provide a new approach for exploring potential shifts in the distribution of shallow water coral reef ecosystems with future climate change. Here we present the results from two different SDM techniques, Maximum Entropy Modelling (a presence-only method) and Boosted Regression Trees (presence/absence). The relative contribution of environmental factors determining present-day coral reef distribution are calculated on a global 1° x 1° grid using reef location data from ReefBase. The two SDM models are projected to output from a fully-coupled General Circulation Model from the Hadley Centre, HadGEM, to give decadal predictions of future coral reef habitat to 2100 under IPCC AR5 future climate scenarios. These results represent a first-order estimation of the impacts of climate change on coral reef ecosystems.

Covish, A. P., University of Georgia, Athens, USA, alanc@uga.edu
Crowl, T. A., Utah State University, Logan, USA, facrowl@gmail.com

THE ROLES OF DOMINANT DECAPODS IN TROPICAL, HEADWATER STREAMS THAT SUSTAIN FRESHWATER ECOSYSTEM SERVICES IN THE LUQUILLO MOUNTAINS, PUERTO RICO

Coastal rivers in the Caribbean are dominated by species derived from marine waters that have evolved complex life cycles requiring upstream migrations of post-larvae and downstream drift of larvae. Many species of fishes, decapods and gastropods occupy headwater streams and their populations change over time in response to natural disturbances such as droughts and hurricane-associated floods as well as in response to human activities such as harvesting of top consumers. Eight decapod species influence the rates of detrital processing of riparian leaf inputs. In-stream breakdown of leaf detritus and biofiltration of suspended organic particulates are critical ecosystem processes that sustain water quality. Enhanced water clarity and nutrient retention along with recreational harvesting of freshwater shrimps and crabs are important ecosystem goods and services. The NSF’s Long Term Ecological Research Program in the Luquillo Experimental Forest, Puerto Rico provides more than two decades of data that indicate how these distinct ecosystem services can be managed to sustain complimentary production functions in different locations within drainage networks where food webs differ in complexity.

Cavene, K. J., University of Delaware/College of Earth, Ocean and Environment, Lewes, USA, kcoyne@udel.edu
Countway, P. D., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA, pcountway@bigelow.org
Pilditch, C. A., University of Waikato, Hamilton, New Zealand, conrad@waikato.ac.nz
Caron, D. A., University of Southern California, Los Angeles, USA, dcaron@usc.edu
Lee, C. K., University of Waikato, Hamilton, New Zealand, charles.lee@gmail.com
Cary, S. C., University of Delaware/College of Earth, Ocean and Environment, Lewes, USA, cary@udel.edu

CILIATES ASSOCIATED WITH MICROBIAL MATS AT GUAYMAS HYDROTHERMAL VENT SITE

Ciliates are ubiquitous in marine ecosystems and form an important link between trophic levels. Little is known, however, about the diversity of ciliates at hydrothermal vents, or about their role in ecosystem function at vent sites. Guaymas Basin, in the Gulf of California, is characterized by hydrocarbon rich sediments, with microbial mats composed of filamentous Beggiatoa spp. We constructed ciliate 18S rRNA libraries using RNA extracted from surface sediments of orange, yellow and white microbial mats, and compared ciliate assemblages to those in sediments not associated with mats. Our results demonstrate that ciliates in Guaymas sediments are diverse, with 104 OTUs when grouped at the 97% similarity level (out of 557 total sequences). Statistical analysis shows a significant clustering of ciliate assemblages from duplicate cores of the same mat suggesting that the mat environment plays a role in structuring the community. Phylogenetic analysis and comparison to ciliate sequences from other environments also reveal the presence of a well-defined clad of deep sea ciliates that may be known only by sequence data.

Craig, J. K, Florida State University, Tallahassee, USA, kevin.craig@bio.fsu.edu
Magelnicki, M. A., National Marine Fisheries Service, Galveston, USA, msha77@yahoo.com
Crowder, L. B., Duke University Marine Laboratory, Beaufort, USA, lcrowder@duke.edu
Rose, K. A., Louisiana State University, Baton Rouge, USA, karose@lsu.edu
Creekmore, S., Louisiana State University, Baton Rouge, USA, screek2@tigers.lsu.edu
Diamond, S. A., Texas Tech University, Lubbock, USA, SDiamond@uwu.edu

EFFECTS OF HYPOXIA ON FORAGING AND ENERGETICS OF ATLANTIC CROAKER IN THE NORTHEASTERN GULF OF MEXICO

The northeastern Gulf of Mexico shelf experiences one of the largest seasonal hypoxic zones in the northern hemisphere. Atlantic croaker is a dominant component of the demersal fish biomass on the shelf during the summer when hypoxia is most severe. Hypoxia-induced shifts in spatial distribution alter the temperature and oxygen conditions that croaker experience. To determine whether this habitat loss has consequences for foraging and growth, we investigated the diet of croaker in and around the hypoxic zone. We then used a bioenergetics model to integrate effects on diet with those on the abiotic conditions experienced by croaker. Our results indicate that croaker probably experience suboptimal temperatures for growth as a result of hypoxia avoidance and shifts in spatial distribution, but that foraging success is often high in the vicinity of the hypoxic zone; perhaps due to increased availability of hypoxia-stressed benthic prey along the margins. These compensatory processes associated with hypoxia avoidance are one potential explanation for the lack of strong hypoxia effects on growth and size structure of croaker observed in the limited studies conducted to date.

Crawley Crawford, K. E., NOAA Living Marine Resources Cooperative Science Center, Hampton University, Hampton, VA, USA, kelly.crawley@myhamptonu.edu
Horodosky, A. Z., NOAA Living Marine Resources Cooperative Science Center, Hampton University, Hampton, VA, USA, andrii.horodosky@hamptonu.edu
Brill, R. W., Cooperative Marine Education and Research Program, Northeast Fisheries Science Center, NMFS, Woods Hole, MA, USA, rbrill@vims.edu
Caddle, J., NOAA Living Marine Resources Cooperative Science Center, University of Maryland Eastern Shore, Princess Anne, MD, USA, joella.caddle@yahoo.com
Johnson, A. K., NOAA Living Marine Resources Cooperative Science Center, University of Maryland Eastern Shore, Princess Anne, MD, USA, akjohnson@umes.edu

ONTOGENY OF VISUAL ECOPHYSIOLOGY IN BLACK SEA BASS (SERRANIDAE: CENTROPRISTIS STRIATA)

Black sea bass (Centropristis striata) are protogynous hermaphrodites that support major commercial and recreational fisheries from Nova Scotia to Florida. Optical
micro- and macrohabitats experienced by this species vary widely throughout ontogenetic development; juveniles inhabit shallow estuarine nurseries and adults migrate to deeper offshore hard-bottom and reef ecosystems. Because there are unavoidable tradeoffs between luminous sensitivity and spatial and temporal resolution in the evolution of visual systems, we examined potential ontogenetic and circadian changes in the spectral sensitivities, temporal properties, and absolute sensitivities of the black sea bass visual system using corneal electroretinography (ERG). Juveniles were less sensitive to dim light than adults under photopic conditions, but both life stages had comparable scotopic sensitivities. Flicker fusion frequencies of juveniles were faster than those of adults. Spectral sensitivities were broadest for juveniles and blue-shifted in adults, consistent with migration from coastal waters that are maximally penetrated by green-yellow wavelengths to deeper coastal water maximally penetrated by blue-green wavelengths. Collectively the visual systems of juvenile and adult black sea bass thus correlate with thephotoclimatic experience by each respective life stage.

Crespo-Medina, M., University of Georgia, Athens, USA, mcrespo1@uga.edu
Hunter, K. S., University of Georgia, Athens, USA, kshunter@uga.edu
Slaughter, J., University of Georgia, Athens, USA, jsb2b4@uga.edu
Vossmeyer, A., University of Georgia, Athens, USA, avossmeyer@goooglemail.com
Montoya, J. P., Georgia Institute of Technology, Atlanta, USA, montoya@gatech.edu
Diercks, A., University of Southern Mississippi, USA, az
Asper, V., University of Southern Mississippi, USA, veron.asper@usm.edu
Subramaniam, A., Lamont-Doherty Earth Observatory, USA, ajit@ldeo.columbia.edu
Villareal, T. A., University of Texas, Austin, USA, tvillareal@mail.utexas.edu
Joye, S. B., University of Georgia, Athens, USA, mandyjoye@gmail.com

Patterns of Water Column Aerobic Methane Oxidation Rates in Response to the Deepwater Horizon Hydrocarbon

Typical rates of aerobic oxidation of methane in the Gulf of Mexico water column range from 0.02 to 27 nmol/L/d in the upper water column to single digit nmol/L/d at depths near areas of active methane seepage. We measured the methane concentration and the rates of aerobic methane oxidation during several expeditions following the BP oil spill on early May, May/June, and August/September 2010. In situ dissolved methane concentrations were determined using headspace extraction and gas chromatography, and methane oxidation rates were determined using the tritiated methane radiotracer technique. In early May, methane oxidation rates ranged from 0.02 to 27 nmol/L/d and by early June, rates had increased to 0.05 to 495 nmol/L/d; maximum activity was observed in methane rich subsurface plumes. A considerable decrease in the rates were observed during August/September, when the rates ranged from 0.04 to 3.28 nmol/L/d. Molecular techniques including quantification of methanotrophic populations and expression of the methane monooxygenase enzyme (mmo gene), were used to better understand how injection of gas into the deep waters altered methane cycling in Gulf of Mexico waters.

Crotoof, A. B., University of Nevada, Reno, Reno, USA, acrootof@gmail.com
Saito, L., University of Nevada, Reno, Reno, USA, lsaito@cnbr.unr.edu
Rosen, M. R., U.S. Geological Survey, Carson City, USA, mrosen@usgs.gov
Marchand, E. A., University of Nevada, Reno, Reno, USA, marchand@unr.edu
Nishonov, B., Hydrometeorological Research Institute, Tashkent, Uzbekistan, bnishonov@mail.ru
Lamers, J., ZEF-UNESC German-Uzbek Khorezm Project, Urgench, Uzbekistan, jlamers@zef.uzpak.uz

Assessing Water Resources in Khorezm, Uzbekistan for the Development of Aquaculture

The Khorezm province in northwestern Uzbekistan has over 450 small lakes that could be developed for aquaculture, diversifying the local economy and providing rural communities with an additional food source. Water quality as well as biological and physical characteristics were analyzed for 13 lakes in Khorezm to determine if the lakes could support semi-intensive aquaculture. From June 2006 to October 2008, the lakes were sampled monthly for temperature, pH, salinity, specific conductance, dissolved oxygen, nutrients, trace metals, pesticides and toxicity to organisms. Fish, zooplankton, macroinvertebrates and algae samples were also collected. Lake cores from 12 lakes were collected in 2008, 2009, and 2010 to provide information about lake age and to determine historical pesticide concentrations. Preliminary results indicate the lakes are relatively young (originating within the last century), have low contaminant levels, have self-sustaining food webs, and are therefore well-suited for aquaculture. However, ammonium levels were occasionally high, which could affect fish survival. Although the lakes appear relatively healthy, future changes in land use and water management may reduce the feasibility of developing semi-intensive aquaculture in the Khorezm lakes.

Crotoof, A., University of Nevada, Reno, Reno, USA, acrootof@gmail.com
Lassaline, A., University of Nevada, Reno, USA
Fitzgerald, C., The Planning Center, Reno, USA

Students Educating Students: International Water Development Through Education

In response to the worldwide need for improved potable water supplies, students in the Hydrologic Sciences Graduate Program at the University of Nevada, Reno founded the Student Association for International Water Issues (SAWII) in the fall of 2000. SAWII’s mission is to increase access to clean drinking water for those in need through sustainable water resources development projects that educate and empower communities. To accomplish these objectives, SAWII funds University of Nevada, Reno students travel to developing countries, where students teach community-wide manual well drilling and water catchment workshops. SAWII students focus on education and train locals within the community with the necessary skills to maintain and enhance their water resources. For example, on a trip to Nkambe, Cameroon, SAWII helped a village drill a well using the Water for All International Manual Well Drilling method. Since SAWII left in 2009, the community has been able to drill two additional wells that are providing clean, easily accessible water to the village.

Crosson, L. M., University of Washington, Seattle, USA, lisa418@uw.edu
VanBlaricom, G., University of Washington, Seattle, USA, glnv@mboxuw.edu
Roberts, S. B., University of Washington, Seattle, USA, ss230@uw.edu
Friedman, C. S., University of Washington, Seattle, USA, carolynf@uw.edu

Influence of Rickettsial Pathogens on the Endangered Black Abalone Haliothis Chaceraomi: Differential Susceptibility and Host Response

Withering Syndrome (WS) is a bacterial disease of abalone caused by a rickettsia-like organism (WS-RLO), resulting in up to 99% losses of black abalone in central and southern California, including San Nicolas Island (SNI). Beginning in 2002, abalone densities at SNI have trended upward which led us to hypothesize that disease pressure led to the development of WS resistance in selected populations. We tested this hypothesis in the lab using WS selected abalone from SNI and “naive” or non-selected abalone from Carmel, CA (CAR). Significantly lower mortality was observed in SNI abalone than CAR (p<0.05), while no differences in survival were observed between control groups (p>0.05). Microscopic examination suggests that resistance may be related to host response to initial infection. Using a transcriptional approach, we recently began to compare host response to better understand mechanisms associated with WS resistance. During this study, we also observed a novel bacterium, morphologically distinct from but sharing the same tissue tropism as the WS-RLO. Current data suggest that the new bacterium may dampen losses associated with the WS-RLO.

Crosswell, J. R., University of North Carolina at Chapel Hill, Institute of Marine Sciences, Chapel Hill, USA, jrc62@email.unl.edu
Hales, B., College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, USA, bhales@coas.oregonstate.edu
Wetz, M., Texas A&M University-Corpus Christi, Corpus Christi, Michael.Wetz@tamucc.edu
Paerl, H., University of North Carolina at Chapel Hill, Institute of Marine Sciences, Chapel Hill, USA, hpaerl@email.unl.edu

Air-Water CO2 Fluxes and Inorganic Carbon Dynamics in a Microtidal, Eutrophic Estuary

Given the high degree of monitoring effort required to accurately determine air-water CO2 fluxes in coastal margins, does the short term variability and significance in the coastal carbon cycle justify the means? In an effort to address this question we examined air-water CO2 fluxes in the microtidal, eutrophic Neuse River Estuary, NC (NRE) from June 2009 to July 2010. High-resolution, continuous-flow pCO2 surveys were conducted biweekly spanning the longitudinal axis of the estuary with lateral transects conducted in each of three hydrologically distinct sections. High temporal variability of air-water CO2 fluxes was closely associated with climatological events affecting estuarine stratification and riverine discharge. The greatest flux rate increase over a 10 day period (~301 to 54.76 t-C d-1) was observed during the steepest rise (~500%) in river discharge. Smoother trends were observed on seasonal
the geographic extent, duration and the severity of oxygen depletion in the Bay has generally increased. For the last ten years (2001 -2010) we investigated early season onset of oxygen depletion by measuring oxygen, temperature, salinity and chlorophyll concentrations at 20 stations in the Bay each June (full water column casts with a SeaBird CTD). The slope and depth of the pycnocline along the Bay axis governed the location of oxygen-depleted bottom waters. We calculated the rates of marine-water subduction and the attendant reduction in oxygen concentration by plotting oxygen changes along isopycnals extending from the mouth of the Bay to its upper reaches. We relate these findings to records of precipitation and nutrient loading from the watershed.

Cuker, B. E., Hampton University, Hampton, USA, benjamin.cuker@hamptonu.edu

THE ASLO MULTICULTURAL PROGRAM: 22 YEARS OF BUILDING DIVERSITY IN THE AQUATIC SCIENCES

In 1990, the American Society of Limnology and Oceanography (ASLO) created a program to increase the ethnic diversity of its membership and the aquatic sciences. The ASLOMP (ASLO Multicultural Program) is a NSF funded partnership with Hampton University that is built around annual ASLO meetings. The program includes special workshops, fieldtrips, a student symposium, and a cadre of meeting-motors to aid the students. Typically 65 students and a dozen mentors participate in ASLOMP each year, resulting in 1,109 student participations over the last 21 years, comprised of 70% undergraduates and 30% graduate students) different students from 190 different institutions. The participant group was diverse, consisting of 35% African-Americans, 32% Hispanic, 7% Native-Americans, and 4% Pacific Islanders. Females comprised 66% of participants overall, and in recent years account for as much as 80%. About 42% of students return for subsequent meetings. Thirteen former students who have earned Ph.D. degrees returned as mentors.

Cullison, S. E., The University of Montana, Missoula, USA, cullisonse@gmail.com

DeGrandpre, M. D., The University of Montana, Missoula, USA, michael.degrandpre@umontana.edu

SHORT-TERM AND SEASONAL PH, P CO2, AND SATURATION STATE VARIABILITY IN A CORAL REEF ECOSYSTEM

Autonomous sensors for pH and pCO2 were deployed on Media Luna reef, Puerto Rico over three seasons to quantify pH, air-sea CO2 fluxes and CaCO3 saturation states on the reef. Reef pH and pCO2 ranged from 7.89-8.17 and 176-613 μatm, respectively, over the year, with temperature changes explaining ~50% of the observed seasonal variation in pCO2. The remaining seasonal variability was primarily due to net remineralization of mangrove-derived organic carbon and net CaCO3 production. The diel pH and pCO2 cycles were also large, nearly encompassing the seasonal range of variability. The reef was a source of CO2 to the atmosphere during the summer and fall and a sink during winter, with a net annual flux to the atmosphere of 1.2 mol m-2 year-1. We show, by comparison with calculations from discrete samples, that the pH-pCO2 pair can be used to accurately quantify calcium carbonate saturation states. The modeled aragonite and calcite ranged from 2.7-4.7 and 4.1-7.0, respectively: In contrast to pH and pCO2, seasonal changes in saturation state do not dominate the variability because of the offsetting effect of temperature.

Cumber, N. O., University of South Alabama, Mobile, USA, noel@disl.org

Gundersen, K., University of Southern Mississippi, Stennis Space Center, USA, Kjell.Gundersen@usm.edu

ORTHMANN, A. C., University of South Alabama, Mobile, USA, aortmann@disl.org

ARCHAEOAL COMMUNITY STRUCTURE IN TWO DISTINCT SEASONALLY HYPOXIC ZONES IN THE NORTHERN GULF OF MEXICO REGION

With increased anthropogenic influences such as eutrophication and the onset of intense and accelerated climate change, it is hypothesized that hypoxic zones will increase in size and longevity. To understand these systems, it is important to identify the role of coastal microbial communities including how hypoxia influences microbial assemblages. Archaea represent one group that has been poorly characterized in coastal systems. Two seasonally hypoxic regions were studied, one off the coast of Mississippi and one in Mobile Bay, AL. Surface and bottom samples were collected from both sites from before the onset of hypoxia until the return of oxic conditions. Archaeal 16S rRNA was quantified using qPCR and fingerprints were generated using PCR and denaturing gel electrophoresis (DGGE). Results show a
relatively low number and diversity of Archaea with the number of bands ranging from 4 to 15. The archaeal community structure differed greatly between the two hypoxic regions as well as within regions revealing variation in both abundance and diversity throughout the hypoxic events.

Cumbo, V. R., California State University Northridge, Northridge, USA, vcumbo@csun.edu

Fan, T. Y., National Museum of Marine Biology and Aquarium, Pingtung, Taiwan ROC, tyanf@nmmba.gov.tw

Edmunds, P. J., California State University Northridge, Northridge, USA, peter.edmunds@csun.edu

EFFECTS OF TEMPERATURE AND CO₂ ON THE PHYSIOLOGY OF THE EARLY LIFE STAGE OF POCILLOPORA DAMICORNIS

To determine the effects of global climate change (GCC) on corals, brooded larvae of *Pocillopora damicornis* were exposed to 442 and 604µatm pCO₂ at 25°C and 29°C. Incubations lasted 24hr and were repeated daily over 4d of larval release, after which respiration, dark-adapted quantum yield of PSII (Fv/Fm) and mortality were measured. The only significant interactive effect of temperature and pCO₂ involved respiration, with larvae respiring at a higher rate at high temperature and high pCO₂; in contrast, release day affected all variables. Larvae from day 1 and 2 responded positively to treatments, with increased respiration at high temperature, increased Fv/Fm at high temperature and pCO₂, and decreased mortality at high pCO₂; larvae from day 3 and 4 responded negatively to treatments. Together, these results demonstrate that while GCC can negatively impact coral larvae, the short-term consequences differ among consecutive release days, which we construe as an effect of development. Evidence that coral larvae are resistant to GCC, at least at some point in their development, suggests that constitutive mechanisms may be available to resist aspects of GCC.

Curran, M. C., Savannah State University, Savannah, USA, currcanc@savannahstate.edu

Aultman, T. V., Savannah Christian Preparatory School, Savannah, USA, taulmnan1@comcast.net

Hoover, K. M., Esther F. Garrison School of Visual and Performing Arts, Savannah, USA, Krista.Hoover@savannah.chatham.k12.ga.us

Gerido, L., Southwest Elementary School, Savannah, USA, Leona.Gerido@savannah.chatham.k12.ga.us

Sukkestad, K. E., Johnson High School, Savannah, USA, Kathryn.Sukkestad@savannah.chatham.k12.ga.us

DEVELOPING K-12 ACTIVITIES AS PART OF BROADER IMPACTS: HOW TO USE UNIVERSITY RESEARCH TO ADDRESS OCEAN LITERACY

Ocean literacy concepts can be woven into K-12 activities ranging from animal biology to coastal processes. We will present activities that we have designed as part of a collaboration between a Savannah State University scientist and K-12 teachers in the community. Grass shrimp provide a model for us to discuss the Ocean Literacy concept of predator-prey dynamics; we explain how a small, commercially unimportant species has a great impact on the food web. Other activities focus on mollusks or environmental issues. All activities emphasize mathematics. We encourage students to develop presentation skills by talking to their class or developing a PowerPoint presentation, complete with music and a script.

Currie, W. J., Great Lakes Lab for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, Canada, warren.currie@dlf-mpo.gc.ca

Koops, M. A.

Mandrak, N. E.

Cudmore, B.

MODELING RISK OF ASIAN CARP ESTABLISHMENT IN THE LAURENTIAN GREAT LAKES USING A FOOD-WEB APPROACH

Invasion of the Silver (*Hypophthalmichthys molitrix*) and Bighead Carp (H. nobilis) into the Great Lakes is expected to disrupt the ecosystem and the annual $7 billion economy. In established areas of Mississippi R. they have reduced diversity and now account for 90% of fish biomass. To investigate this threat, Canada and the US have formed the bi-national Asian Carp Risk Assessment. Successful invasions require not only arrival, but also survival, establishment and spread. Asian Carp range is unlikely restricted by temperature, but rather food resources and spawning habitat. Asian Carps differ from other invading freshwater fish in that they are active, large bodied opportunistic planktivore which consumes a wide variety of prey. Silver carp are considered phytoplanktivorous, consuming phytoplankton down to 3-4 microns (including cyanobacteria), but also consume zooplankton. Bighead Cper are primarily zooplanktivorous but also consume algal food. Both consume pests. Here we discuss the bioenergetics and food requirements of Asian Carp. High-risk regions within the Great Lakes will be identified that could support establishment based on estimates of algal production and zooplankton including microbial food web densities.

Cusick, K. D., University of Tennessee, Knoxville, USA, kduarueh@utk.edu

Minkin, Jr., S. C., University of Tennessee, Knoxville, USA, sminkin@utk.edu

Wilhelm, S. W., University of Tennessee, Knoxville, USA, wilhelm@utk.edu

Sayer, G. S., University of Tennessee, Knoxville, USA, sayler@utk.edu

THE PLASMA MEMBRANE COPPER TRANSPORTER AS A MOLECULAR TARGET OF SAXITOXIN IN MICROBIAL CELLS

Saxitoxin is produced by multiple dinoflagellates and cyanobacteria. While there are many studies addressing its ecological function, no data exist that define its effects on microbial systems. Prior microarray analyses with the model eukaryote *Saccharomyces cerevisiae* identified multiple copper and iron homeostasis genes as differentially regulated following saxitoxin exposure. We compared transcripts and proteins from these genes under conditions of excess copper, excess iron, copper starvation, and saxitoxin. Patterns of gene regulation upon exposure to saxitoxin were identical to excess iron and very similar to excess copper, with the exception of FET3. This gene, which encodes a multicopper oxidase involved in high-affinity iron uptake, was derepressed under conditions of excess iron, copper starvation, and saxitoxin, with repression greatest in saxitoxin-exposed cells. The expression and localization of Fet3p-GFP following saxitoxin exposure resembled that seen in copper-starved cells. However, localization of the copper transporter (Ctr1p-GFP) in saxitoxin-exposed cells was similar to that of copper-exposed cells. Based on these data, a molecular model is proposed in which saxitoxin binds to the copper transporter of yeast cells, reminiscent of sodium channel binding in mammals.

Cyphers, T. W., Winona State University, Chatfield, MN, USA, TCyphers06@Winona.edu

Mason, C. M., Fairleigh Dickinson University, Madison, NJ, USA, cmason@student.fdu.edu

Wisenden, B. D., Minnesota State University Moorhead, Moorhead, MN, USA, wisenden@gmail.com

MALE FATHEAD MINNOW TERRITORY DEFENSE BEHAVIOR BASED ON PATERNITY

Fathead minnows (*Pimephales promelas*) are cyprinids that demonstrate alloparental care. Male fathead minnows are responsible for the care and defense of offspring. The objective of this study was to see if male fathead minnows recognize if the eggs they guard are genetically theirs. To answer this, mock nests were created and observed for territory defense behaviors. To test territory defense of males, three possible predators were placed in the males’ territory: a fathead female, a stickleback, and a breeding male. Nests were put through either a switch or sham-switch. Switches involved taking two nests and swapping them, while a sham-switch involved picking up the nest and placing it back to its original position. Numbers in defense behaviors towards sticklebacks and females stayed consistent, while actions toward breeding males decreased after being switched. Two things were evident: sticklebacks and female fatheads are not viewed as major threats toward the brood like breeding males. Also, allo-sired eggs were defended to the same extent as self-sired eggs by male fathead minnows. This may be because males use allo-sired eggs to attract new females.

Dabney, B. L., Wayne State University, Detroit, USA, aw1923@wayne.edu

Kashian, D. R., Wayne State University, Detroit, USA, dkashian@wayne.edu

TOXICITY DIFFERENCES BETWEEN DREISSENA POLYMORPHA (ZEBRA MUSSEL) AND D. BUGENSIS (QUAGGA MUSSEL)

Dreissena bivalves, *Dreissena polymorpha* (zebra mussel) and *Dreissena bugensis* (quagga mussel) are two invasive mussels in the Great Lakes that have greatly influenced the local water quality and fauna. Zebra mussels initially spread across the Great Lakes, but have recently been displaced by quagga mussels. Differences between these two species including their tolerance to various environmental stressors have not been well studied. We compared the differences in polychlorinated biphenyls (PCBs) toxicity between these two species under different environmental regimes: temperature and conductivity. Both species were exposed to water from canals in St. Clair Shores, MI, USA, a site known to be heavily contaminated with PCBs. Preliminary studies indicate that *D. polymorpha* has a higher tolerance to PCB
contamination than D. begoniensis, and temperature has no effect on toxicity to either species. Knowing the effects of contamination on the two invasive species can lead to better management of these Great Lakes invasive species. Also, understanding the differences between these organisms will contribute to our understanding of behavior in these mussels and how they continue to persist in the Great Lakes.

**Effects of Enhanced Nitrogen Deposition and Changing DOC Concentrations on Phytoplankton in Boreal Lakes**

In recent decades, boreal lake ecosystems in the U.S. have experienced enhanced nitrogen (N) deposition and changing precipitation patterns. These changes can lead to N enrichment as well as altered influx of dissolved organic material (DOM), which can affect water transparency as well as nutrient influx. To investigate the combined effects of N enrichment and changing DOM influx on phytoplankton in boreal lakes, we conducted a series of experiments in which we established a gradient of N concentrations, and tested the shading versus nutrient addition effects of DOM additions in a factorial design with the N gradient. Experiments were conducted in two lakes, one N limited and one N&P co-limited. As expected, N additions increased chlorophyll concentrations in the N limited lake, but not the N&P co-limited lake. While the shading effects of DOM did not alter chlorophyll concentrations in both lakes, with chlorophyll concentrations more than double those in control treatments. Our results suggest that changing DOM influx will have widespread effects on phytoplankton production across boreal lakes.

**A Comparison of Free-Living and Particle-Associated Community Composition and Function**

We investigated the relationship between microbial community composition and function by comparing DNA clone libraries, RNA clone libraries, and extracellular enzyme activities of particle-associated and free-living microbial communities. We focused on polysaccharide degradation, since extracellular enzymatic hydrolysis is the first step in organic matter remineralization, and carbohydrates constitute a large fraction of living and detrital marine organic matter. Surface water from coastal North Carolina was gravity filtered into 3um “particle-associated” and 0.2um “free-living” fractions. From these filters, we constructed the clone libraries and measured enzyme activities using fluorescently-labeled polysaccharides. Free-living and particle-associated bacteria hydrolyzed different suites of substrates. However, clone library analysis suggested that the overall community composition among the size fractions was similar. There were significant differences between active (RNA) and extant (DNA) communities in both size fractions. The parallel community and enzyme data indicate that small differences in bacterial community composition can lead to great differences in the suite of enzymatic “tools” that allow them to access different fractions of organic carbon.

**The Influence of Hypoxia/Anoxia on Silicate Concentrations in the Baltic Proper (Baltic Sea)**

Decreasing silicate (Si) concentrations are seen in numerous water bodies, and recently it was found that Si is in risk of becoming a limiting in the Baltic Sea. Some of this decrease is attributed to eutrophication, when intensified siliceous algae blooms and subsequent sedimentation of biogenic silica exhaust the Si pools in the water column. Another consequence of the eutrophication is the spreading of anoxic conditions. Several studies have shown that silica fluxes and dissolution rates of biogenic silica might be larger during low oxygen conditions. In a recent Si budget of the Baltic Sea there seems to be a silica source below the halocline due to the export of DSI from the deep boxes and biogeochemical processes. Can the eutrophication have both sink and source affects of silica in the Baltic Sea? Present study aims to analyze the variation in silica due to variation in oxygen concentrations. A stationwise regression analysis showed a significant positive relationship between Si and oxygen. However, the intrusion of water from the North Sea gave a significant impact on the nature of this relationship.

**Tropical Stony Corals Diseases: Interactions Between Environmental Contamination and Microbial Infections**

We investigated the involvement of bacteria in the appearance of “White Syndrome” (WS), a term used to refer to any disease causing acute tissue loss in corals and leaving the white skeleton exposed. We collected WS-diseased and healthy corals from two reefs (Manado, Indian Ocean and Fiji, Pacific Ocean). By using culture-dependent and -independent techniques, we found that a large fraction of WS-affected corals was associated with high prokaryotic and Vibriosp. abundances. Among isolated species, Vibrio harveyi and Vibriocorallilyticus were the most represented isolates. The pathogenicity of two V. harveyi strains, isolated from diseased corals, was demonstrated by the failure of Koch's postulate. Additional experiments were conducted on the impact of five contaminants (including pharmaceutical and personal care products) on wild hard corals of the Astrolabio reef (Fiji). We demonstrated that these compounds were able to induce bleaching on the corals and favor the probability of prokaryotic-mediated coral infections. Our results suggest that several Vibriosp. species are potentially associated with the White Syndrome of scleractinian corals. The White Syndrome, however, is characterized by different etiologies and Vibriosp. species can act as opportunistic pathogens. We conclude that pharmaceutical and personal care products can favor coral disease outbreaks, representing a potential risk for both the direct and indirect effects on coastal tropical ecosystems.
Picocyanobacteria were diverse and with groups similar to those found in other oceanic regions. The majority of sequences had closest matches to other uncultivated environmental clones, but were easily assignable at classical phyla level, including dinoflagellates, stramenopiles, prasinophytes, haptophytes and cryptophytes.

Dave, A. C. | Duke University, Durham, USA, apurva.dave@duke.edu
Lozier, M. S., Duke University, Durham, USA, s.lozier@duke.edu
Gerber, L. M., Duke University, Durham, USA, lmv@duke.edu
Palter, J. R., Princeton University, Princeton, USA, jpalter@princeton.edu
Barber, R. T., Duke University, Durham, USA, rbarber@duke.edu

STRAITIFICATION AND PRODUCTIVITY IN THE SUBTROPICS

Strengthened stratification of the upper ocean due to global warming is generally expected to inhibit marine primary productivity in the subtrtropics, based on the supposition that increased water column stability will decrease vertical mixing and consequently the entrainment of deep nutrients into the euphotic zone. We analyze time-series data from the subtropical North Atlantic (BATS) and North Pacific (HOT) and demonstrate that productivity in these regions is not correlated with stratification on interannual time scales over the observational record. Although basin-wide climate processes have been suggested to impact local stratification and vertical nutrient supply, we find no evidence in the HOT record of a strong or consistent linkage of this type. The lack of correlation between stratification and productivity may reflect a lack of sufficiently strong interannual physical forcing and/or the influence of other factors that affect mixing and nutrient supply, such as wind mixing, buoyancy forcing and mode water dynamics. Changes in the mid-latitude wind field could also impact subtropical productivity via changes in horizontal Ekman nutrient fluxes and wind-forced thermocline/ nutrientline structure.

Davenport, E., morgan state university, baltimore, USA, Eric.Davenport@noaa.gov
Fan, C., Morgan State University, Baltimore, USA, cunlei.fang@morgan.edu
Govoni, J., National Oceanic and Atmospheric Administration, Beaufort, USA
Anderson, J., Allen | Hamilton, Lexington Park, USA

DESCRIPTION OF A DYNAMIC NPZD MODEL THAT SIMULATES HURRICANE EFFECTS ON SECONDARY PRODUCTION

A four compartment nutrient, phytoplankton, zooplankton and detritus (NPZD) dynamic model was developed to simulate changes in primary and secondary production after the hurricane passage. Perturbation of in situ measurements of wind speed, river discharge, nutrients, temperature, and salinity are used to simulate hurricane conditions. Hurricane and non-hurricane simulation results for phytoplankton and zooplankton are compared to characterize and predict its ecological impacts. Parameter sensitivity analysis indicates that small changes in the zooplankton grazing coefficient will result in large changes in zooplankton stocks. Behavior analysis show that the model will maintain a stable equilibrium with adjustments to environmental inputs (i.e., wind speed, temperature, nutrients, and river discharge). Perturbation of nominal wind speed inputs to category 4 hurricane wind speeds in simulations adjusted by depth, salinity, and nutrients displayed enhanced levels of destabilization and recovery of zooplankton and phytoplankton for adjustments of depth greater than 50m. The robustness of the model to perturbations suggest it could be used to forecast qualitative stability of secondary production after hurricane passage in estuarine and shallow coastal systems.

Davis, C. E. | University of Liverpool, Liverpool, United Kingdom, cdavis2@liv.ac.uk
Mahaffey, C., University of Liverpool, Liverpool United Kingdom, mahaffey@liv.ac.uk
Palmer, M. R., NERC National Oceanography Centre, Liverpool, United Kingdom, rolm@pol.ac.uk
Sharples, J., University of Liverpool and NERC National Oceanography Centre, Liverpool, United Kingdom, jls@pol.ac.uk
Wolff, G., University of Liverpool, Liverpool, United Kingdom, wolff@liv.ac.uk

ARE SHELF SEAS A NET SOURCE OF DISSOLVED ORGANIC PHOSPHORUS TO THE PHOSPHORUS LIMITED NORTH ATLANTIC?

Coastal seas are highly productive due to the diapycnal mixing of nutrients across the thermoline, which sustains summertime subsurface chlorophyll maxima (SCM). During the summers of 2008, 2009 and 2010 phosphorus dynamics were studied in the nitrate-limited Celtic and Irish Seas and the potential accumulation of dissolved organic phosphorus (DOP) and subsequent export to the P-limited Atlantic Ocean was assessed. Dissolved organic phosphorus, phosphonomesters, phosphate and particulate phosphorus concentrations were measured along with algal phosphatase activity (APA). Phosphate fluxes were calculated from turbulent kinetic energy measurements. Results show that when stratification followed spells of enhanced mixing and larger phosphate fluxes across the thermoline, DOP accumulated in the surface layer where remineralisation rates were low. During stratified periods with modest phosphate fluxes, DOP production generally exceeded consumption and subsurface DOP-maxima were coincident with the SCM. Mixing exported DOP to bottom waters, where it was remineralised by bacteria. Consistently well mixed regions like the Irish Sea exhibited more P-stress and had less DOP export potential. Thus, seasonally stratified shelf seas are potentially a source of DOP to the North Atlantic.

Davis, T. W., Stony Brook University, Southampton, USA, timothy.walter.davis@gmail.com
Gobler, C. J., Stony Brook University, Southampton, USA, christopher.gobler@stonybrook.edu

DIFFERENTIAL ECOLOGY OF TOXIC AND NON-TOXIC STRAINS OF MICROCYSTIS DURING BLOOMS EVENTS

Microcystis blooms are comprised of toxic and non-toxic strains that are morphologically indistinguishable. Using quantitative molecular techniques, we sought to elucidate the effects of nutrients, temperature, and zooplankton grazing on toxic and non-toxic Microcystis strains during blooms on the US east coast (VT, NY, MD) by quantifying the microcystin synthetase gene (mcyD) and rRNA gene, 16S. We found that concurrent experimental increases in temperature and phosphate concentrations often yielded the highest growth rates of toxic Microcystis cells. Furthermore, toxic and non-toxic strains were promoted by different forms of nitrogen (N) with inorganic N stimulating the growth of toxic strains. These results suggest that future inorganic nutrient loading and climatic warming may additively promote toxic Microcystis populations. Natural populations of microzooplankton and mesozooplankton grazed toxic and non-toxic strains of Microcystis at equal frequencies and rates during bloom events suggesting that these zooplankton have developed a tolerance to microcystin and that the ability to produce this metabolite does not provide a defense from grazing. Implications of these findings regarding the ecology of toxic Microcystis blooms will be discussed.

Dawson, M. N., University of California, Merced, USA, mdawson@ucmerced.edu

EVOLUTIONARY CONTEXTS FOR GELATINOUS ZOOPLANKTON BLOOMS

Predictions of the future population dynamics of jellyfishes and salps are poorly constrained, in part because modern data are gappy and in part because recent discussions have tended to treat the pelagic medusa, comb-jellies, and salps as a single functional group under an umbrella term 'jellyfish'. These 'jellyfish' are expected to thrive in waters that are eutrophic, warmer, dysoxic, and/or lacking competition from larval fish, and so all jellyfish are implied to increase in all places experiencing climate warming, environmental degradation (including coastal development), and overfishing. Yet cnidarian medusae, pelagic comb-jellies, and salps display great diversity in form and function, in part a legacy of their different ancestors and a consequence of the different pelagic environments into which they evolved. I will explore what the evolutionary history of these pelagic taxa may tell us about their current and future dynamics. The pelagic environment is a challenging environment in which different strategies to make a living are employed by diverse gelatinous zooplankton. Thus, contemporary and future population dynamics of pelagic medusae, comb-jellies and salps are, and are likely to be, varied.

Davies, R. D. | National Institute of Standards and Technology/University of Pau, USA, russell.davies@noaa.gov
Rose, D. G., U.S. Fish and Wildlife Service, Homer, USA, Dave_Rose@fws.gov
Donard, O. F., University of Pau, Pau, France, olivier.donard@univ-pau.fr
Moors, A. J., National Institute of Standards and Technology, Charleston, USA, amanda.moors@noaa.gov
Pugh, R. S., National Institute of Standards and Technology, Charleston, USA, stacy.vanderpol@noaa.gov
Vonder, S. S., National Institute of Standards and Technology, Charleston, USA, stephen.long@nist.gov
Vocke, R., National Institute of Standards and Technology, Gaithersburg, USA, robert.vocke@nist.gov
Mann, J., National Institute of Standards and Technology, Gaithersburg, USA, jacqueline.mann@nist.gov
COASTAL INFLUENCES ON MERCURY ISOTOPE FRACTIONATION PATTERNS IN ALASKAN SEA BIRD EGGS

Mercury mass dependent (MDF) and mass independent (MIF) isotope fractionation have recently been documented in natural aquatic environments. Previous work showed that seabird eggs can be used to detect lower mercury MIF in Alaskan marine food webs at higher latitudes with seasonal ice compared to ice-free regions. Differing degrees of mercury photoreduction is believed to be the mechanism driving variability in MIF in this environment. The current study investigates other environmental factors that may contribute to variation in mercury isotope signatures in this region. We found that seabird eggs (Uria spp., Larus spp.) from coastal colonies in Norton Sound exhibit higher mercury concentrations, and lower mercury MIF than more oceanic colonies. Norton Sound is strongly influenced by the Yukon and Kuskokwim Rivers and has historically heavy gold mining. These terrestrial derived mercury sources are probably isotopically distinct from atmospheric/oceanic sources, and subject to different biogeochemical cycling and photochemistry (e.g. turbidity and dissolved organic carbon) than the open ocean. Mercury MIF shows promise as a tool for studying photochemistry-related environmental changes and for distinguishing mercury sources in marine food webs.

Becker, P. R., National Institute of Standards and Technology, Gaithersburg, USA, paul.becker@nist.gov
De Beer, D., Max-Planck-Institute for Marine Microbiology, Bremen, Germany, debeer@mpi-bremen.de
Feseker, T., Ifm-Geomar, Kiel, Germany, feseker@ifm-geomar.de
Boetius, A., Max-Planck-Institute for Marine Microbiology, Bremen, Germany, aboetius@mpi-bremen.de
Foucher, J., Ifremen, Bre, France, foucher@ifremen.fr
Olu, K., Ifremen, Bre, France, olu@ifremen.fr
Mienert, J., University in Tromso, Tromso, Norway, jienert@uit.no
Schlueter, M., AWI, Bremerhaven, Germany, Michael.Schlueter@awi.de
Waldmann, C., MARUM, Bremen, Germany, waldmann@marum.de
German, C., WHOI, Woods Hole, USA, cgerman@whoi.edu
Yoerger, D., WHOI, Woods Hole, USA, dyoerger@WHOI.edu
Camilli, R., WHOI, Woods Hole, USA, rcamilli@WHOI.edu
Kinsey, J., WHOI, Woods Hole, USA, jkinsey@WHOI.edu

CONSEQUENCES OF SPECIES LOSS FOR THE ABILITY OF COMMUNITIES TO RECOVER FROM A SIMULATED HEAT WAVE

We studied the importance of community structure on the recovery of biomass production after a heat wave in spatially heterogeneous metacommunities of marine benthic diatoms of the Baltic Sea. We specifically tested how subdominant species may contribute to resilience after the heat treatment. The experimental metacommunity consisted of 10 naturally occurring species. We manipulated community structure by creating four different communities: 1) all 10 species, 2) the dominant producer removed, 3) the most heat-resistant species removed and 4) both the dominant producer and the most heat-resistant species removed. When the dominant producer was removed two other species increased to dominate the community. These communities showed better recovery after the heat wave than the communities with the dominant producer present, but the total biomass production was lower. Our results show that the communities without a dominant producer were more resilient to a simulated heat wave by maintaining community functioning while undergoing change. This ability to resist changes and regenerate functions could be addressed to a shift in dominant species that was more heat tolerant, but less productive.

De Carlo, F. H., University of Hawaii, Department of Oceanography, Honolulu, USA, edecarlo@soest.hawaii.edu
Drupp, P. S., University of Hawaii, Department of Oceanography, Honolulu, USA, drupp@hawaii.edu
Mackenzie, F. T., University of Hawaii, Department of Oceanography, Honolulu, USA, fredm@soest.hawaii.edu
Shamberger, K., NOAA/PMEL, Seattle, USA
Maenner-Jones, S., NOAA/PMEL, Seattle, USA
Muscielewics, S., NOAA/PMEL, Seattle, USA
Sabine, C. L., NOAA/PMEL, Seattle, USA
Feely, R. A., NOAA/PMEL, Seattle, USA

OCEAN-ATMOSPHERE EXCHANGE OF CO2 ON CORAL REEFS OF OAHU, HAWAII

Three buoys deployed in coastal waters of Oahu have produced multiyear high temporal resolution CO2 records in differing coral reef settings. The records allow us to elucidate the influence of forcing mechanisms and biochemical cycles on the composition of carbonate system parameters in the water column and ultimately the exchange of CO2 between the ocean and atmosphere on hourly to seasonal cycles. Although primary productivity in nearshore waters is strongly impacted by rainfall and land runoff, albeit for relatively short durations, calcification depends more on the physical setting of the reef and chemical conditions controlled by dominant biogeochemical processes. The CRIB-MC02 buoy deployment from 2005 to 2008 in southern Kanehoe Bay demonstrated how high frequency data are necessary to characterize the impact of short-term local climatic changes on carbonate system parameters. Subsequent data sets show all Oahu sites to be sources of CO2 to the atmosphere on annual scales, but they can be short term sinks. Ranges of pCO2 and variability vary dramatically between buoys deployed offshore Honolulu and those in lagoonal and barrier reef sites of Kanehoe Bay.

de Kluijver, A., NIOO-CMEM (KNAW), Yerseke, Netherlands, a.dekluijver@nioo.knaw.nl
Schoon, P., NIOZ, Den Burg, Netherlands, p.schoon@nioz.nl
Schouten, S., NIOZ, Den Burg, Netherlands, schouten@nioz.nl
Downing, J. A., Iowa state University, Ames, IA, USA, downing@iastate.edu
Middelburg, J. J., Utrecht University, Utrecht, Netherlands, j.j.middelburg@hugur.knaw.nl

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potential CO₂ control on compound-specific fractionation. For food-web interactions, we used carbon isotope signatures to specifically examine CO₂ control on phytoplankton and bacteria coupling (based on polar-lipid derived biomarkers) via dissolved organic carbon (DOC), since this coupling can be particularly vulnerable to changes in dissolved CO₂.

DeMuts, K., Louisiana State University, Baton Rouge, USA, kdemuts1@lsu.edu
Cowen, J. H., Louisiana State University, Baton Rouge, USA, jbcowan@lsu.edu
Walters, C., The University of British Columbia, Vancouver, Canada, c.walters@fisheries.ubc.ca

AN ECOPATH MODEL OF THE NORTHERN GULF OF MEXICO WITH AN ADDED FUNCTION TO FACILITATE SIMULATIONS OF FISHERIES SPECIES RESPONSE TO HYPOXIA.

The Northern Gulf of Mexico (NGOMEX) has the most prominent hypoxic zone in the US as a result of Mississippi River water input. Given the high economic value of NGOMEX fisheries, it is important to investigate the effect of hypoxia on ecosystem health and the need to include potential impacts of hypoxia on fisheries species in management efforts. In order to simulate this, an ecosystem model is built in Ecopath that includes key fisheries species and the components of their food web (e.g. phyto- and zooplankton and other fish species). The focal area is the region of the NGOMEX where hypoxia has been recorded. The Ecopath model is a stand-alone product, and has value as a virtual presentation of the NGOMEX, elucidating trophic interactions and energy flows and pools present in the system. Differential species responses to low oxygen levels are expected to generate complex indirect effects of hypoxia. With the addition of an empirical species-specific oxygen function, this differential response of fisheries species to variable oxygen levels and fishing effort can be simulated using Ecosim as well as Ecospace.

De Troch, M., Ghent University, Ghent, Belgium, marleen.detrouch@ugent.be

BACTERIA ON FAECAL PELLETS OF HARPTACTICOID COPEPODS: TROPHIC UPGRADING AT THE PLANT-ANIMAL INTERFACE

Faecal pellets make up a significant fraction of the global flux of organic matter in oceans, and the associated bacterial communities are a potential food source for marine organisms. However, these communities remain largely unknown and are neglected in trophic studies at the plant-animal interface. In a lab experiment, the bacterial communities on faecal pellets of the benthic harpacticoid copepod Paramphiascella fulvofasciata feeding on the diatoms Navicula phyllepta and Seminavis robusta were analysed. Next to DGGE profiling, isolated bacteria were characterised by means of partial 16S rRNA gene sequencing. The composition of the bacterial microflora on faecal pellets differed according to the original food source, the age of the faecal pellets and the copepod's identity. Additional bacteria on the faecal pellets were found to originate from the copepod's digestive tract. The trophic upgrading of faecal pellets through bacterial colonization can guarantee the copepod's energy requirements and production, especially during periods of low algal abundance or low-quality primary production. The close interaction between bacteria, faecal pellets, diatoms and consumers are crucial to organic matter processing and nutrient cycling in the sea.

Deary, A. L., Virginia Institute of Marine Science, Gloucester Point, USA, aldeary@vims.edu

COMPARATIVE ONTOGENY OF THE ORAL JAWS IN SIX GENERA OF SCIAENIDAE FROM THE CHESAPEAKE BAY: RELATIONSHIP TO DIET AND HABITAT

Starvation and predation are the main causes of larval mortality; by studying the ontogeny of structures that are used for feeding, such as the oral jaws, better predictions regarding larval survival may be devised. Adult drums (Sciaenidae) occupy a diversity of habitats and it has been demonstrated that the morphology of the feeding apparatus can influence the exploitation of essential fish habitat and the strategy utilized for prey capture. Adults of closely related species show segregation in feeding niches determined by the mouth position, dentition, and structure of the oral jaws. Benthic feeding species have a more inferior mouth position, relatively longer premaxillae, and enlarged ascending processes of the premaxillae. Little research has investigated the ontogenetic shifts in the oral jaws in larval sciaenids.

This presentation focuses on the anatomy and ontogeny of the oral jaws in six genera of Sciaenidae that have representatives in the Chesapeake Bay; comparisons will be made to the freshwater drum Aplodinotus grunniens. Clearing and staining techniques were used to examine the structure of the oral jaws in larval and post-larval (juveniles and adults) specimens. No differences in tooth structure or density were observed in the specimens. The species that forage in the water column as adults had a larger lower jaw to head length ratio and a smaller ascending process on the premaxillae compared to species that are benthic foragers as adults.

De Bossuyt, L., Smithonian Marine Station at Fort Pierce, Fort Pierce, USA, debossuyt@si.edu

FOLLOWING THE SCENT OF OPPORTUNITY: REVEALING THE CHEMICAL ECOLOGY OF FISH FORAGING AGGREGATIONS

Marine fish often aggregate for foraging and spawning over coral reefs and other productive areas. Yet, the chemosensory cues these mobile organisms use to direct their behaviors are largely unknown. Recent studies have revealed that dimethylsulfoniopropionate (DMSP), an algal metabolite, may play a role in the foraging ecology of marine fish through its mechanism of release into the environment via zooplankton grazing and algal cell damage. Though DMSP has been widely studied for its role in plankton physiology and climate regulation, it may also serve as a means for predatory and planktivorous fish to eavesdrop on trophic interactions and time their arrival to exploit transient foraging opportunities. Here we present new research into how DMSP and other compounds released during foraging events vary between foraging aggregations, as well as among seasons, over coral reefs. Plankton-based trophic cascades, which release DMSP and other compounds into the environment, produce informative chemical signatures which we show can drive fish behavior. Understanding the chemosensory landscape over coral reefs will provide a basis for assessing how changing chemical environments will impact reef fish assemblages.

Deem, R. R., Washington State University, Vancouver, USA, bridget.deemer@wsu.edu
Harrison, J. A., Washington State University, Vancouver, USA, john_harrison@washington.edu
Henderson, S. M., Washington State University, Vancouver, USA, steve_henderson@washington.edu

DAM SPILL IS A HOT MOMENT FOR MICROBIAL NITROGEN REMOVAL IN A EUTROPHIC RESERVOIR

The microbially mediated removal of biologically available nitrogen (N) in aquatic ecosystems is an important ecosystem service. Reservoirs are thought to be sites with disproportionately high N removal rates. Previous work indicates that thermal stratification and resulting hypolimnetic hypoxia can reduce rates of microbial N removal. We hypothesized that reservoir releases may re-supply oxidized N to sediment microbial communities, thus boosting microbial removal rates. We measured bottom water N₂ concentrations using the MIMS N₂:Ar technique before and during a large dam spill to investigate whether a large water release could facilitate a hot moment for N removal. We measured significant accumulation of bottom-water N₂ both before and during the dam spill. Linear regressions reveal that N² production was nearly an order of magnitude higher during the spill (3 µmol N₂ L⁻¹ d⁻¹, R²=0.97, p<0.001, n=7) than during the stratified summer period (0.5 µmol N₂ L⁻¹ d⁻¹, R²=0.97, p<0.05, n=4). While seasonal changes in system N removal rates are thought to be controlled largely by temperature, these results show that physical mixing can exert an important control on process rates.

DeGermyn, R. J., Umeå University, Umeå, Sweden, richard.degerman@eng.umu.se
Anderson, A., Umeå University, Umeå, Sweden, agneta.anderson@eng.umu.se

THE EFFECT OF CHANGES IN TEMPERATURE AND SUBSTRATE SUPPLY ON THE GROWTH AND COMMUNITY COMPOSITION OF MARINE BACTERIA

To evaluate the effect of changes in temperature and substrate availability on the bacterial growth rates, biovolumes and community composition, an annual study was performed in the northern Baltic Sea. Each experimental set followed a 2x5 treatment design with three replicates, with two temperatures (in situ and in situ + 4 °C) and five nutrient concentrations. Both nutrient enrichment (yeast extract) and temperature increase yielded significant differences in bacterial growth and biovolumes (p<0.001). Data clearly showed that the lowest nutrient concentration was not enough to support high growth, causing a dependence of nutrient addition to obtain significant increase in growth due to temperature. Thus there was an interactive effect by temperature and nutrient availability on bacterial growth rates. The
most obvious effects on species composition were between low and high nutrient additions and for the largest temperature increase. These results support the concern that climate change might lead to a shift towards heterotrophy in many aquatic environments. However, these effects seem to be minor in oligotrophic systems.

Dekas, A. E., California Institute of Technology, Pasadena, USA, dekas@caltech.edu
Lee, R. W., Washington State University, Pullman, USA, rwlee@wsu.edu

BOWLES, M., University of Georgia, Athens, USA, marshall.bowles1@gmail.com
Joye, S., University of Georgia, Athens, USA, mjoyeruga.edu
Orphan, V. J., California Institute of Technology, Pasadena, USA, vorph@caltech.edu

BENTHIC NITROGEN FIXATION DETECTED AT DIVERSE DEEP-SEA SITES
Biological nitrogen fixation is a critical process in the oceans, however, deep-sea benthic diazotrophy has not been well characterized. Previously, we found that the ANME archaea, anaerobic methane oxidizers in marine sediments, are able to fix nitrogen. In the present study, we investigate the distribution of nitrogen fixation at methane seeps (Mound 12, Costa Rica; Eel River Basin, USA; and Monterey Canyon, USA) and whale falls (Monterey Canyon, USA) up to 2900m deep, by incubating sediment slurries with 15N. Nitrogen fixation was detected as 15N enrichment in 100%, 75%, and 40%, of the sediment cores examined from methane seep sites (n=6), whalefalls (n=4) and background sediment (n=5), respectively. Nitrogen fixation rates were highly spatially variable, both laterally and with sediment depth, with the highest rates in methane seep sediment observed within the methane-sulfate transition zone. Additionally, nitrogen fixation was often dependent on or enhanced by the addition of methane at all sites, implicating the ANME archaea in the process. Our results suggest that benthic nitrogen fixation is concentrated at sites of natural carbon loading, but may be widespread throughout the deep-sea.

del Giorgio, P. A., Université du Québec à Montréal, Montreal, Canada, del.giorgio.paul@uqam.ca
St-Pierre, A., Université du Québec à Montréal, Montreal, Canada, st-pierre.anick@uqam.ca
Lapierre, J. F., Université du Québec à Montréal, Montreal, Canada, jfrancoislapierre@gmail.com
Vachon, D., Université du Québec à Montréal, Montreal, domvachon@gmail.com
Ducharme-Riel, V, Université du Québec à Montréal, Montreal, Canada, veronique.riel@hotmail.com
Fauteux, L., Université du Québec à Montréal, Montreal, Canada, lisa.fauteux@gmail.com

MAJOR ROLE OF BEAVER DAMS IN THE REGIONAL CARBON DIOXIDE AND METHANE BUDGET IN THE BOREAL REGION OF QUEBEC.

Dramatic declines in hunting and predation pressure in the past decades have resulted in a large increase in beaver populations throughout North America. Beaver dams are hot spots of biogeochemical activity, and in particular, of CO2 and CH4 fluxes. Here we present results of a large-scale survey of beaver dams in the Abitibi region of Northern Quebec. The region is dominated by mixed boreal forest boreal, and beaver dams now cover from 1 to over 3% of the territory. We sampled a wide range of beaver dam types that exist in this landscape, and found widespread and strong energy limitation of zooplankton growth.

DeMott, W. R., Indiana-Purdue University, Fort Wayne, USA, demott@ipfw.edu
van Donk, E., NIOO Center for Limnology, Nieuwervek, Netherlands, e.vandonk@nioo.knaw.nl

A TEST OF ALGAL DEFENSES AGAINST DAPHNIA GRAZING IN PHOSPHO-RUS-LIMITED MICROCMS

The effectiveness of algal defenses was tested by manipulating grazers (Daphnia) and algal composition (single species cultures and mixtures of an undefended and a digestion resistant one). The experiment was run for 25 d in eighteen 10-L carboys under mesotrophic conditions that quickly lead to strong P-limitation of algal growth. After day 6, Daphnia showed very poor survival and reproduction in the digestion resistant (Oocystis) treatment relative to the undefended (Ankistrodesmus) and mixed treatments, even though Daphnia growth was P-limited in the undefended and mixed treatments. Algal dynamics and Daphnia growth assays showed that Oocystis’ defenses were much stronger than expected from growth assays with P-sufficient cultures. Over the final 19 d, Ankistrodesmus declined sharply in the mixed algal Daphnia treatment (mean±SE, r=0.24±0.03 d-1) while Oocystis was stable in the same microcosms (r=0.005±0.016 d-1) and both species were stable in microcosms without Daphnia. Algal-P-limitation enhances algal defenses, favoring high abundance of well-defended algal and strong energy limitation of zooplankton growth.

Tunin-Ley, A., Ifremer, Arcachon, France, Alina.Tunin.Ley@ifremer.fr
Denis, K., University Of Mons, Mons, Belgium, Kevin.Denis@umons.ac.be
Tunin-Levy, A., Ifremer, Arcachon, France, Alina.Tunin.Ley@ifremer.fr
Maurer, D., Ifremer, Arcachon, France, Daniele.Maurer@ifremer.fr
Grosjean, P., University Of Mons, Mons, Belgium, Philippe.Grosjean@umons.ac.be

STATISTICAL ERROR CORRECTION OF ZOO/PHYTOIMAGE IDENTIFICATION BY PARTIAL MANUAL VALIDATION OF SUSPECT PARTICLES
Manual validation of all predicted items recently became a standard practice in automatic recognition of plankton. This semi-automated identification, although faster than fully manual processing of the samples, remains time-consuming. We present here an original method where only the most suspect, automatically identified, particles are manually validated. Statistical analysis of this partial validation, combined with a mathematical modeling of the error, allows to optimize the predic-
tion of the abundance per group. As an example, this technique is applied to an artificial mixture of known composition containing 5 different groups digitized with the FlowCAM and classified by Zoo/PhytoImage with 18% of global error (from 32% to 10% per group). Manual validation of the 20% most suspect particles decreases the global error down to 9% (from 19% to 1% per group). Statistical correction of the remaining error further reduces the error down to 3% (from 12% to 0.2% per group). Moreover, ecological or biological information can be used to better detect suspect particles. As far as we know, it is the first time that such metadata are used to correct prediction error.

**deRada, S., Naval Research Laboratory, Stennis Space Center, USA, derada@nrlssc.navy.mil**

**Ladner, S., Naval Research Laboratory, Stennis Space Center, USA, sherwin.ladner@nrlssc.navy.mil**

**Casey, B., Naval Research Laboratory (QNetQ), Stennis Space Center, USA, brandon.casey.ctr@nrlssc.navy.mil**

**Arnone, R. A., Naval Research Laboratory, Stennis Space Center, USA, robert.arnone@nrlssc.navy.mil**

**Jolliff, J. K., Naval Research Laboratory, Stennis Space Center, USA, jason.jolliff@nrlssc.navy.mil**

**USING NUMERICAL OCEAN MODELS TO TEST AND VALIDATE EMPIRICAL FORECASTING SYSTEMS**

A 4Km-resolution bio-optical-sensing Gulf of Mexico ocean model (deRada et al., 2008) is used to test and validate forecasting systems whose predictions are solely derived from in-situ and satellite measurements. Observational data are fraught with so many limitations that validation of these empirical systems is unfeasible; thus, a model-based approach is developed whereas model output is used to produce synthetic observations in order to afford a "controlled" validation and assessment of the predictive skill of Navy forecasting systems such as 3DOG (Ladner et al.) and OpCast (Casey et al.). Model-derived fields are used as input to these systems, and also as "truth" to evaluate their predictions at multiple forecast scales. In order to quantify the affinity of these systems under prescribed conditions, perturbations (e.g. cloud-cover, number/location of gliders) are introduced to mimic the nature of observational data. These metrics can then be used in optimizing resource allocation, sampling, and other pragmatic factors affecting operations. The methodology demonstrated here elucidates a novel technique for testing and validation of empirical systems whose inherent uncertainties and predictive skill cannot otherwise be easily quantified or accurately measured.

**Detrás, Y., Universidad de Puerto Rico, Mayagüez, Puerto Rico, yasmin.detres@upr.edu**

**Almodóvar, L., University of Puerto Rico, Mayagüez, Puerto Rico, lalulita_2006@yahoo.com**

**Romero, A., University of Puerto Rico, Mayagüez, Puerto Rico, abmer_18@hotmail.com**

**Hernández, W., University of Puerto Rico, Mayagüez, Puerto Rico, william.hernandez@upr.edu**

**Mas, E., USDA - NRCS, Mayagüez, Puerto Rico, edwin.mas@pr.usda.gov**

**SALT FLAT VEGETATION FOR COASTAL CONSERVATION BUFFERS IN PUERTO RICO**

Land-based activities around Puerto Rico and the Caribbean Islands represent a potential threat to marine life due to increase in sediments, nutrients and pollutants to coastal waters. Resulting phytoplankton blooms and eutrophication may particularly harm coral reefs that have already experienced an 80% decline due to natural and anthropogenic disturbances. Coastal vegetation buffers acts as natural filters reducing the negative impacts of agricultural practices thereby improving water quality and protecting marine biodiversity. Effectiveness of vegetation buffers depends on selection of appropriate plant species, attributes, adaptability and site characteristics. This study is the first known effort to identify an appropriate salt flat vegetation to be used in coastal buffer zones in Puerto Rico. Percentages of ground and foliar cover, soil slope, conductivity, pH and nutrients were determined at four undisturbed salt flat areas. Among the twenty two identified species, Spartina patens was the most abundant and Spartina patens showed the highest ground cover reaching 64 percent. The data obtained and recommendations to concerning conservation agencies will be presented.

**Deutsch, B., Stockholm University, Stockholm, Sweden, barbara.deutsch@itm.su.se**

**Hamburg, C., Stockholm University, Stockholm, Sweden**

**Mörth, M., Stockholm University, Stockholm, Sweden**

**TRACING RIVERINE INPUTS OF DISSOLVED ORGANIC MATTER INTO THE BALTIC SEA ECOSYSTEM**

A multiple stable isotope approach with δ13C-, δ15N- and δ34S values of DOM was applied to investigate the importance of riverine inputs of DOM for the Baltic Sea ecosystem. Samples were taken in the salinity gradients of two major rivers draining the southern parts of the Baltic Sea, which is densely populated and dominated by agricultural land use (Odra and Nemanus) as well as from the Kalix River which is located in the mainly forested and sparsely populated northern part of the Baltic Sea. The isotope data was used in an end-member mixing analysis (EMMA) to calculate the terrestrial DOM fractions. To further characterize the DOM in Baltic Sea surface waters additional samples were taken and analyzed for DOM isotopic composition along the Baltic Sea salinity gradient during a transect cruise from the North Sea to the Bothnian Bay.

**Devol, A. H., University of Washington, Seattle, USA, devol@uw.edu**

**Whitney, H. R., U.S. Army Corps of Engineers, Seattle, USA, hw whitney@gmail.com**

**Mordy, C. W., NOAA Pacific Marine Environmental Laboratory, Seattle, USA, Calvin.W.Mordy@noaa.gov**

**Shull, D. H., Western Washington University, Bellingham, USA, David.Shull@wwu.edu**

**DENITRIFICATION AND THE SOURCE OF THE NITRATE DEFICIT IN BERING SEA SHELF WATERS.**

Using N* (N* = N – 16PO4 +2.9; where N=[NO3 + NO2 + NH4]) we investigated the N-deficit (deficit relative to the mean oceanic N:P) in Bering Sea shelf waters. A section along the 70 m isobath during spring showed a well mixed water column and a persistent N-deficit of about 700 mmoles N m-2 in the north, decreasing to 400 mmoles N m-2 in the South. During summer a mixed layer developed and the deficit decreased to 550 mmoles N m-2 in the north and 200 mmoles N m-2 in the south. Nearly all of the decrease from winter to summer occurred in the mixed layer, likely due to some combination of advection and non-Redfield nutrient uptake. Over the winter, the nitrate deficit in the surface was reestablished by sedimentary denitrification and some advection from offshore. During 2010 we determined sedimentary denitrification rates at 15 stations located throughout the shelf. Denitrification rates averaged 0.5 mmoles N m-2 d-1 in spring 2010 and were likely higher during the summer. This denitrification rate is sufficient to reestablish half to all the deficit.

**Di Fiore, E., Universidad de Buenos Aires; ANPCyT, Buenos Aires, Argentina, eugenia@ege.fcen.uba.ar**

**Pizarro, H. N., Universidad de Buenos Aires; CONICET, Buenos Aires, Argentina, hay@ege.fcen.uba.ar**

**Ramírez, M., Universidad de Buenos Aires, Buenos Aires, Argentina**

**Cataldo, D. H., Universidad de Buenos Aires; CONICET; Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina, daniel@ege.fcen.uba.ar**

**INTERACTION OF TWO ANTHROPOGENIC STRESSORS IN FRESHWATER: GLYPHOSATE AND THE INVASIVE MUSSEL LIMNOPOERNA FORTUNEI ON PERIPHYTON COMMUNITY.**

A manipulative experiment was carried out to evaluate the effect of glyphosate herbicide and the invasive fresh-water mussel Limnoperna fortunei on periphyton. The experimental design consisted of 24 microcosms (70L plastic bags) to which different glyphosate concentrations (0, 1, 3 and 6ppm) were applied in combination with L. fortunei (presence or absence), therefore resulting in eight treatments per triplicate. All microcosm bags contained artificial substrate previously colonized during one month with periphyton. Water and periphyton samples were obtained at days 0, 1, 8, 15 and 26 in order to quantify glyphosate, total phosphorus and dissolved phosphate concentration in water, whereas chlorophyll-a, dry weight and ash-free dry weight were determined for periphyton samples. Glyphosate half-life decreased a 66-70% (ANOVA <0,01) in treatments with mussels. Periphyton mass variables increased with glyphosate concentration, and even more under mussel presence. Total phosphorous increased with herbicide for all treatments while dissolved phosphate was significantly correlated with glyphosate only in microcosm containing L. fortunei. The mussel Limnoperna fortunei would be participating in glyphosate degradation, releasing phosphate, favoring periphyton growth and altering water quality.

**Mörth, M., University of Puerto Rico, Mayagüez, Puerto Rico, yasmin.detres@upr.edu**

**Cataldo, D. H., Universidad de Buenos Aires; CONICET; Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina, daniel@ege.fcen.uba.ar**
A POSITIVE RELATIONSHIP BETWEEN THE SIZE OF THE MOON JELLY AURELLIA AURITA AND THE SIZE OF EXTRACELLULAR POLYMERIC SUBSTANCES (EPS) RELEASED

The moon jelly Aurelia aurita is known to release mucus. We conducted experiments to determine that transparent exopolymeric particles (TEP) and Coomassie-stained particles (CSP) were released in this mucus. These extracellular polymeric substances exist in the ocean as labile DOM and can form marine snow; having important effects on the microbial community and nutrient cycling. To test whether the size of particles released correlates to the size of Aurelia aurita individuals, the jellyfish were divided into size categories and left to incubate for 24 hours. Results from these experiments will be presented, as well as their implications for carbon cycling during jellyfish blooms.

D'itullio, G. R., Hollings Marine Lab, Charleston, USA, ditullio@cofc.edu
Lee, P. A., Hollings Marine Lab, Charleston, USA, leap@cofc.edu
Riseman, S. E., Hollings Marine Lab, Charleston, USA
McLenon, A. L., Hollings Marine Lab, Charleston, USA, amandamclenon@gmail.com
Saito, M., Woods Hole Oceanographic Institution, Woods Hole, USA, msaito@whoi.edu
Poulton, N., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA, npoulton@bigelow.org
Sieracki, M., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA, msi@bigelow.org

COLIMITATION EFFECTS OF NITROGEN AND IRON ON PHYTOPLANKTON COMMUNITY COMPOSITION AND INTRACELLULAR DMSP IN THE SOUTH ATLANTIC SUBTROPICAL GYRE

Flow cytometric sorting techniques were utilized on samples collected from nutrient enrichment bioassay experiments conducted in the South Atlantic Subtropical Gyre (SASG) to determine cell-specific concentrations of the biogenic sulfur compound, dimethylsulfoniopropionate (DMSP). Concurrent measurements of pigment concentrations and microscopic determination of sorted populations provided corroborative data for assessing phytoplankton community composition. Two bioas-
say experiments with macronutrients and iron were conducted and revealed that nitrogen was the main control on eukaryotic photoautotrophic growth with iron functioning as a colimiting nutrient in the SASG. At the end of the 6-day incubation period class-specific pigment concentrations in the N-amended treatments increased by approximately 10 fold in diatoms and pelagophytes populations and by 15 fold in haptophytes relative to the control and nitrogen unamended treatments. Cell-specific DMSP concentrations in the larger eukaryotic fraction were highest (7,500–15,000 fg/cell) in treatments without added nitrogen or iron compared to treatments with additions of both nitrogen and iron (approximately 4,000 fg DMSP/cell). These results are consistent with the anti-oxidant role for DMSP and will be discussed within the context of transects completed in this region.

Doeckalova, H., Mendel University in Brno, Brno, Czech Republic, hana.doeckalova@ Mendeluniversity.cz

Skarpa, P., Mendel University in Brno, Brno, Czech Republic

Mladkova, Z., Brno University of Technology, Brno, Czech Republic

Travnickova, J., Brno University of Technology, Brno, Czech Republic

ASSESSMENT OF COPPER PHYTOAVAILABILITY TO RAPHANUS SATIVUS – COMPARISON WITH DGT MEASUREMENT

The aim of this study was to assess the copper uptake of radish (Raphanus sativa) and to test the capability of DGT to predict phytoavailability of the metal for this plant. Radish was grown in pots filled with control-uncontaminated and artificially contaminated soils differing by copper content. Copper concentrations in plant roots were compared with soil metal concentrations obtained by common leaching procedures and free ion metal concentrations in soil pore water, and effective concentration measured by DGT.

Doherty, M., University of Maryland Center for Environmental Sciences, Cambridge, MD, USA, mdoherty@umces.edu

Crump, B. C., University of Maryland Center for Environmental Sciences, Cambridge, MD, USA, bcrump@umces.edu

Cornwell, J. C., University of Maryland Center for Environmental Sciences, Cambridge, MD, USA, cornwell@hpl.umces.edu

SUCCESSION OF METABOLICALLY ACTIVE MICROBIAL COMMUNITIES IN SEASONALLY ANOXIC WATERS OF THE CHESEAPEAKE BAY ASSESSED WITH PYROTAG SEQUENCING

The Chesapeake Bay estuary undergoes seasonal cycles of eutrophication-elevated phytoplankton production, which induce high levels of bacterial respiration resulting in anoxic and hypoxic bottom waters. We sampled microbial communities in vertical profiles across oxygenated surface, pycnocline, and anoxic bottom waters, throughout the seasonal development of this ‘dead zone’. Additionally, we sampled a north-south transect of five stations representing the stages in the development of the anoxic zone (hypoxic, sub-oxic, sulfidic). We pyrosequenced PCR-amplified V1–V2 regions of 16S-rRNA genes and their transcripts from bacteria to characterize both the abundant (rDNA) and the metabolically active (rRNA) microbial communities in each sample. Preliminary data suggest: (1) In well-mixed oxygenated waters, bacterial communities are indistinct both temporally and spatially. (2) As the anoxic layer develops, we detect a distinct assemblage in the bottom waters, not present in the oxygenated region. (3) The anoxic community composition changes throughout the season in membership and relative abundances, potentially due to the depletion of electron acceptors in the environment over time. We have experimentally observed community differences in utilization of electron acceptors between sulfide and sulfidic waters.

Dolan, J. R., Microb Ecol, Lab Oceanogr Villefranche-sur-Mer, Villefranche-sur-Mer, France, dolan@ obs-vlfr.fr

NICHE SEPARATION AND THE ROLE OF DOMINANTS AMONG TINTINNID CILIATES, GRAZERS OF THE MICROZooplANKTON

In tintinnids lorica oral diameter, roughly equivalent to mouth size, correlates with several ecological traits. I examined niche separation by equating it to this morphological trait. Temporal changes in the tintinnid community of the Bay of Villefranche (N.W. Mediterranean Sea) were explored based on weekly sampling over an annual cycle. Although overall abundance and species richness varied widely, community average oral diameter reflected changes in the identity of the dominant or most abundant species. The dominant species, the “#1, the second most abundant,” #2, and the third most abundant, “#3” shifted together; changes in the identity of the #1 species were accompanied by changes in the identities of the #2 and #3 species. The lorica oral diameters of #2 and #3 species almost invariably differed from the #1 species. The differences were similar in magnitude and scaled with the size of the dominant species. Overall, the lorica oral diameters of the #2 and #3 differed by 40% from that of the #1 species. Deviations from the average of 40% decreased with relative dominance of the #1 species. The relative dominance of the most abundant species also appeared to influence the species abundance distribution of the entire tintinnid assemblage. Thus, the characteristics of the most abundant species, its morphology and relative dominance, structured the tintinnid community. Financial support provided by the ANR Biodiversité du large PACA project QUPARADOX.

Domaisson, L., INRA CARTEL, Thonon, France, isabelle.domaison@thonon.inra.fr

Savichtcheva, O., INRA CARTEL, Thonon, France, osavichtcheva@thonon.inra.fr

Kircham, A., INRA CARTEL, Thonon, France, akircham@thonon.inra.fr

Debroas, D., Université Blaise Pascal LMGE, Aubiere, France

Vilar, C., INRA CARTEL, Thonon, France, vilar@thonon.inra.fr

Jenny, J. P., Edytem, Le Bourget du Lac, France

Pignol, C., Edytem, Le Bourget du lac, France

Arnaud, F., Edytem, Le Bourget du Lac, France

Perga, M. E., INRA UMR CARTEL, Thonon, France, perga@thonon.inra.fr

THE ANALYSIS OF PRESERVED DNA TO ASSESS CHANGES IN CYANOBACTERIA AND DIATOMS DYNAMICS AND DIVERSITY: COUPLING PALEO- LIMNINOLOGY AND MOLECULAR TOOLS

DNA preserved in sediments was used to study the succession of historic phytoplanktonic communities in a deep lake (Bouget France). DNA was extracted successfully from a sediment core recording the last 100 years. The diatom and cyanobacterial communities were targeted. Cloning-sequencing (185 rRNA, 16S, ITS and 23S rRNA genes) was used to compare distinct regions of the core, corresponding to a priori to different trophic periods in the lake (oligotrophic to eutrophic). Clear changes in the diatom and cyanobacterial communities were identified between the analysed time points. Moreover we reconstructed the quantitative distribution of Planktothrix spp. (cyanobacteria) by real-time quantitative PCR (on PC, 16S and mcyA genes). We showed that deep calcareous lakes are favorable environments for an efficient preservation of DNA (high quality sequences obtained) and we revealed that designed qPCR assay could be applied successfully to these laminated sediments. The reconstruction of temporal variations in past community assemblages and biodiversity, using biomarkers, is a promising approach. We identified further areas for future studies in order to optimize the use of DNA biomarkers in lacustrine sediments analysis.

Donadi, S., Department of Marine Benthic Ecology and Evolution, CIES, University of Groningen, Groningen, Netherlands, s.donadi@rug.nl

van der Heide, T., Community and Conservation Ecology Group, University of Groningen, Groningen, Netherlands, t.van.der.heide@rug.nl

van der Zee, E., Animal Ecology Group, University of Groningen, Groningen, Netherlands, els.vanderzee@nioz.nl

Ekdöf, J., Department of Marine Ecology, Göteborg university, Göteborg, Sweden, johane@ecology.su.se

van de Koppel, J., Department of Spatial Ecology, Netherlands Institute of Ecology (NIOO), Verwijk, Netherlands, j.vandeKoppel@nioo.knaw.nl

Eriksson, B. K., Department of Marine Benthic Ecology and Evolution, CIES, University of Groningen, Groningen, Netherlands, B.K.Eriksson@rug.nl

SCALE-DEPENDENT EFFECTS OF AN ECOSYSTEM ENGINEER DETERMINE THE SPATIAL DISTRIBUTION OF BIVALVES IN AN INTERTIDAL ECOSYSTEM

Increasing evidence shows that scale-dependent biotic interactions mediated by ecosystem engineering species structure associated communities and promotes landscape heterogeneity of many ecosystems. Here we tested the hypothesis that contrasting scale-dependent effects of Mytilus edulis (blue mussel), a dominant intertidal ecosystem engineer in the Wadden Sea, might explain increased abundances of the bivalve Cerastoderma edule (cockle) at intermediate distances from mussel aggregations. A field survey revealed high cockle densities behind a mussel bed. Next, field experiments showed higher survival of young cockles and increased spatfall behind the bed compared to a control area. Contrastingly, growth was significantly decreased behind the mussels. Field measurements suggested that the peak in cockle numbers resulted from a scale-dependent interaction between 1) settlement facilitation, caused by reduction of hydrodynamics, and 2) inhibition of growth caused by algal depletion and deteriorated sediment conditions. Our results indicate that ecosystem engineers can have large effects on the community structure through scale-dependent interactions that encompass long distances. Understanding
these spatial, cross-habitat interactions is crucial for conservation and restoration of intertidal communities, such as the Wadden sea.

Dorado, S., Texas A&M University at Galveston, Galveston, USA, dorado_sam@yahoo.com
Quigg, A., Texas A&M University at Galveston, Galveston, USA, quigg@tamug.edu
Rooker, J. R., Texas A&M University at Galveston, Galveston, rookerj@tamug.edu
Simms, J., Texas A&M University at Galveston, Galveston, jsimms2003@neo.tamu.edu

LINKING FISH PRODUCTION TO THE GLOBALLY IMPORTANT DIAZOTROPH, TRICHODESMIUM, IN THE GULF OF MEXICO

Spawning events by ecologically important fishes such as billfish and tuna occur in oligotrophic regions of the Gulf of Mexico (GOM) where biological nitrogen fixation by cyanobacteria has been shown to occur. Nitrogen fixation rates by Trichodesmium in the GOM are comparable to other oligotrophic regions where it has been shown diazotrophy enhances primary, secondary, and bacterial production. Previous efforts have used the natural abundance of stable carbon and nitrogen isotopes as a method of establishing the source of organic material to larval and juvenile fish species in the GOM. Depletion in the δ15N signature of both Sargassum sp. and POM in these regions has led us to re-evaluate the food web dynamics in the GOM using the products of diazotrophy as a source of carbon and nitrogen. Results identify Trichodesmium as a distinct source of supplying material to larval and juvenile fish populations in our study area. This research highlights Trichodesmium as an important component of the pelagic ecosystem and provides insight into how this genus contributes to the success of higher trophic levels.

Dorfner, E. M., University of Washington, Seattle, USA, edorfmei@uw.edu
White, S. J., University of Washington, Seattle, USA, samwhite@uwashington.edu
Roberts, S. B., University of Washington, Seattle, USA, sc320@u.washington.edu
Friedman, C. S., University of Washington, Seattle, USA, carolyn@uwashington.edu

INFLUENCE OF OCEAN ACIDIFICATION ON FIBRIO TUBILISHI GROWTH AND PATHOGENICITY TO PACIFIC OYSTER LARVAE

Vibrio tubilishii (VT) is a causative agent of vibriosis in molluscan bivalves. Recent re-emergence of vibriosis in economically valuable bivalve species, such as the Pacific oyster (Crassostrea gigas), in Washington State (USA) has increased the urgency to understand the ecology of the pathogen. Although environmental factors contributing to the presence and pathogenicity of VT are poorly understood, outbreaks of bacterial disease in the Pacific Northwest strongly correlate with increased surface sea water temperature and coastal upwellings high in CO2. This study will investigate how environmental cues, such as temperature and partial pressure carbon dioxide (pCO2), are associated with physiological changes in VT. Molecular, water chemistry and challenge trial data will provide important insights into the environmental factors that influence proliferation and pathogenesis of VT and its impact on Pacific oyster larvae. Baseline VT growth curves were generated in the laboratory at 12°, 18° and 25°C. Laboratory trial results manipulating temperature, pCO2, and pathogen levels with C. gigas larvae will be presented and discussed.

Dornback, L. M., University of Southern Mississippi, Stennis Space Center, USA, m.dornback@gmail.com
Lohrenz, S. E., University of Southern Mississippi, Stennis Space Center, USA, Steven.Lohrenz@usm.edu

TEMPORAL AND SPATIAL VARIATIONS IN PHYTOPLANKTON BIOMASS IN MISSISSIPPI COASTAL WATERS

The western Mississippi Sound is a vital economic and ecological resource to the northern Gulf of Mexico. At present, there is a limited understanding of the patterns of seasonal and spatial variation in phytoplankton abundance in the Sound. In addition, the relation of phytoplankton abundance to the influences of freshwater inputs such as the Mississippi River need to be addressed. Here, we examine a time-series of observations of phytoplankton distributions in relation to nutrient concentrations and environmental conditions. Phytoplankton abundances were determined using in situ profiles of chlorophyll fluorescence. The data were acquired from a sustained monthly time-series (11/2007-Present) along a transect extending from Mississippi Sound to shelf waters beyond the barrier islands. A general decrease of phytoplankton abundance occurs as sampling moves away from the mainland. In addition, a seasonal increase in phytoplankton abundance was observed accompanying the onset of stratification in the spring and early summer, with a yearly maximum in occurring in August. Differences between years are considered in relationship to differences in freshwater inputs and associated impacts on light and nutrient availability.

Douglas, F. M., University of Massachusetts Boston, Boston, USA, ellen.douglas@umb.edu

CHANGING HYDROLOGIC VARIABILITY IN NORTHERN NEW ENGLAND AND THE POTENTIAL IMPACTS ON SHALLOW COASTAL MARINE SYSTEMS.

Freshwater inputs to coastal marine systems are known to influence a wide range of biological and biogeochemical processes over different spatial and temporal scales. Recent observations have shown that anomalous precipitation in northern New England and high river discharge events into the Gulf of Maine can result in considerable freshening and depletion of dissolved inorganic carbon (DIC) in coastal surface waters. Annual average temperatures have been rising at a rate of 0.5°F per decade since 1970; winter average temperatures have risen at a much faster rate. Hydrologic observations consistent with this warming include a higher percentage of winter precipitation falling as rain, smaller snowpack extent and changes in the timing of ice-out and snow melt. Given that New England streamflow variability is strongly linked to snowmelt, it is not surprising that streamflow characteristics have been observed to be changing in rivers throughout New England. I will present an overview of how climate change may be affecting precipitation and freshwater flows in Northern New England and the potential impacts of these changes on shallow coastal marine systems.

Downing, J. A., Iowa State University, Ames, USA, downing@iastate.edu
Heathcote, A. J., Iowa State University, Ames, USA, aheathco@iastate.edu
Balmer, M. B., Iowa State University, Ames, USA, mbbalmer@iastate.edu
Filtz, C. T., Iowa State University, Ames, USA, filtrepia@iastate.edu

EUTROPHICATION IS INVERTING THE CARBON-ROLE OF LAKES IN THE BIOSPHERE

The high carbon-intensity of continental waters leads them to be very important for guiding the global carbon budget. Because the intensity of lakes in processing carbon is commonly 10-1000-times that of terrestrial and marine ecosystems, subtle changes in the function of freshwater ecosystems may have profound influences on carbon cycling and global climate change. Normally, lakes are thought to convert dissolved organic carbon to atmospheric CO2, butiker has shown that most carbon-roles invert in eutrophic ecosystems. For example, eutrophic lakes sequester and store carbon at biophysically unprecedented rates, appear to absorb atmospheric carbon as production peaks, but may substantially augment the evasion of aggressive greenhouse gases. This survey, based on data from a region of intensive eutrophication, suggests that much of the role of lakes may invert as eutrophication accelerates.

Downing-Kunz, M. A., University of California, Berkeley, Berkeley, USA, mokunz@berkeley.edu
Stacey, M. T., University of California, Berkeley, Berkeley, USA, mstacey@berkeley.edu

PHYSICAL INTERACTIONS BETWEEN FLOATING MACROPHYTES AND ENVIRONMENTAL FLOWS: TOWARDS THE PREDICTION OF WEED DISPERsal

Water hyacinth (Eichhornia crassipes) is a free-floating macrophyte that has invaded freshwater systems worldwide, causing detrimental effects to native ecosystems and human activities. Water hyacinth grows in dense floating mats, reproduces asexually, and disperses by passively drifting on wind and water currents. This research examines physical interactions between water hyacinth and surrounding air/water flows to better understand transport mechanisms governing regional dispersal. Experiments in an open-channel flume and a wind tunnel were conducted using live plants to directly measure flow-induced forces for varying approach velocities and mat configurations. For a given mat geometry, forces and drag coefficients in water exceed those in air. Over similar Reynolds number (Re) regimes, water drag coefficients decrease with increasing Re while air drag coefficients are relatively constant. Comparison to field observations of trajectories of GPS-equipped floating mats in-situ corroborate laboratory results, suggesting water currents, when present, are the dominant dispersal mechanism; however ambient flow conditions at source locations must be considered. This research forms the basis of a predictive model for floating macrophyte dispersal based on physical processes.
Drenkard, E., Woods Hole Oceanographic Institution, Woods Hole, USA, edrenkard@whoi.edu
Cohen, A., Woods Hole Oceanographic Institution, Woods Hole, USA, acohen@whoi.edu
McCorkle, D. C., Woods Hole Oceanographic Institution, Woods Hole, USA, dmc-Corkle@WHOI.edu
de Putron, S., Bermuda Institute Of Ocean Sciences, St Georges, Bermuda, samantha.deputron@bios.bmu.edu
FEEDING MODULATES THE IMPACT OF ELEVATED CO2 ON THE SKEL- ETAL GROWTH OF AN ATLANTIC CORAL
Scleractinian corals reared in experimental OA studies exhibit a wide range of re- responses to moderately elevated pCO2 including negative, positive and neutral. These results suggest that the calcification response to changes in seawater saturation state (Ω) is influenced by other factors. We investigated the role of coral energetic status in modulating the calcification response to ocean acidification. Newly settled, zooxanthellate flat of the Atlantic coral Favia fragum were reared for three weeks under ambient temperature and orthogonal conditions of feeding and non-feeding with ambient (420 ppm) or elevated (1670 ppm) CO2. Skeletons (corallites) of fed corals were significantly larger (>50%) than those of unfed corals under both ambient and elevated CO2 conditions. CO2 had a significant, negative impact on coralite diameter only in the unfed treatments. Corallite diameters of fed corals reared under ambient and elevated CO2 were not statistically different. These results suggest that host energetic status plays a key role in the coral calcification response to ocean acidification with important implications for the survival of coral reef ecosystems over the 21st century.

Duarte, C. M., IMEDEA (CSIC-UIB), Esplugues de Llobregat, Spain, carlosduarte@imedea.uib-csic.es
Laita, P. A., IMEDEA (CSIC-UIB), Esplugues de Llobregat, Spain, patricia.alonso@uib.es
Agustí, S., IMEDEA (CSIC-UIB), Esporles, Spain, sagusti@imedea.uib-csic.es
RAPID RELEASE AND USE OF DISSOLVED ORGANIC CARBON IN THE OILGOTRIGENIC OCEAN
Reconciling high bacterial carbon use with estimates of primary production and carbon flow from phytoplankton has remained a challenge for over two decades, particularly for the oligotrophic ocean. Here we report on very rapid dynamics of DOC production and use in experiments examining gross rates of primary production and the short-term fate of this primary production in microplankton communities. We examined these dynamics across a range of communities spanning from highly oligotrophic ones in the Subtropical Atlantic Ocean, mesotrophic ones in the Mediterranean Sea and productive ones in the N. African upwelling and the Southern Ocean. The results obtained show that plankton communities in produc- tive ocean waters are able to accumulate organic carbon over hourly time scales, whereas only a small fraction of net primary production accumulated in communi- ties from oligotrophic waters.

Ducklow, H. W., The Ecosystems Center, Woods Hole, USA, hdducklow@mbl.edu
Bernard, K., Virginia Institute of Marine Sciences, Gloucester Point, USA, kber- nard@vimms.us
Erickson, M., MBL, Woods Hole, USA, merickson@mbl.edu
Middaugh, N., Virginia Institute of Marine Sciences, Gloucester Point, USA, nmidd- daugh@gmail.com
Moran, X. A., Spanish Institute of Oceanography, Xixon, Spain, xelu.moran@ioe.es
Schofield, O., Rutgers University IMCS, New Brunswick, USA, oscar@marine.rutgers.edu
Steinberg, D., Virginia Institute of Marine Sciences, Gloucester Point, USA, deb- bies@vimms.us
Vernet, M., Scripps Institution of Oceanography, La Jolla, USA, mvernet@ucsd.edu
Sailley, S., WHOI, Woods Hole, USA, ssailley@whoi.edu
PALMER LTER: WHY IS BACTERIAL PRODUCTION SUCH A LOW FRA- CTION OF PRIMARY PRODUCTION NEAR THE ANTARCTIC PENINSULA?
We analyze information on 444 individual paired determinations of water column bacterial and primary production made along the western Antarctic Peninsula over seven Austral summers between 2002-2006. In a season-resolving dataset consisting of 176 stations measured between October and April each year in the vicinity of Palmer Station (64S, 64W, 75-200 meters), the ratio of bacterial to primary produc- tion (BP:PP) was 0.05. In a spatially extensive dataset extending from inshore across the shelf into the Antarctic Circumpolar Current, the BP:PP was 0.05. Chlorophyll has declined in the Peninsula region since 1978, but the bacterial time series is too short to detect a trend. Experimental determinations of the extracellular DOC release from phytoplankton averaged 10% of the production rates. If bacteria use this DOC with a growth efficiency of 25%, BP:PP would be 0.025, suggesting an equiva- lent role for DOC from zooplankton in supporting the BP. The Antarctic Peninsula region is warming rapidly, sea ice is declining and zooplankton populations are changing. Understanding potential bacterial bacterial responses to climate change is a grand challenge for microbial oceanography.

Dukhovskoy, D. S., Florida State University, Tallahassee, USA, d.dukhovskoy@fsu.edu
Morey, S. L., Florida State University, Tallahassee, USA, smorey@fsu.edu
STORM SURGE MODELING IN THE NORTHERN GULF OF MEXICO
Storm surge is a rapid rise of sea level caused by a tropical cyclone. This rise in water level can cause severe flooding in coastal areas especially with flat topogra- phy. There is an obvious necessity to develop a reliable methodology for simulating and predicting a storm surge capable to provide accurate assessment of potential hazards from a storm for emergency preparations and response. Although the physics of a storm surge is conceptually straightforward, it is still a challenge to...
provide an accurate numerical forecast of a storm surge. There are several sources of uncertainties in surge modeling: 1) Errors in the forcing parameters (surface and lateral open boundary conditions); 2) Neglecting of or uncertainty in estimates of factors contributing to the total sea level rise; 3) Insufficient horizontal resolution or topographic representation; 4) Simplified physics, i.e. vertically averaged momentum equations. Sensitivity analyses reveal high dependence of the model solution to the vertical discretization. The presentation will discuss numerical and physical aspects of a storm surge modeling based on real-case simulations of storm surges in the northern Gulf of Mexico.

Dulac, F., LSCE / CEA CNRS UVSQ & LISA / UPEX UPTDD CNRS, Saclay and Créteil, France, Francois.Dulac@cea.fr
Desboeufs, K. V., LISA / UPEX UPTDD CNRS, Créteil, France, Karine.Desboeufs@lisa.u-pec.fr
Bon Nguyen, E., LISA / UPEX UPTDD CNRS, Paris, France, Elisabeth.Bon Nguyen@lisa.u-pec.fr
Tran, S., LISA / UPEX UPTDD CNRS, Créteil, France, sophie.trang@lsce.ipsl.fr
Losno, R., LISA / UPEX UPTDD CNRS, Créteil, France, Remi.Losno@lisa.u-pec.fr
Chevallier, S., LISA / UPEX UPTDD CNRS, Créteil, France, Servanne.Chevallier@lisa.u-pec.fr
Guieu, C., LOV / UPMC CNRS, Villefranche-sur-Mer, France, Guieu@obs-vlfr.fr
Leblond, N., LOV / UPMC CNRS, Villefranche-sur-Mer, France, Leblondobs-vlfr.fr
Labiadhi, M., IRA, Medenine, Tunisia, mohamed.labiadhi@ira.mrt.tn
A METHOD TO PRODUCE LARGE AMOUNTS OF MINERAL DUST FOR CONTROLLED IN SITU EXPERIMENTS ON THE MARINE BIOGEOCHEMICAL IMPACT OF ATMOSPHERIC DEPOSITION
We present an original approach to produce large amounts of desert dust aerosol needed to conduct realistic in situ controlled experiments on the biogeochemical impact of dust atmospheric fallout, which has been developed for mesoscale seeding experiments in the Mediterranean. We first produce an analogue of fine long-range transported desert dust particles by grinding and dry-sieving clay aggregates from a soil rich in clay minerals sampled in an Aeolian aerosol source area in southern Tunisia, reproducing the effects of sandblasting of the soil and sedimentation. Subsequent processing of the dust with simulated cloud water is performed to reproduce aging of dust particles during atmospheric transport. This adds N. The dust is dispersed into pure water or seawater sprayed at the sea surface for simulating wet and dry deposition, respectively. The whole process is performed in clean conditions to avoid chemical contamination. A detailed comparison of physical and chemical characteristics of our dust analogue with both the local uplifted dust and literature data confirms that our mechanical production and chemical aging method is adapted to simulate desert dust deposition to seawater.

Dupont, C. P., The University of Hong Kong, Hong Kong, Hong Kong POC, cdumont@hku.hk
ROLE OF THE SEA URCHIN DIADEMA SETOSUM ON THE BIOEROSSION OF CORALS IN HONG KONG
A loss of coral resilience is often the underlying cause of catastrophic shift to degraded states. High densities of the sea urchin Diadema setosum at the Hoi Ha Wan marine park have been suggested to cause extensive damage on coral communities, which resulted to the initiative of the Hong Kong governmental authority to manually remove thousands of individuals. However, identifying the role of urchins on the bioerosion of corals is of major importance to adequately preserve the coral reef biodiversity and resilience. To determine the effect of urchins on coral bioerosion, we conducted a field enclosure that showed no grazing effect of sea urchins on Porites colonies. Further, lab experiments revealed that urchins do not graze on live corals (Porites and Platygyra) but only on damaged Platygyra that have a weak calcification, probably due to important pollution and high sedimentation. Removing urchins might reduce the grazing on dead coral structures but, on the other hand, may actually increase the colonization of macroalgae and boring species which could cause more damage.

Dupont, C. L., J. Craig Venter Institute, San Diego, USA, cdupont@j cvi.org
Araujo, W. L., Max Planck Institute for Molecular Plant Physiology, Golm, Germany, Araujo@mpimp-golm.mpg.de
Nunes-Nesi, A., Max Planck Institute for Molecular Plant Physiology, Golm, Germany, Nesi@mpimp-golm.mpg.de
Fernie, A., Max Plank Institute for Molecular Plant Physiology, Golm, Fernei@mpimp-golm.mpg.de
Allen, A. E., J. Craig Venter Institute, San Diego, alllen@jcvi.org
A BIFURCATED NITROGEN ASSIMILATION SYSTEM IN MARINE DIATOMS
The simple organic nitrogen compound urea supports 30-50% of primary production in marine phytoplankton communities. The nickel containing metalloenzyme urease catalyzes the breakdown of urea into ammonium and carbon dioxide in most marine phytoplankton. Long assumed to be localized in the cytoplasm based on studies in plants, several microscopic approaches are used here to show that urease is located in the mitochondria of diatoms. A two-part uptake system, involving a plant-like outer membrane transporter and a metalozan-like mitochondrial transporter, delivers urea from the extracellular matrix to the mitochondria. Genomic analyses and metabolite flux studies show that the ammonium produced by urease is assimilated using a complete GS-GOGAT cycle found in the mitochondria, with ancillary fixation through CPS III and the urea cycle. In contrast, nitrate-derived ammonium is clearly assimilated through a plastid-localized GS-GOGAT cycle, with a transfer to the urea cycle metabolite pool via arginosuccinate synthase. Comparative genomic analyses suggest this bifurcated nitrogen assimilation system may be present in other phytoplankton of the chromophyte lineage.

Dupont, S. T., University of Gothenburg, Fiskebackskil, Sweden, sam.dupont@marecol.gu.se
Stumpf, M., IFM-GEOMAR, Kiel, Germany, m.stumpf@ifm-geomar.de
Dorey, N., University of Gothenburg, Fiskebackskil, Sweden, nariname.dorey@ marecol.gu.se
Melzner, F., IFM-GEOMAR, Kiel, Germany, fnmelzner@ifm-geomar.de
Thorning, M. S., Royal Swedish Academy of Sciences, Fiskebackskil, Sweden, mike.thording@marecol.gu.se
THE COST OF CLIMATE CHANGE – ENERGY BUDGET IN ECHINODERM LARVAE
The impact of global warming and ocean acidification (OA) appears to be extremely species- and population-specific making any large scale prediction virtually impossible. Recent literature highlights the fact that the classic paradigms (e.g. calcifiers will be more sensitive to OA) are unable to explain those differences. We will present some experimental data showing that the key to explain the impact of those stressors is physiology. Marine organisms are not pieces of calcium carbonate and resilience or sensitivity of a given individual to global warming and OA impact is related to its energy budget and ability to buffer or regulate those changes. Using sea urchin larvae as a model, we will show how near-future changes in the ocean can impact energy budget and fundamental processes such as maintenance, calcification and growth.

Durbin, E. G., University of Rhode Island, Graduate School of Oceanography, Kings- ton, USA, edurbin@gso.uri.edu
Casas, M. C., University of Rhode Island, Graduate School of Oceanography, Kingston, USA, mcasas@gso.uri.edu
Rynearson, T. A., University of Rhode Island, Graduate School of Oceanography, Kingston, USA, t.rynearson@gso.uri.edu
DNA CHARACTERIZATION REVEALS DIVERSE ICE ALGAL AND WATER COLUMN PROTISTAN COMMUNITIES IN THE NORTHERN BERING SEA DURING EARLY SPRING
Extensive ice algal communities are present under the one-year old sea ice in the Bering Sea during early spring. During a cruise to the northern Bering Sea on the USCGC Polar Sea in March 2010 we sampled ice algal and water column communities and characterized their composition with 18S clone libraries and through microscopic enumeration for four different locations. Water column communities were similar throughout the region and dominated by Thalassiosira antarctica with smaller numbers of other diatoms including those typically associated with ice algae, dinoflagellates and ciliates. Ice algal communities were dominated by T. antarctica, normally considered to be planktonic, and a diverse group of other heterotrophic protists including Telenema (phagotrophic flagellate), Thaumatomonas and Cryptecononas ( cercozoan flagellates), and ciliates including Novastrombidium. Our preliminary results indicate that ice-bound and planktonic habitats are phylogenetically diverse but harbor distinct communities. However, there are some surprising overlaps that may provide insights into where seed populations for the spring bloom originates.
The northern Gulf of Mexico is a region dramatically affected by fresh water inflow from several sources. While the Texas/Louisiana shelf region has received attention in the past, it is becoming increasingly clear the shelf region in the northeastern Gulf of Mexico in Mississippi/Alabama/Florida Panhandle is also dramatically affected by very large fresh water contributions from the Mississippi River, the Pearl River, Pascagoula River, and Mobile Bay river system. We examine the effects of fresh water input on regional hydrography and circulation. Seasonal fluctuations from representative discharge sources (Mississippi River and Mobile River System) show clear relationships with seasonal pattern in salinity and current structure. Consequently, change in fresh water input, as a result of a climate change, for example, will have significant impact on physical aspects of the marine system. These physical properties as well as biogeochemical properties affected by discharge variability have significant consequences on marine fisheries. For example, a long term fluctuation in the Mobile Bay river system discharge is found to be the primary environmental factor affecting the recruitment patterns of many coastal fish species on the Alabama shelf. Understanding the impact of fresh water discharge variability at present levels will have significant impact on physical aspects of the marine system. These physical and trophic conditions upon seasonal and spatial changes in production and in the trophic structure.

**IMPACT OF FRESH WATER VARIABILITY ON PHYSICAL AND BIOLOGICAL ASPECTS OF THE MARINE SYSTEM ON THE NORTHEASTERN GULF OF MEXICO**

Dzwonkowski, B., Dauphin Island Sea Lab, Dauphin Island, USA, brianz@disl.org
Carassou, L., Dauphin Island Sea Lab, Dauphin Island, AL, USA
Park, K., University of South Alabama, Mobile, AL, USA

**EVIDENCE FOR A FUNDAMENTAL THREE-WAY TRADEOFF IN A TREAT COMPIILATION OF MARINE AND FRESHWATER PHYTOPLANKTON**

Some evidence suggests that phytoplankton species exhibit a tradeoff in their ability to compete for nitrogen vs phosphorus. At the same, it is generally thought that small cell size is advantageous when competing for any limiting nutrient. Therefore, any tradeoff in competitive ability for N vs P may be obscured by the general effect of cell size on nutrient competition. We have used a literature compilation of nutrient uptake traits to resolve the overall relationship between cell size and competitive ability for N and P. We find that these three traits exhibit a three-way tradeoff that can be described as a constraining plane in trait space. At a given cell size, competitive ability for N and P are negatively correlated, but as cell size increases, competitive ability decreases for both nutrients. The advantage of large size is not quantified in our analysis, but may include resistance to grazing or enhanced nutrient storage capability.

**PHYTOPLANKTON DIVERSITY AND ECOSYSTEM FUNCTIONS IN CHESAPEAKE BAY**

Species diversity has been shown to relate to ecosystem functions including productivity and stability in a variety of ways. While examples of terrestrial and aquatic systems have shown both positive and negative correlations between diversity and productivity, there is a growing consensus that at a larger scale the relationship is unimodal, with the highest diversity at intermediate productivities. An examination of the phytoplankton community of lower Chesapeake Bay and its tributaries over a 20 year period indicates a significant positive relationship between diversity (both species richness and Shannon diversity index $H'$) and productivity (both total biomass and carbon fixation rate) as well as stability (negative coefficient of variation of total biomass). To investigate the relationship at higher productivity levels, a study of a smaller tributary of the Bay prone to dense dinoflagellate blooms demonstrates a negative correlation between the two, providing support for an overall unimodal relationship.

**HOW MUCH IS TOO MUCH? RECORD CARIBBEAN CORAL BLEACHING IN 2005, AGAIN IN 2010?**

In 2005, sustained anomalously high temperatures and storm-free weather added to ongoing ocean warming to cause the most severe and extensive coral bleaching event on record in the Caribbean region. Over 80% of corals bleached and over 40% died at many sites. The most severe bleaching occurred near a western Atlantic warm pool centered off the northern end of the Lesser Antilles, with bleaching seen throughout the greater Caribbean-Gulf of Mexico region. In 2010, this time forced by El Niño/La Niña conditions, thermal stress comparable to that seen in 2005 struck corals a bit farther south in the region. Reports are coming in of bleaching and mortality of corals in Panama, the Flower Garden Banks, the Lesser Antilles, and islands off the Venezuelan coast. These two events will be compared to tease out similarities and differences between climate drivers, thermal stress, and the response of corals. These events and the repeated bleaching since 1983 raise numerous questions that will be considered: How much is this bleaching the response to simple warming and how much may be related to other stressors such as nutrients or acidification? Has there been any sign of acclimation or adaptation to changing environmental conditions? Most importantly, what do these repeated thermal stress events mean for Caribbean coral reefs in the 21st century?

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The sediment carried by the Melong River plays a large role in supporting the world’s largest fresh-water fishery, the Tonle Sap Lake. However, the organic composition of riverine particulate organic matter (POM) carried by the Melong remains largely unstudied. Here we examine changes in POM composition throughout one year by measuring δ¹³C, δ³⁴S, δ¹⁵N, δ¹⁵N, δ¹⁵N, δ¹⁵N, and δ¹⁵N. Our results indicate that autochthonous production comprises a greater proportion of POM during the dry season than in the rainy season. This is evidenced by higher δ¹³C values during the dry season (7.2 ± 2.4 vs. 2.2 ± 0.4 ‰), lower yields of lignin-derived phenols (0.40 ± 0.05 mg C/100 mg OC vs. 1.1 ± 0.3 mg C/100 mg OC), and a decrease of CN ratios from 1.58 to 8.7 throughout the dry season. Further, vascular-plant derived POM appears to transition from gymnosperms to POM during the dry season to angiosperms during the rainy season. This study provides baseline data to assess how anthropogenic change due to dam installation will affect regional carbon cycling and the Tonle Sap Lake.
allochthonous organic sources subside this C evasion. This mangrove also present a hypersaline tidal flats colonized by microheteral algae an important mangrove compartment, that is a significant C sink fueled by the net microphytobenthic production. Therefore, the important role of mangrove ecosystems on C cycle may be influenced by the relative area and conditions of their hypersaline plains.

Ezhner, D. L., University of Texas Marine Science Institute, Port Aransas, USA, derdner@mail.utexas.edu

Richlen, M. L., Woods Hole Oceanographic Institution, Woods Hole, USA, mrichlen@whoi.edu

Kulis, D., Woods Hole Oceanographic Institution, Woods Hole, USA, dkulis@whoi.edu

McCauley, L. A., Woods Hole Oceanographic Institution, Woods Hole, USA

Anderson, D. M., Woods Hole Oceanographic Institution, Woods Hole, USA, danerson@whoi.edu

DIVERSITY AND DYNAMICS OF A BLOOM OF THE TOXIC DINOFLAGELLATE AXELRODIA IHAKUENSIS

Coastal waters of the northeastern U.S. are subject to recurrent outbreaks of paralytic shellfish poisoning (PSP) caused by the toxic dinoflagellate *Alexandrium fundyense*. PSP toxics shows considerable spatial and temporal variability, likely resulting from the interaction of genetic, environmental and hydrographic factors. This study examined the genetic diversity of a toxic dinoflagellate bloom, and tracked how that diversity changed through time. In 2005, the Gulf of Maine region was affected by the largest toxic *Alexandrium* bloom in decades. During this event, 157 clonal isolates of *A. fundyense* were established from samples collected at six different locations during the first six weeks of the bloom and analyzed using microsatellite markers. Overall, the bloom samples were highly diverse and showed no evidence of genetic differentiation on short (1-2 week) time scales. However, samples from the end of the bloom were genetically distinct from early-bloom samples collected ca. one month earlier. These changes do not appear to result from the mixing of distinct sub-populations, but likely represent selection of different subsets of strains due to changing environmental conditions.

Erickson, M. J., MBL, Woods Hole, USA, merickson@mbl.edu

Ducklow, H. W., MBL, Woods Hole, USA, hdducklow@mbl.edu

DISTRIBUTION AND ABUNDANCE OF MARINE MICROBIAL COMMUNITIES NEAR THE WESTERN ANTARCTIC PENINSULA

The Palmer Long-Term Ecological Research (LTER) study extends over a large oceanic area west of the Antarctic Peninsula and Palmer Station, on Anvers Island (64°S, 64°W). One focus of the study is the distribution and abundance of marine microbial populations over time and space. Water column samples collected biweekly at Palmer Station and samples collected aboard two summer cruises (2010 to 2011) were analyzed using an Accuri C6 flow cytometer. Auto- and stain fluorescence were used to detect heterotrophic nanoflagellates, phytoplankton, and bacteria. Significant correlations among microbial abundance, biogeochemical properties, and production rates were determined. Nanophytoplankton was positively correlated with bacterial abundance, bacterial productivity, and temperature. Seasonal changes in microbial abundance and composition were observed over time at Palmer Station. Seasonal differences in percent phytoplankton community composition of non- and picophytoplankton were observed near Palmer Station. Offshore-onshore and north-south differences were observed in both nanophytoplankton abundance and phytoplankton community composition on both cruises. Real-time shipboard flow cytometric analyses permit vital stain-based analyses and adaptive sampling while avoiding storage and preservation artifacts.

Eriksson, B. K., Marine Benthic Ecology and Evolution, University of Groningen, Groningen, Netherlands, b.d.h.ekriksson@rug.nl

Sieben, K., Marine Benthic Ecology and Evolution, University of Groningen, Groningen, Netherlands

Eklöf, J., Department of Marine Ecology, Gothenburg University, Gothenburg, Sweden

Ljunggren, L., Swedish Board of Fisheries, Oregrund, Sweden

Olsson, J., Swedish Board of Fisheries, Oregrund, Sweden

Casini, M., Swedish Board of Fisheries, Göteborg, Sweden

Bergström, U., Swedish Board of Fisheries, Oregrund, Sweden

CONSEQUENCES FOR COASTAL HABITATS OF HUMAN TRANSFORMATION OF OFFSHORE FOOD-WEBs

Coastal ecosystems are connected to offshore ecosystems via transport of energy, materials and organisms, and may therefore be significantly affected by changes in offshore food-webs. On the Atlantic and Baltic coasts of Sweden, experimental studies suggest that degenerating habitat quality, which includes declines of seagrass beds and increasing blooms of filamentous algae in shallow bays, may be linked to trophic cascades generated by increases in meso-predatory fish. Here we demonstrate that mesopredator populations have increased on both coasts and suggest that offshore exploitation of larger predatory fish could act as a trigger in these processes. We identify migrations of both larger and meso-predatory fish as the likely link between coastal and offshore areas that may mediate such effects of fisheries across ecosystems. This synthesis of studies indicate the potential for cross ecosystem effects of fisheries and stress the need to integrate an ecosystem based management of marine resources in a spatial context that exceeds individual ecosystems, and to develop joint targets for fisheries, nature conservation and coastal water quality management.

Escoffier, N., IPGP, UMR 7154, Université Paris Diderot - Paris 7, Laboratoire de Géochimie des Eaux, Paris, France, escoffer@ipgp.fr

Bensoussan, N., Ipsu Facto, Marseille, France

Bernard, C., Muséum National d'Histoire Naturelle, FRE 3206 CNRS-MNHN, Equipe CCE, Paris, France

Guillermie, O., nke electronics, Hennebont, France

Métivier, F., IPGP, Université Paris Diderot - Paris 7, Equipe Dynamique des Fluides Géologiques, Paris, France

Groleau, A., IPGP, UMR 7154, Université Paris Diderot - Paris 7, Laboratoire de Géochimie des Eaux, Paris, France

REAL TIME MONITORING OF PRIMARY PRODUCTION AND CONTRIBUTION TO CARBON DYNAMICS IN THE URBAN PART OF THE SEINE RIVER HYDROSYSTEM

The objective of this study is to document the contribution of phytoplanktonic primary production in the carbon balance of the Seine ecosystem. This work is based on high resolution multi-parameter measurements (4/hour) (weather, CTD, oxygen, turbidity, pH, phosphorus, chlorophyll a (multi-wavelength fluoroprobe)) performed by an autonomous buoy deployed downstream from Paris city. These data sets are used to study the dynamics of phytoplankton blooms and associated environmental drivers. Particular work, in laboratory and on the field, will involve the study of relationships between chlorophyll a - Carbon - O2 in the photosynthetic process in order to quantify the primary production linked to these dynamics. This will allow a better understanding of the influence of this production on trophic functioning at the ecosystem scale. Ecological and trophic indicators will be developed and calculated in real time from measurements made by the buoy. These indicators will be assessed in terms of two potential applications: 1) management of water resources by operators 2) environmental monitoring in the context of the Water Framework Directive.

Estapa, M. L., University of Maine, Orono, ME, USA, margaret.estapa@maine.edu

Mayer, L. M., University of Maine, Walpole, ME, USA, lmayer@maine.edu

Boss, E. S., University of Maine, Orono, ME, USA, emmanuel.boss@maine.edu

PHOTOCHEMICAL GENERATION OF DOC FROM SUSPENDED SEDIMENTS IN COASTAL LOUISIANA

Under simulated sunlight, resuspended sediments from a number of coastal and aquatic environments release DOC, a process not included in coastal carbon budgets. "Photodissolution" during natural resuspension events hinges on the in-situ solar irradiance, CDOM concentration, and amount of sediment in suspension. We present temporally- and spatially-resolved estimates of the contribution of sunlit-driven DOC production from resuspended sediments to carbon fluxes in the Louisiana shelf system. Satellite reflectance data and numerical model outputs are used to derive irradiances, CDOM concentrations, and suspended sediment concentrations, while sediment absorption coefficients and photochemical reaction efficiencies are determined with laboratory measurements. Daily, area-normalized photodissolution rates show seasonal summertime maxima driven primarily by high ultraviolet irradiance, although wind-driven sediment resuspension, which is more common in cooler months, also intensifies rates. CDOM, rather than phytoplankton, competes most effectively with sediments for photons in the shallowest waters with the highest resuspension. The largest uncertainties arise from parameterizations of irradiance, relative CDOM/sediment absorption coefficients, and photochemical reaction efficiency. We use calculated rates to explore implications of photodissolution for coastal carbon cycling in the Northern Gulf of Mexico.
Etnoyer, P. J., NOAA/CCEHBR, Charleston, SC, USA, peter.etnoyer@noaa.gov
Shirley, T. C., Texas A&M University- Corpus Christi/Harte Research Institute, Corpus Christi, TX, USA, thomas.shirley@tamucc.edu
Stanley, K. A., Roatan Institute for Deepsea Exploration, Roatan, Honduras, kadin@stanleysubmarines.com

EXPLORING DEEP CORAL ECOLOGY WITH A TOURIST SUBMERSIBLE IN ROATAN, HONDURAS

Deep-sea exploration is expensive, because manned submersibles and remotely operated vehicles (ROVs) require large ships and crew to access deep-sea habitats. Some less expensive private submersibles can dive 300-700 m deep, and these may be adapted for science. We used Idabel, a shore-based tourist submersible, to explore deep-coral assemblages in deep-sea and mesophotic habitats in Roatan, Honduras. Nearly all samples were photographs, but two physical specimens were collected: the constructional scleractinian Dendrophyllia alternata and slit shell Bayerotrochus paramus. Patterns of vertical zonation were evident among the suspension feeders. Octocorals were large and abundant at all depths. Paramuricea was predominant 300-700 m deep. Narella, Corallium, and Isidella were also present. Nicella was predominant in the mesophotic zone (100-200 m). Octocoral predation and recolonization were observed. One denuded Paramuricea colony was photographed after two years. Regrowth of denuded branches was negligible. Lasers will be installed on Idabel in the future, and more samples will be collected, but new tools are necessary for more comprehensive species inventory.

Evans, M. A., University of Michigan, Ann Arbor, USA, mevans@umich.edu
Scavia, D., University of Michigan, Ann Arbor, USA, scavia@umich.edu

FORECASTING HYPOXIA IN THE CHESAPEAKE BAY AND GULF OF MEXICO: MODEL ACCURACY, PRECISION, AND SENSITIVITY TO ECOSYSTEM CHANGE

Increasing use of ecological models for management and policy requires robust evaluation of model precision, accuracy, and sensitivity to ecosystem change. We conducted such an evaluation of a hypoxia model for the Gulf of Mexico and Chesapeake Bay using hindcasts of historical data and comparing several approaches to model calibration. For both systems we find that model sensitivity and precision can be optimized and model accuracy maintained within reasonable bounds by calibrating the model to relatively short, 3-year, recent datasets. We propose a rolling calibration for future, annual or short-term, hypoxia forecasting and the use of ensemble modeling incorporating sensitivity trends and expected environmental change for longer term forecasting. Model accuracy was higher for Chesapeake Bay than for the Gulf of Mexico, potentially indicating the greater importance of un-modeled processes in the latter system. Retrospective analysis suggests both directional and variable changes in sensitivity of hypoxia to nutrient loads. Given current trends in climate and anthropogenic stressors we expect hypoxia in these systems to become more sensitive to those loads.

Evans, T. M., Ohio State University, Columbus, USA, evans.1250@osu.edu
Bauer, J. E., Ohio State University, Columbus, USA, bauer.362@osu.edu
Barrrett, A., Ohio State University, Columbus, USA
Loffler, S., Ohio State University, Columbus, USA

IDENTIFYING FOOD AND NUTRITIONAL RESOURCES SUPPORTING INVADE SEA LAMPREY AMMOCOETES IN LAKES MICHIGAN AND HURON WATERSHEDS USING ISOPTIC NATURAL ABUNDANCES

Sea lamprey (Petromyzon marinus) invaded the Laurentian Great Lakes in the mid 1900s, and caused the collapse of important commercial and recreational fish stocks until control measures were enacted in the 1960s. While the diet of the juvenile stage (which is parasitic on teleost fishes) has been well described, this stage constitutes a small part (~0.5-1.5 yrs) of the animal’s total life span (4-8 yrs). In contrast, larval lamprey (ammocoetes) filter feed in sediments for up to 7 years before metamorphosing and becoming parasitic juveniles. However, the diet of the ammocoete stage is at best ambiguous and largely non-quantitative because its gut contents have been difficult to identify visually. Through the use of natural stable (δ¹⁵N, δ¹³C) and radio (Δ¹⁵N) isotopes we identify and estimate the relative amounts of different organic materials ingested and assimilated by sea lamprey ammocoetes for growth and maintenance. Identification of potential food sources supporting P. marinus ammocoetes may allow for development of alternate and less environmentally damaging control methods.

Evans-White, M. A., University of Arkansas, Fayetteville, USA, mevanswh@uark.edu
Bumpers, P. M., University of Arkansas, Fayetteville, USA, pbumpers@uark.edu
Kanopsic, J., University of Arkansas, Fayetteville, USA, jkanopsi@uark.edu
Eldridge, Z., University of Arkansas, Fayetteville, USA, zeldridge@uark.edu

LANDUSE EFFECTS ON BENTHIC ALGAE AND METABOLISM RECOVERY AFTER FLOOD EVENTS IN OZARK STREAMS

Watershed land use can regulate the delivery of water, nutrients, and organic matter to stream ecosystems and may alter the recovery of stream ecosystem processes after hydrodynamic disturbance events. We measured water chemistry, benthic algae (chlorophyll a) and metabolism in agricultural (n=3), urban (n=4), and forested Ozark streams (n=4) prior to and after a flood event in autumn 2009 and spring 2010. Soluble reactive phosphorus [SRP (µg/L)] and nitrate-nitrogen [N₃-N (µg/L)] concentrations were greater in agricultural (mean±SE: SRP=38±20; N₃-N=2.3±0.2) and urban (SRP=18.8; N₃-N=0.7±0.1) streams than in forested streams (SRP=8.5; N₃-N=0.3±0.04). Benthic chlorophyll a required more days to recover in forested (mean±SE=25±11) than in agricultural (12.3) streams (p=0.038). Gross primary production also took more time (days) to recover in forested streams (16.3) compared to agricultural (mean±SE=7.2) and urban (mean=10.1) streams (p=0.048). Since climate change is expected to alter the magnitude and/or frequency of flood events in lotic ecosystems, our study suggests that stream community and ecosystem responses to those hydrochemical changes will likely depend upon watershed land use.

Fixeillard, D., Université de Nantes, Nantes, France, Damien.Eveillard@unist-nantes.fr
Bouskill, N. J., Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA, USA, nbouskill@lbl.gov
Bourdon, J., Université de Nantes, Nantes, France, jeremie.bourdon@unist-nantes.fr
Ward, B. R., Princeton University, Princeton, NJ, USA, bhw@princeton.edu

MODELING THE MICROBIAL CYCLE: FROM A PROBABLISTIC BACKBONE TO BIOLOGICAL INSIGHTS

Modeling the microbial carbon cycle is a difficult task. (i) Cycles driven by bacterial systems are complex. Moreover, (ii) microbial knowledge remains incomplete. Therefore, reasoning on the microbial cycle implies to integrate partial informations on complex networks. In another context, but similar purposes, systems biologists developed modeling techniques that achieve such an integration. Based on a probabilistic framework, Event Transition Graph (ETG) is one of them. First, one must consider the structure of the microbial network (i.e the skeleton of the probabilistic model). Second, one must consider partial time-series knowledge about a given bacterial compound. Such knowledge are, for illustration, the evolution of functional gene diversity along an environmental gradient, or a bacterial community composition over times. We then propose, via reverse engineering techniques, to infer the probabilities of the ETG that are accurate with experiments. As a result, it gives a prediction of the overall quantitative behaviors of the microbial cycle based on incomplete molecular experiments. The predictions emphasize the most important functional genes and the bacterial communities that co-occur together for given environmental conditions.

Everett, J. D., University of New South Wales, Sydney, Australia, Jason.Everett@unsw.edu.au
Baird, M. E., University of Technology Sydney, Sydney, Australia, Mark.Baird@uts.edu.au
Henschke, N., University of New South Wales, Sydney, Australia, N.Henschke@unsw.edu.au
Pitt, K. A., Griffith University, Gold Coast, Australia, k.pitt@griffith.edu.au
Suthers, I. M., University of New South Wales, Sydney, Australia, I.Suthers@unsw.edu.au

SWARMS OF THE SALP THALIA DEMOCRATICA OFF SOUTH-EASTERN AUSTRALIA: THE INTERACTION OF OCEANOGRAPHY, FECUNDITY AND GROWTH

Salps are the fastest growing multicellular animals. With rapidly sinking faeces and a comparatively large size, they potentially have a major role in the ocean’s carbon flux. Salps are relatively unstudied in Australian waters since the work of Heron and others over 20 years ago. During the Austral Spring (October) of 2008 and 2009 we sampled the dynamic region to the south of the East Australian Current Separation Zone. Dense blooms of Thalia democrita were observed across the continental shelf, but particularly within a coastal cold-core eddy. An Optical Plankton Counter, undulating between the surface and 120 m was towed though the centre of a cold-core eddy, recording counts of ~8000 ind. m⁻³ of zooplankton in a subsurface layer
(20-40 m) at the centre of the eddy, relative to <1000 ind. m$^{-3}$ at the edge. Up to 75% of these are believed to be T. democratica based upon size distribution and community composition analysis from nearby net samples, meaning this is the highest abundance of T. democratica measured in south-east Australian waters. The fecundity of T. democratica during these sampling periods is also assessed from laboratory studies in order to understand the mechanisms for bloom development. The size and number of buds released by the solitary form of T. democratica was observed in tanks, and numbers and lengths of internal buds before release was measured from preserved net samples.

**Everhart, J. C.**, University of Delaware, College of Earth, Ocean, and Environment REU, Lewes, USA, jeverhart@fandm.edu

Hennige, S., University of Delaware, College of Earth, Ocean, and Environment, Lewes, USA, sjhenn@udel.edu

Warner, M. E., University of Delaware, College of Earth, Ocean, and Environment, Lewes, mwarner@udel.edu

**TESTING THE IMPACT OF OCEAN ACIDIFICATION IN A CONTINUOUS CULTURE OF THE HARMFUL RAPHIDOPHYTE HETEROSIGMA AKASHIKI FROM THE EASTERN UNITED STATES**

Understanding the changes that harmful algae will experience under future climate conditions is critical to their potential impacts on human health and marine ecosystems. In order to determine the possible effects of ocean acidification on cell growth and physiology of the harmful raphidophyte Heterosigma akashiwo, cultures were grown in pH controlled cyclostats at 25°C, under ambient and elevated CO$_2$ conditions. Cell growth did not increase when grown under an excess CO$_2$ scenario designed to mimic projected CO$_2$ emissions in 100 years, remaining at approximately 1.0/d for both treatments. Both the maximum photochemical efficiency of photosystem II (PSII) and efficiency at the growth light intensity (40 µmol photons m$^{-2}$ s$^{-1}$) significantly increased under the elevated pCO$_2$ condition. However, PSII efficiency during a temporary shift to high light (400 µmol photons m$^{-2}$ s$^{-1}$) did not significantly differ between the two treatments, indicating no enhancement of photoprotection. There was also no change in the effective absorption cross-section of PSII, nor the amount of chlorophyll a/cell between CO$_2$ treatments, while there was a slight yet significant decline in total carbon assimilation in the elevated CO$_2$ treatment. Neither cellular protein nor nitrate reductase activity changed when Heterosigma received excess CO$_2$.

**Exton, D. A.**, University of Essex, Colchester, United Kingdom, daexto@essex.ac.uk

McGenity, T., University of Essex, Colchester, United Kingdom, tjmgen@essex.ac.uk

Steinke, M., University of Essex, Colchester, United Kingdom, msteinke@essex.ac.uk

Suggett, D. J., University of Essex, Colchester, United Kingdom, dsuggett@essex.ac.uk

**SPATIAL AND TEMPORAL PATTERNS IN BIOGENIC ISOPRENE EMISSIONS FROM A TEMPERATE ESTUARY**

Patterns of isoprene production in coastal environments remain relatively unknown, with models of marine emissions based on a handful of mostly open ocean and laboratory studies. Estuaries are highly variable systems; accounting for ca. 2.5% of total marine primary productivity. This study investigated temporal and spatial variability in isoprene along the Colne Estuary, UK, using purge-and-trap followed by gas chromatography with a flame ionisation detector. The concentration of isoprene in water decreased seawards and at high tide, which was confirmed with diurnal variation ranging from 102.12 ±9.77 (high tide) to 407.98 ±21.37 (low tide) pmol L$^{-1}$. Annual variation matched changes in water temperature, with high tide values ranging from 0.70 ±2.05 to 205.03 ±43.77 pmol L$^{-1}$, and low tide values ranging from 16.47 ±9.27 to 405.99 ±265.43 pmol L$^{-1}$. Microphytobenthos production showed no spatial variation, but ranged from 0.05 ±0.01 to 2.34 ±1.08 pmol cm$^{-2}$ h$^{-1}$ across the year, peaking during the summer. This demonstrates the high variability of isoprene in estuarine environments in response to patterns in environmental conditions, which should prove important for future emission models.

**Fallon, N. M.**, University of Massachusetts Boston, Boston, USA, Nicole.Fallon001@umb.edu

Christian, A. D., University of Massachusetts Boston, Boston, USA, Alan.Christian@umb.edu

**CONSUMER-DRIVEN NUTRIENT RECYCLING AND ECOLOGICAL STOICHIOMETRY OF FRESHWATER MUSSELS IN A NEW ENGLAND NORTH-EASTERN COASTAL ECOREGION POND**

The goal of this study was to evaluate consumer-driven nutrient recycling and ecological stoichiometry of the freshwater mussel Elliptio complanata (Lightfoot, 1796; Mollusca: Unionidae) in a Northeastern Coastal Ecoregion pond. This was accomplished by conducting nutrient-release and nutrient-limitation experiments and analyzing the nutrient content (i.e. C, N, and P) of mussels and mussel tissue, excretion, and biodeposition at three time periods (spring, summer, autumn). We hypothesized that mussel tissues would maintain a homeostatic C:N:P ratio, that excretion and biodeposition rates would show an allometric relationship, and that excretion and biodeposition rates would increase with increasing water temperature. Temporal variability in excretion and biodeposition rates and ratios and mussels C, N, and P percentages and ratios were observed. However, Tispaquin pond was not limited by P or N, or N+P (ANOVA, p = 0.298). As expected, mussels' tissues maintained relatively constant C, N, and P percentages and ratios and had higher excretion and biodeposition rates at higher temperatures. Our results suggest that mussels can influence communities by controlling the release of nutrients and providing nutrient resources through their excretion and biodeposition.

**Faithfull, C. L.**, University of Western Australia, Perth, Australia, jim.falter@uwa.edu.au

Lowe, R. J., University of Western Australia, Perth, Australia, ryan.lowe@uwa.edu.au

Atkinson, M. J., University of Hawaii, Kaneohe, USA, mja@hawaii.edu

Cuet, P., Université de la Reunion, Reunion, France, Pascale.Cuet@univ-reunion.fr

**SEASONAL DIFFERENCES IN PHYSICAL AND CHEMICAL FORCING OF CALCIFICATION RATES ON NINGALOO REEF, WESTERN AUSTRALIA**

Experimental evidence indicates that coral calcification rates are influenced by ambient carbonate chemistry as well as other sources of physical and chemical forcing. Predictions of future declines in coral calcification rates as a result of increasing ocean acidification vary greatly, thus emphasizing the need to verify such predictions with observations of in situ calcification rates. We measured calcification of a shallow coral community on Ningaloo Reef, Western Australia where incident light differed by a factor of two between summer and winter but water temperatures were ~1°C lower in summer. In summer, community calcification rates were independent of light and daily integrated calcification rates were not significantly different from summer. Furthermore, gross primary production was just 20-30% lower in winter than in summer. Seasonal differences in nutrient loading and carbonate chemistry along
with minor differences in temperature driven by oceanic forcing could explain the modest seasonality in coral community production and calcification.

Faneüstl, V. P., University of North Florida, Jacksonville, USA, vfaneüstl@yahoo.com
Craft, E. A., Gallaudet University, Washington, USA, elizabeth.craft@gallaudet.edu
Alexander, J. A., University of Maryland Center for Environmental Science, Cambridge, USA, jalexand@umces.edu
Gilbert, P. M., University of Maryland Center for Environmental Science, Cambridge, USA, gilbertg@umces.edu
Hellard, E., University of Maryland Center for Environmental Science, Cambridge, USA, egilbert@umces.edu

Signman, D. M., Princeton University, Princeton, USA, signman@princeton.edu
SMALL EUKARYOTIC PHYTOPLANKTON DRIVE THE SARGASSO SEA’S BIOLOGICAL PUMP
In the subtropical ocean gyres, intense surface stratification limits nitrate supply from below (“new” nitrogen [N]), and it is assumed that “regenerated” N supports most phytoplankton growth. In such N-poor systems, it is notoriously difficult to measure new and regenerated N uptake by the entire community, much less by individual taxa. Coupling flow cytometry with sensitive N isotope analysis, we find that, in the summertime Sargasso Sea, Prochlorococcus and Synechococcus have uniformly low 15N/14N, consistent with their reliance on regenerated N. In stark contrast, the 15N/14N of small eukaryotic phytoplankton (<30 µm) is higher and more variable, with a mean value comparable to thermocline nitrate. We infer that eukaryotes consume this nitrate, relying on it for >50% of their N. The high eukaryotic 15N/14N also explains the observed 15N/14N difference between sinking and suspended particulate N, implying that sinking material derives largely from eukaryotic, not prokaryotic, phytoplankton biomass. Thus the region’s biological pump is driven predominantly by eukaryotic phytoplankton. Analysis of samples from fall and winter/spring will determine whether differential N use by eukaryotic and prokaryotic photoautotrophs occurs year round.

Fay, A. R., University of Wisconsin-Madison, Madison, USA, arfay@wisc.edu
McKinley, G. A., University of Wisconsin-Madison, Madison, USA, gamckinley@wisc.edu

ESTIMATING GLOBAL CARBON TRENDS USING IN-SITU PCO2 OBSERVATIONS
Is the global oceanic CO2 sink in decline (Le Quere et al. 2009; Knoor 2009)? Recent studies of the North Atlantic carbon cycle, for example, suggest conflicting flux trends: data-based extrapolations report a declining sink (Schuster et al. 2009), while models have suggested an increasing flux (Ullman et al. 2009). Likewise, significant debate is ongoing regarding the Southern Ocean sink (Le Quere et al. 2009; Böning et al. 2008; Ho et al. 2010). Using the vast, newly updated, in-situ pCO2 dataset (Takahashi et al. 2009), analysis of trends in the global ocean carbon sink over recent decades can be considered. We use two global biogeochemical models (Doney et al. 2009; Dunne et al. 2005) to evaluate methodologies for determining trends in global timeseries constrained by limited spatial and temporal coverage. Using a robust methodology within large, biogeochemically-consistent regions, we diagnose pCO2 trends over decadal and multi-decadal timescales, along with the dominant mechanisms of change.

Feagin, R. A., Texas A&M University, College Station, USA, feaginr@tamu.edu
Colón-Ríos, R. J., Texas A&M University, College Station, USA, rjjcolum@tamu.edu
West, J. B., Texas A&M University, College Station, USA, jbwest@neo.tamu.edu
Yeager, K. M., University of Southern Mississippi, Stennis Space Center, USA, kevin.yeager@usm.edu

HYDROLOGICAL CONNECTIVITY IN SALT MARSH PONDS: MULTIPLE METHODS INCLUDING TIDAL GAUGES, WATER ISOTOPES, AND LIDAR ELEVATION MODELS
Salt marshes are often thought of as being hydrologically connected to the ocean via tidal creeks, though water bodies within a salt marsh may also be semi-permanently disconnected ponds. At a salt marsh in Matagorda, Texas, USA, there are many isolated ponds, located at varying elevations. Our primary objective was to quantify the hydrologic connectivity of spatially isolated ponds at this site. We sampled water for stable isotopes (δ2H, δ18O) and salinity to determine the relative contribution of tidal water and precipitation within each pond. We also quantified the water level at which each pond floods its banks and connects to each of the other ponds, using a LIDAR elevation model. We found that the similarity in isotopic value or salinity between any two sampled ponds was correlated with the water level elevation at which they connected together. Tidal gauge readings corroborated this relationship. We conclude that the connectivity of the hydrological network, and the similarity of water samples within it, profoundly changes when specific water level thresholds are exceeded.

Fenchel, T., University of Copenhagen, DK-3000 Helsingør, Denmark, tfenchel@bio.ku.dk

PROTIST EXTREMOPHILES
What is considered an “extreme condition” is somewhat relative to the organisms in question. When it comes to extremes with respect to environmental parameters such as e.g., temperature, salinity, and pH, prokaryotes hold all records. For prokaryotes life and growth in the absence of free O2 can hardly be considered “extreme”
since many forms including all members of several major groups are obligate anaerobes. Eukaryotes, however, probably evolved as aerobic organisms. Among them several species have secondarily adapted to permanent life without oxygen. This implies a number of adaptations including special types of energy metabolism and symbiosis with prokaryotes. Considerations of bioenergetics suggest that phagotrophs play a limited role in anaerobic habitats and that food chains must be short.

Feng, Y., Texas A&M University, College Station, USA, cathyyangfeng@neo.tamu.edu
DiMarco, S. F., Texas A&M University, College Station, USA, dimarco@tamu.edu
George, J. A., Texas A&M University, College Station, USA, jackson@fathom.tamu.edu

UNDERSTANDING THE RELATIVE ROLE OF WIND AND NUTRIENT FORCING OF THE NORTHERN GULF OF MEXICO HYPOXIA USING STATISTICAL AND A COUPLED NUMERICAL MODEL

The variability of the areal extent of mid-summer hypoxia in the northern Gulf of Mexico is well known to be associated with variations of late spring and early summer nutrient loading. However, when all years are included in a single variable regression analysis, nutrients can only account for 30-50% of the overall variability. We present a multivariate regression analysis that includes both the nutrient loading and number of upwelling days in one-month before the July shelf wide cruise. This regression explains about 73% of hypoxic area variation from 1993-2009, when a shift in areal variability has been documented. A coupled physical-biogeochemical model is used to mechanistically investigate how the upwelling wind controls hypoxic area. Scenario experiments using identical nutrient loading but predominantly upwelling or downwelling favorable winds shows that long duration of upwelling favorable wind is capable of changing the direction and flux of freshwater and nutrients onto the Texas-Louisiana shelf. This influences the dynamics of the Mississippi-Atchafalaya River plume. By reducing or increasing freshwater and nutrients, the stratification and productivity of the shelf waters is modified.

Ferreze, M., Universidade Estadual Paulista, Botucatu, Brazil, mferreze@ebib.unesp.br
Nogueira, M. G., Universidade Estadual Paulista, Botucatu, Brazil, nogueira@ebib.unesp.br

POTENTIAL ROLE OF ZOOPLANKTON AS FOOD RESOURCE FOR NEOTROPICAL FISH

The aim of this study was assess the potential role of zooplankton for the Neotropical fish. This study focused on juveniles and small size fish. Fieldwork was carried out bimonthly along a year. In each sampling station and period, five manual throws were performed towards aquatic macrophyte stands, using a hand net. Simultaneously, zooplankton was collected in order to assess the feeding selective. The samples were mesh, subdivided by vertical hauls with conical plankton net (50 Stomach contents of fishes were analyzed under stereo microscopy. The ichthyofauna was represented by 44 species. The zooplankton community was composed of 74 species. The diet was composed by 94 items. Microcrustaceans were the most diversified group (21 species), followed by algae (14 species) and aquatic insects (11 species). In terms of frequency of occurrence, zooplankton dominated, occurring in 67% of the stomach contents. Zooplankton also had a major contribution in the diet of the young fish, but when these individuals increase in size, the aquatic insects assumed the position of the main food item. These results show zooplankton community suffers high predation pressure by small size Neotropical fish.

Ferrugia, B., University of Maryland Center for Environmental Science, Integration and Application Network, Cambridge, USA, bferrugia@umes.edu
Carruthers, T. J., University of Maryland Center for Environmental Science, Integration and Application Network, Cambridge, USA, tcaruth@umes.edu
Dennisson, W. C., University of Maryland Center for Environmental Science, Integration and Application Network, Cambridge, USA, dennisson@umes.edu

SPATIAL LIMITS TO THE APPLICATION OF OYSTER δ²⁹⁸Ｎ AS AN INDICATOR OF NITROGEN SOURCES

Stable nitrogen isotopes (δ²⁹⁸Ｎ) in oysters have identified nitrogen derived from human and/or animal waste, integrating them over time, but few large-scale studies have been undertaken. This technique was applied broadly (11,600 km², 87.9 km² site) across Chesapeake Bay tributaries. Spatial patterns were mapped and δ²⁹⁸Ｎ measurements were compared across land cover (watershed areas 4% to 63% developed; 0.00% to 0.27% animal agriculture), salinity (9.6 to 28.2 ppt), flushing time (0.7 to 6.2 days), and oyster size (44.7 to 81.4 mm). Oyster δ²⁹⁸Ｎ increased away from Chesapeake Bay’s mouth (8.9% in Lynnhaven River to 14.9% in Eastern Bay), and was related to flushing time (y = 1.71x + 10.2, R² = 0.62, p < 0.01), salinity (y = -0.91x + 22.2, R² = 0.36, p < 0.05), and shell height (y = 0.14x + 21, R² = 0.83, p < 0.01). Due to spatial variability, oyster δ²⁹⁸Ｎ may not be appropriate to infer nitrogen sources across 1000s of km². Nevertheless, spatial patterns were apparent within tributaries (100s of km²), so smaller scale applications of oyster δ²⁹⁸Ｎ are still appropriate.

Ficzek, D., Pomeranian University in Slupsk, Slupsk, Poland, ficzek@apls.edu.pl
Zapadka, T., Pomeranian University in Slupsk, Slupsk, Poland, zapad@apls.edu.pl
Meler, J., Institute of Oceanology, Polish Academy of Sciences, Sopot, Poland, kunicka@oian.gda.pl
Majchrowski, R., Pomeranian University in Slupsk, Slupsk, Poland, majchrowski@apls.edu.pl

ABSORPTION PROPERTIES OF PARTICULATE AND DISSOLVED MATTER IN POMERANIAN LAKES (POLAND)

Concentrations of the main optically active constituents (OAC: chlorophyll a, suspended matter, and colored dissolved organic matter) and absorption properties of particulate and dissolved matter were investigated empirically in 15 Polish lakes. The research revealed a high variability of chlorophyll a concentration (Cₐₐₓ=1.3-336 mg m⁻³), concentration of suspended particulate matter (SPM(Cₐₐₓ=0.8-265 g m⁻³)) and absorption coefficient of colored dissolved organic matter CDOM (aₐₐₓ=0.35-17.8 m⁻¹). The research enabled to analyse the values and range of variability of spectral absorption coefficient of phytoplankton, monolagal particles, colored dissolved organic matter and their exponential slopes. The results have been...
compared with some published data obtained in inland and coastal waters located in various parts of the world. The comparisons have revealed certain similarities and disparities among the main constituents of absorption occurring in Polish lakes and those observed in other inland and coastal waters. It has also been shown that extrapolating of commonly used parameterisation onto rich in OAC lakes waters may lead to the lowering of light absorption coefficient values.

Fields, D. M., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA, dhfields@bigelow.org

Shema, S. D., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA, SSShema@bigelow.org

Browne, T. Q., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA

DO THE COCCOLITHS OF EMILIANIA HUXLEYI CONFER PROTECTION AGAINST COCEPOD-GRAZING?

Increase in atmospheric pCO2 decreases the degree of calcification in coccolithophorids. One of the inferred evolutionary functions of exterior algal mineral deposits is to deter zooplankton grazing. However, to date, there are no direct measurements of grazing rates as a function of the algal CaCO3 content. In this study, we examine the grazing rates of Acartia tonsa on Emiliania huxleyi with and without coccoliths and the subsequent sinking rates of the fecal pellets produced under each diet. Our data suggest that denuded E. huxleyi are consumed at significantly higher rates than cells with coccoliths and the fecal pellets produced sink at significantly slower rates. Changes in the ingestion rates and fecal pellet production rates of copepods can have significant effects on both the biological and the alkalinity pumps of the ocean. Data will be discussed in light of the indirect effects of ocean acidification.

Figary, S. E., State University of New York College of Environmental Science and Forestry, Syracuse, USA, sefigary@syr.edu

Schulz, K. L., State University of New York College of Environmental Science and Forestry, Syracuse, USA, kschulz@syr.edu

Teece, M. A., State University of New York College of Environmental Science and Forestry, Syracuse, USA, mteece@esf.edu

Rudstam, L. G., Cornell University, Ithaca, USA, rudstam@cornell.edu

INVESTIGATING THE IMPACT OF AN INVASIVE ZOOPLANKTON, CERCOPAGIS PENGEOI, ON THE LENGTH OF FOOD CHAINS IN NEW YORK’S FINGER LAKES

The predatory zooplankton Cercopagis pengoei invaded Lake Ontario in 1998, and one year later spread to 6 of the 11 Finger Lakes in N.Y. State (USA), leaving five non-invaded lakes. Cercopagis invaded a relatively empty niche in these lakes, where the native zooplankton assemblage is dominated by herbivores. We hypothesize this mid-trophic level invasion could increase the length of the food chain in invaded lakes as planktonic fish shift from consuming predominantly herbivorous zooplankton to a diet including the predatory invader. To compare food chain length in invaded and non-invaded lakes, we collected alewife (Alosa pseudoharengus) which are known to consume Cercopagis (Storch et al., 2007), from invaded and non-invaded lakes during August 2010. Stable nitrogen isotope analysis was used to determine the trophic position of the collected alewife, using zebra mussels (Dreissena polymorpha) collected from each lake as a baseline. The potential impact of the Cercopagis invasion on the length of the food chain is of interest because a longer food chain would increase bioaccumulating toxins, such as polychlorinated biphenyls (PCBs) in fish.

Figueres-Nieves, D., University of New Hampshire, Durham, USA, dpv3@unh.edu

McDowell, W. H., University of New Hampshire, Durham, USA, bill.mcdowell@unh.edu

Potter, J. D., University of New Hampshire, Durham, USA, jody.potter@unh.edu

RATES OF NUTRIENT UPTAKE IN STREAMS RECEIVING TREATED SEWAGE EFFLUENT IN PUERTO RICO

Collection and treatment of sewage in waste water treatment plants (WWTP) has potentially important impacts on stream ecosystems. This study investigated rates of ammonium, nitrate, phosphate, TDN, DON, and DOC uptake in several Puerto Rican streams receiving WWTP effluent. Water samples were collected upstream of the sewage effluent, at the WWTP effluent, and at six stations downstream of the sewage effluent. Nutrients in the sewage effluent were treated as solutes injected into the stream during a nutrient addition experiment. Preliminary findings show long uptake lengths for nitrate, phosphate and TDN suggesting low retention in these streams. Overall, DON and ammonium showed shorter uptake lengths than the other nutrients, however, no clear pattern was observed for areal rate (U) and uptake velocity. When nitrate uptake data from this study were combined with other studies done in Puerto Rican streams, we observed that U and uptake velocity increased with nitrate concentrations, suggesting that these streams are becoming more efficient at removing nitrate under elevated concentrations, contrary to continental-scale patterns observed in previous work.

Filip, J., University of Oldenburg, Oldenburg, Germany, Joanna.filip@uni-oldenburg.de

Hillebrand, H., University of Oldenburg, Oldenburg, Germany, hillebrand@ceb.uni-oldenburg.de

Moorthi, S. D., University of Oldenburg, Oldenburg, Germany, stefanie.moorthi@uni-oldenburg.de

RELEVANCE OF FUNCTIONAL DIVERSITY IN (MICROBIAL) FOOD WEBS

We investigated the effects of ciliate consumer diversity and their degree of specialization (generalists vs. specialists) on algal prey biomass, diversity and composition in freshwater microbial microcosms. Ciliates differed in feeding preferences and grazing rates (Experiment 1), but also in feeding strategies (heterotrophic vs. mixotrophic consumers, Experiment 2). Increasing consumer richness decreased prey biovolume in both experiments, but decreased evenness only in Experiment 1. These effects were stronger for specialist compared to generalist consumers in Exp 1, as well as for heterotrophic compared to mixotrophic consumers in Exp 2. Furthermore, consumer richness led to increased secondary production (Exp 1). In a more complex configuration (Experiment 3), we used a natural lake assemblage of phytoplankton as prey for ciliate generalists and specialists and added an omnivorous cladoceran (Daphnia magna) as an additional trophic level. This study demonstrates that consumer diversity and consumer traits significantly affect adjacent trophic levels in terms of biomass, diversity, composition and trophic transfer, and therefore substantially advances our understanding of diversity effects across trophic levels and dynamics in plankton food webs.

Filstrup, C. T., Iowa State University, Ames, USA, cfilstrup@iastate.edu

Downing, J. A., Iowa State University, Ames, USA, downing@iastate.edu

THE INFLUENCE OF EUTROPHICATION ON PHYTOPLANKTON COMMUNITY COMPOSITION: IS THERE A MONOTONIC INCREASE IN CYANOBACTERIA?

Analyses of world patterns in phytoplankton composition suggest that Cyanobacteria increasingly dominate lake phytoplankton as nutrients increase. As eutrophication increases worldwide due to increased food and energy demands, cross-scale interactions may yield different responses, especially where human impacts are felt over broad geographical areas. We tested the hypothesis that this same relationship holds across temperate regions that receive high nutrient loads from agricultural watersheds. We analyzed phytoplankton taxonomic composition and summer average total phosphorus and total nitrogen concentrations across 131 temperate lakes sampled from 2000-2009 to describe these relationships. We hypothesized that the relative contribution of Cyanobacteria would increase with increased phosphorus and decrease with increasing total nitrogen. Analyses suggest that the relative contribution of Cyanobacteria was unexpectedly unrelated to total phosphorus concentration. Analyses also suggest that both chlorophyll a concentrations and the relative contribution of Cyanobacteria decrease in lakes with high total nitrogen concentrations. Other taxonomic groups also show unexpected relationships to nutrient concentrations. We suggest that historical studies may describe inter-regional phytoplankton-nutrient relationships and that these analyses may not be valid for making predictions at smaller spatial scales.

Finiguerra, M. B., University of Connecticut, Gorton, USA, michael.finiguerra@uconn.edu

Flores, H. M., University of Connecticut, Gorton, USA, hayley.flores@algenolbiofuels.com

Senft, C., University of Connecticut, Gorton, USA, christina.senft@huskymail.uconn.edu

Chen, L., University of Connecticut, Gorton, USA, lihua.chen@huskymail.uconn.edu

Avery, D. E., University of Connecticut, Gorton, USA, david.e.avery@uconn.edu

Dam, H. G., University of Connecticut, Gorton, USA, hans.dam@uconn.edu

FUNCTIONAL SHIFTS IN ZOOPLANKTON GRAZING DURING THE PROGRESSION OF A TOXIC DINOFLAGELLATE BLOOM

Simultaneous cascade and dilution experiments were conducted spanning the entire course of the spring 2010 toxic Alexandrium sp. bloom in Northport Harbor,
Long Island Sound, NY. We determined the effect of both micro- (<20µm) and meso- (> 200µm; dominant copepod species) zooplankton on the growth rates of the phytoplankton community (chlorophyll a) and Alexandrium spp. Throughout the time course copepods never affected the phytoplankton community. Similarly, neither did micro- zooplankton prior to the bloom. Early in the bloom, though, microzooplankton had a negative effect on phytoplankton, but not on Alexandrium. Copepods, however, directly reduced Alexandrium sp. growth rates. Conversely, late in the bloom, copepods had an indirect effect on Alexandrium growth rates: growth increased with copepod density. At this stage, microzooplankton had a strong direct effect on phytoplankton, but no effect on Alexandrium sp. Finally, immediately after the bloom, microzooplankton had no effect on phytoplankton, but a direct effect was observed six weeks post-bloom. These results suggest that the varying functional roles of micro and mesozooplankton grazing on HAB dynamics deserve further attention.

**Fink, P.** University of Cologne, Koeln, Germany,patrick.fink@uni-koeln.de

Mölzer, J., University of Cologne, Koeln, Germany

**VOLATILE FORAGING KAIROMONES IN THE LITTORAL ZONE: GAS-TROPOD GRAZERS PERCEIVE RESOURCE QUANTITY AND QUALITY VIA ALGAL OXYLIPINS**

Gastropods have a key function in the food web of marine and freshwater littoral zones. Since the distribution of primary producers in littoral habitats is patchy, it should be highly adaptive for herbivorous gastropods to utilize chemical signals in order to locate (high quality) food patches. In earlier studies, we have demonstrated that freshwater snails are able to detect chemical cues from their resource (benthic algae) and to respond with a chemotactic behavior towards the odor bouquet released from benthic diatoms and green algae. These volatile foraging kairomones (oxylipins) are produced upon cell damage from membrane lipids via an enzyme cascade. We here investigated whether aquatic gastropods are not only able to detect the presence of food, but if they are also able to distinguish high- and low-quality food from a distance based on the characteristic bouquet of infochemicals released by resources (algae) of different quality. Controlled laboratory experiments with the pond snail *Lymnaea stagnalis* and infochemicals from green algae of different nutrient stoichiometry (C:N:P ratios) revealed a dynamic adaptation of the gastropods to resource quality perceived over a distance.

**Finlay, K., University of Regina, Regina, Canada, kerri.finlay@uregina.ca**

Leavitt, P. R., University of Regina, Regina, Canada, peter.leavitt@uregina.ca

Vogt, R., University of Regina, Regina, Canada, richard.vogt@uregina.ca

Bogard, M., University of Regina, Regina, Canada, bogardzm@uregina.ca

Wissel, B., University of Regina, Regina, Canada, bjorn.wissel@uregina.ca

**GLOBAL WARMING REDUCES CO2 EFLUX FROM HARDWATER LAKES AND OFFSETS AGRICULTURAL CO2 EMISSIONS**

Inland lakes play an important role in regulating global carbon (C) fluxes, including atmospheric emissions, long-term sequestration, and linkages between dissolved inorganic (DIC) and organic (DOC) pools. However, to date, few studies have quantified the role of climatic variability in controlling CO2 exchange between lakes and the atmosphere, despite the observation that the magnitude and direction of these fluxes vary 35-fold among years and lakes. To address this issue, we quantified how meteorological variability during a 16-year monitoring period regulated the fluxes of CO2 in 6 lakes in the Northern Great Plains of North America. Unexpectedly, we found that net CO2 exchange was regulated by variation in summer pH, which in turn controlled by changes in the duration of ice cover. Specifically, warmer winters promoted shorter ice cover, decreased metabolic production of CO2 under ice, high spring pH, and elevated chemical enhancement of CO2 uptake. As a result, mean CO2 flux declined from out-gassing at 75 g C/m2/summer to in-gassing >50 g C/m2/summer; a difference which when regionally-scaled was of the same magnitude of total agricultural CO2 emissions.

**Fischer, J. P.** Max Planck Institute for Marine Microbiology, Bremen, Germany, jfischer@mpi-bremen.de

Koop-Jakobsen, K., Max Planck Institute for Marine Microbiology, Bremen, Germany, kkoopjak@mpi-bremen.de

Holtappels, M., Max Planck Institute for Marine Microbiology, Bremen, Germany, mholtapp@mpi-bremen.de

Wenzhoefer, F., Max Planck Institute for Marine Microbiology, Bremen, Germany, fwenzhoe@mpi-bremen.de

**SPATIO-TEMPORAL OXYGEN DYNAMICS ON DIFFERENT SCALES: INVESTIGATIONS WITH A NOVEL MULTI FIBER OPTODE IN SEDIMENTS AND WATER COLUMN**

Dissolved oxygen concentrations in the water column and porewaters are controlled by physical, chemical and biological processes, often subject to high variability. Assessing spatio-temporal fluctuations in oxygen concentration on different scales requires a high number of simultaneous measurements at an adequate resolution. To achieve this, a Multi Fiber Optode (MuFO) consisting of 100 fiber optic sensors was build. All sensors record oxygen concentrations simultaneously. The MuFO was first used to investigate fluctuations in oxygen profiles on the Crimene shelf in the Black Sea with the sensors arranged as a vertical string, extending 8 m from the seafloor into the water column. Strong temporal variations in the oxygen availability were recorded and are expected to have profound influence on benthic ecosystems. In a second application, the sensors were inserted into a salt marsh rhizosphere at different depths to monitor sediment oxygenation during day-night cycles and at high and low tide. We observed only short periods of oxygenation in the top sediment layers notwithstanding the very dense rhizosphere. This work was supported by the 7th framework EU projects HYPOX and SENSENET.

**Fisher, C. R.** Pennsylvania State University, University Park, USA, cfisher@psu.edu

Hsing, P. Y., Pennsylvania State University, University Park, USA, Pen-Yuan.Hsing@psu.edu

Podowski, E. L., Pennsylvania State University, University Park, USA, elp145@gmail.com

Becker, E. L., Pennsylvania State University, University Park, USA, elb209@psu.edu

Lessard-Pilon, S., Pennsylvania State University, University Park, USA, sal225@psu.edu

Cordes, E. E., Temple University, Philadelphia, USA, ERIK CORDES

Endlerlein, T., Pennsylvania State University, University Park, USA, tm110@psu.edu

Shank, T., Woods Hole Oceanographic Institution, Woods Hole, USA, tshank@whoi.edu

Brooks, J. M., TDI Brooks Int., College Station, USA, drjmbrooks@aol.com

**MONITORYING OF DEEP CORAL AND SEEP COMMUNITIES IN THE GULF OF MEXICO**

In 2009 we established fifteen long-term observation stations in eight areas of the deep Gulf of Mexico with extensive coral development by constructing high-resolution photomosaics of well-marked stations between 25 and 100 m. Over half of these areas were newly discovered in 2009 as part of ongoing BOEMRE/NOAA OER project. We have two cruises with deep submergence assets in late 2010 to revisit these and other sites in the wake of the Deep Water Horizon disaster.

In addition to coral sites ranging from 10 to over 200 miles distant from the spill we will visit additional hard ground sites closer to the source of the spill that are being surveyed in late October 2010 for the presence of seep or coral communities. This presentation will describe the range of coral communities encountered in the deep Gulf of Mexico, present results from our long term imaging studies, and provide an update on the visible effects (if any) of the Deep Water Horizon disaster on the deep hard bottom communities in the central and northern Gulf of Mexico.

**Fisher, J. A.** Queen’s University, Kingston, Canada, jonathan.fisher@queensu.ca

Frank, K. T., Bedford Institute of Oceanography, Dartmouth, Canada, kenneth.frank@dfo-mpo.gc.ca

Leggett, W. C., Queen’s University, Kingston, Canada, wleggett@queensu.ca

**QUANTIFYING MARINE FISH CONNECTIVITY ON THE SCOTTISH SHELF: RESULTS FROM FOUR DECADES OF ECOSYSTEM MONITORING**

Research on the dynamics of exploited aquatic ecosystems continues to yield insights into the patterns and implications of degraded population and community connectivity. Ecosystem monitoring data from the Scottish Shelf large marine ecosystem spans 41 years and has been used to diagnose patterns of marine fish larval diversity, abundance-distribution relationships, spillover from marine protected areas, population sub-structure, community similarity, and thermal range limits. While previously examined in isolation, these patterns are interdependent, yet an ongoing challenge is to link disparate dynamics within a common context. We review and integrate community-level marine fish patterns using concepts derived from terrestrial landscape ecology. Illuminating the interconnections among patterns remains critical for establishing and evaluating marine protected areas, as well as for predicting the influences of fisheries and climate change on the geographic range limits and interactions among species within this and other large marine ecosystems.
GROUNDWATER NO

Using vertical fluxes of N and O to indicate transport via diffusive and advective processes to the atmosphere.

Fisher, T. R.

the lower egg production rate of copepods fed Fe-deficient diets.

in FA and sterol concentrations than their algal food. Differences in lipid concentrations for specific saturated, monounsaturated, and polyunsaturated FAs, but across species was evident for Fe effects on algal sterol concentration and composition. Which was about 2x higher in Fe-replete algae. No consistent pattern for all algal species was evident for Fe effects on algal sterol concentration and composition. PUMPING IRON PRODUCES FATTY PHYTOPLANKTON

The effects of iron on planktonic lipids have not been well-studied. Because Fe is required in fatty acid (FA) desaturases, Fe availability may affect the composition of FAs in marine algae. Fe-limited and Fe-replete cultures of 3 algal species and a copepod that fed on these algae were analyzed for FAs and sterols. The total mass of FAs cell-1 was 2.2 to 3.1x as high as Fe-deficient copepods as in Fe-deficient cells (1.4-1.5x as high on a C-normalized basis). Significant differences were noted between Fe treatments for specific saturated, monounsaturated, and polyunsaturated FAs, but across all algal species, the only consistent difference between Fe treatments was for 18:4ω3, which was about 2x higher in Fe-replete algae. No consistent pattern for all algal species was evident for Fe effects on algal sterol concentration and composition. Copepods feeding on Fe-replete and Fe-deficient algae displayed smaller differences in FA and sterol concentrations than their algal food. Differences in lipid concentration and composition between Fe-replete and Fe-deficient algal species may partly explain the lower egg production rate of copepods fed Fe-deficient diets.

Fisher, K. M.

NOAA, National Ocean Service, Silver Spring, USA, kathleen.fisher@noaa.gov

Allen, A. L.

NOAA, National Ocean Service, Silver Spring, USA, Allison.Allen@noaa.gov

Stumpf, R. P.

NOAA, National Ocean Service, Silver Spring, USA, Richard.Stumpf@noaa.gov

OPERATIONAL ECOLOGICAL FORECASTING: A HARMFUL ALGAL BLOOM SUCCESS STORY PROVIDES REALISTIC PROSPECTS FOR THE FUTURE OF ECOFORECASTING

Harmful algal blooms are a costly and frequently occurring natural hazard with severe impacts to human and ecological health and regional economies. Since 2004, NOAA’s National Ocean Service (NOS) has issued operational harmful algal bloom (HAB) forecasts for the eastern Gulf of Mexico in order to alert coastal managers to the potential presence of new HABs, changing bloom conditions, and possible impacts. In the fall of 2010, HAB forecasts for the western Gulf of Mexico were transitioned to operations, allowing for full operational forecasting coverage of HABs in the Gulf of Mexico and initiating a five year plan to expand operational HAB forecasting nationally. The success of the Harmful Algal Bloom Operational Forecast System has required extensive collaboration within NOAA, and with federal, state and local monitoring and public health agencies. This success has not been met without challenges. In particular, the need for a structured end-to-end research to operations strategy is a difficult, but essential, challenge that provides a realistic prospect for the future of operational ecological forecasting.

Fisher, N. S.

Stony Brook University, Stony Brook, NY, USA, nfisher@notes.cc.sunysb.edu

Chen, X., Stony Brook University, Stony Brook, NY, USA, xichen2@ic.sunysb.edu

Wakeman, S. G., University of Washington, Seattle, WA, USA, Stuart.Wakeman@skio.usg.gov

FISHING FOR THE INFLUENCE OF IRON ON PHYTOPLANKTON AND ZOOPLANKTON IN THE GREAT SALT LAKE (UTAH)?

High mercury concentrations in birds that utilize the Great Salt have led to consumption advisories for three duck species, but the pathways behind this problem are not well understood. A railway causeway dividing the lake allows saltier water from the north arm to form a deep brine layer (monimolimnion) in the bottom of the lake's south arm. Respective MeHg and total Hg in this anoxic monimolimnion were 28 and 48 ng/L—24 and 16 times higher than the overlying surface water. Particulate N was nearly 10 times higher in the monimolimnion, potentially providing denitrification in hydric soils has the potential to account for most of the missing N in the Choptank Basin.

Fitzgerald, W. E.

University of Connecticut, Groton, USA, william.fitzgerald@uconn.edu

Hammerschmidt, C. R., Wright State University, Dayton, USA, chad.hammerschmidt@wright.edu

Bowman, K. L., Wright State University, Dayton, USA, bowmankg@wright.edu

DISTRIBUTION AND FLUXES OF MONOMETHYL AND DIMETHYL MERCURY ON THE CONTINENTAL MARGIN OF THE NORTHWEST ATLANTIC OCEAN

We are engaged in a comprehensive investigation of the biogeochemistry of monomethylmercury (MMHg) and dimethylmercury (DMHg) in sediments and waters of the continental shelf and slope in the northwest Atlantic Ocean. Results from three oceanographic cruises (2008-2010) suggest that total Hg in filtered seawater is relatively uniform throughout the study area. In contrast, dissolved MMHg increases typically with depth and DMHg is present in waters near the sediment-water interface on the shelf. Peaks of MMHg (80-300 fm) in slope water are consistent with mobilization from sediment. MMHg (22 ± 5 fm) and DMHg (11 ± 2 fm) in North Atlantic Deep Water are comparable to levels we have observed recently in deep water of the eastern North Pacific (19 ± 2 fm MMHg, 15 ± 1 fm DMHg). These distributions suggest that both MMHg and, uniquely, DMHg are produced and mobilized from deposits on the continental margin. MMHg gradients on the shelf yield estimates of benthic MMHg fluxes that are similar to those determined in other coastal studies.

Flear, K.

Queen's University, Kingston, Canada, 9kf5@queensu.ca

Wiltsie, B., Queen's University, Kingston, Canada

Paterson, A. M., Dorset Environmental Science Centre, Dorset, Canada

Cumming, B. F., Queen's University, Kingston, Canada

INVESTIGATING THE ROLE OF RECENT CLIMATE CHANGE ON ASSEMBLAGES OF SCALED CHRYSOPHYTES IN BOREAL LAKES FROM THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO

Over the past several decades, many boreal lakes across Canada's Precambrian Shield have experienced an increase of taste and odour events, which have been frequently associated with algal blooms of colonial chrysophytes. Because these nuisance blooms have been recorded across a wide geographic area, climate change is hypothesized as one of several factors to be influencing their increasing occurrence. While most boreal lakes are affected by multiple regional stressors, (e.g. acid rain, watershed development), the minimally impacted lakes of the Experimental Lakes Area (ELA), northwestern Ontario, offer an ideal setting to study the effect of recent climate change on colonial chrysophyte blooms. Sediment cores spanning the past 200 years were retrieved from six small (≤500 ha) ELA lakes, and scaled-chrysophyte assemblages were analyzed at a sub-decadal resolution from pre-industrial (pre-1850s) to modern times. Each core was dated using the constant rate of supply model for 210Pb activity. Results indicate that each lake has experienced substantial changes in the chrysophyte community since pre-industrial times, with colonial species showing large shifts occurring over the past several decades.

Fleming, E.

Utah State University, Logan, USA, erin.e@aggiemail.usu.edu

Wurtsbaugh, W. A., Utah State University, Logan, USA, wayne.wurtsbaugh@usu.edu

DO ARTEMIA BIOACUMULATE METHYL MERCURY FROM THE MONIMOLIMNION OF THE GREAT SALT LAKE (UTAH)?

High mercury concentrations in birds that utilize the Great Salt have led to consumption advisories for three duck species, but the pathways behind this problem are not well understood. A railway causeway dividing the lake allows saltier water from the north arm to form a deep brine layer (monimolimnion) in the bottom of the lake's south arm. Respective MeHg and total Hg in this anoxic monimolimnion were 28 and 48 ng/L—24 and 16 times higher than the overlying surface water. Particulate N was nearly 10 times higher in the monimolimnion, potentially providing...
Flors, R., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, ruth.flors@awi.de
Koch, B. P., University of Applied Sciences and Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, boris.koch@awi.de
Lucio, M., Helmholtz Zentrum Muenchen, German Research Center for Environmental Health, Neuherberg, Germany, mariana.lucio@helmholtz-muenchen.de
Schmitt-Kopplin, P., Helmholtz Zentrum Muenchen, German Research Center for Environmental Health, Neuherberg, Germany, schmitt-kopplin@helmholtz-muenchen.de
Lechtenfeld, O. J., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, oliver.lechtenfeld@awi.de
Kattner, G., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, gerhard.kattner@awi.de

MOLECULAR LEVEL INVESTIGATION OF COMPOSITION AND SURFACE-TO-DEPTH TRANSFORMATION OF DISSOLVED ORGANIC MATTER IN THE EAST ATLANTIC OCEAN USING FT-ICR MS

Marine dissolved organic matter (DOM) plays an important role in many marine processes and in long-term carbon storage in the deep ocean. In order to track these processes, it is crucial to know its molecular properties. Using ultrahigh resolution Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS), it is possible to simultaneously distinguish thousands of compounds of different elemental composition in one sample. Our aim was to investigate the transformation of fresh DOM in the Atlantic Ocean on a molecular basis. We sampled DOM from different climate zones and water depths on a north-south transect. After solid phase extraction, 140 DOM extracts were analyzed with FT-ICR MS. Principal component analysis (PCA) and cluster analysis, allowed to distinguish provinces of water masses based on their molecular composition. We investigated the differences between the provinces on an elemental formula basis and followed the compositional changes from surface to the deep ocean water. The relative abundance of specific homologous series decreased from surface to the deep ocean representing a molecular proxy for the transformation of fresh into refractory organic matter.

Flores, H. M., University of Connecticut, Groton, USA, hayley.flores@alum.mit.edu
Wilfors, G. H., National Marine Fisheries Service, Milford, USA, gwilfors@clam.mil.nmfs.gov
Dam, H. G., University of Connecticut, Groton, USA, hans.dam@uconn.edu

REACTIVE OXYGEN SPECIES ARE LINKED TO TOXICITY OF ALEXANDRIUM spp. TO PROTISTS

Several species in the dinoflagellate genus Alexandrium produce neurotoxins (saxitoxins). Saxitoxins block voltage-gated sodium channels and prevent nerve transmission signals in metazoans. However, protists lack nerve cells, and therefore the mechanism of toxicity might be different. We conducted experiments to examine the response of a ciliate, Tiarina sp., and a heterotrophic dinoflagellate, Polykrikos sp., to three strains Alexandrium tamarense, each with a different toxin content. Both protist species fed on all three Alexandrium strains, but significant mortality occurred within 24 h when exposed to high densities of each strain. Protist mortality, however, was not related to the saxitoxin content of the Alexandrium strains, indicating indeed a different mechanism of toxicity for protists. Addition of antioxidants significantly increased survival of both protist species when exposed to all Alexandrium strains, suggesting that reactive oxygen species and/or the secondary compounds produced by ROS-induced lipid peroxidation are involved in the toxicity of Alexandrium spp. to ciliates and heterotrophic dinoflagellates. This mechanism of toxicity is previously unknown for Alexandrium spp., and suggests revision of our conception of Alexandrium-protist interactions.

Flores, I. M., Nova Southeastern University, Ft. Lauderdale, USA, flucy@nova.edu
Hoagland, P., Woods Hole Oceanographic Institution Marine Policy Center, Woods Hole, USA, phoagland@whoi.edu
Jin, D., Woods Hole Oceanographic Institution Marine Policy Center, Woods Hole, USA, djin@whoi.edu
Ralston, E., Woods Hole Oceanographic Institution Marine Policy Center, Woods Hole, USA, eralston@whoi.edu

THE POTENTIAL RELATIONSHIP BETWEEN HARMFUL ALGAL BLOOMS AND TOURISM ON CAPE COD

Certain species of marine algae produce toxins that are known to be harmful to both other marine life and to humans. When blooms of these species occur, they are called harmful algal blooms (HABs). It is possible that coastal tourism to Cape Cod, Massachusetts, can be affected negatively by HABs. Our goal is to determine whether or not there is a negative relationship between HABs and tourist visits to Cape Cod. If so, we might be able to predict fluctuations in tourism and regional economic impacts in the event of HABs. We start with the null hypothesis that there is no effect between HABs and the tourist visits to Cape Cod. We consider two whether other factors, such as the amount of precipitation, number of rainy days per month, and air temperature, could be more important than HABs in determining tourism rates. To test our hypothesis, we conducted a statistical analysis of the relationship between measures of Cape Cod tourism and PSP levels and other explanatory variables. Analysis of our results suggests that rejection of our null hypothesis is necessary.

Forczyk, R. L., Northeast Fisheries Science Center, Woods Hole, USA, Michael. Forczyk@noaa.gov
ECOSYSTEM-BASED FISHERY MANAGEMENT ON THE NORTHEAST U.S. CONTINENTAL SHELF: OPTIONS FOR IMPLEMENTATION

There is an emerging global consensus on the need to adopt an ecosystem approach to management of human activities in marine systems. Key elements of the approach include the recognition that humans are an integral part of the ecosystem, that management must consider inter-relationships among components of the system and the effects of environmental forcing, and that management units should be based on ecological rather than political boundaries. I will review progress toward defining strategies for Ecosystem-based Fishery Management (EBFM) on the Northeast U.S. continental shelf. The approach focuses on the objective delineation of ecological subregions of the northeast shelf as potential management units, specification of a transition strategy from current management structures to EBFM, estimation of fishery production potential for ecological management units, specification of sustainable ecosystem exploitation rates, and an allocation strategy to define allowable harvest levels of individual species subject to constraints designed to protect ecosystem structure and function. The overall approach is set within a precautionary and adaptive management framework.

Forrest, D. R., Virginia Institute of Marine Science, Gloucester Point, VA, USA, df @vim s.edu
Hetland, R. D., Texas A&M University, College Station, TX, USA, hetland@tamu.edu
DiMarco, S. F., Texas A&M University, College Station, TX, USA, sdmarco@tamu.edu
MULTIVARIATE MODELLING OF SEASONAL HYPOXIA OVER THE TEXAS-Louisiana CONTINENTAL SHELF

We relate seasonal hypoxic area surveys for the Texas-Louisiana shelf from 1985 through 2010 with the Mississippi river discharge, nitrogen loading, wind forcing, wind stress, wind power, and sea surface temperatures using multivariate statistical models. By including exogenous factors in the model, we can directly assess the impacts of controllable variables relative to environmental factors. We find the eastwards component of the wind to be one significant mechanism controlling hypoxia.

Forr yb, M. K., University of Maryland Center for Environmental Science, Solomons, MD, USA, forryb@ces.umces.edu
Harris, L. A., University of Maryland Center for Environmental Science, Solomons, MD, USA, harris@ces.umces.edu
AN EXPLORATION OF RESTORATION STRATEGIES USING A HYBRID ECO SYSTEM-INDIVIDUAL-BASED OYSTER MODEL

The Potomac River estuary is susceptible to changes in water quality, affected by watershed land use, population, and climate that affect sediment, nutrient, and freshwater inputs to the receiving water. Feedbacks between a decline in water quality and the Eastern oyster are of interest to current efforts to restore the oyster population and meet Total Maximum Daily Load regulatory requirements. Existing models describe the bioenergetics of oyster growth in the simulation environment of a complex hydrodynamic water quality model. Here we explore implications of parameterizing oysters using model units of individuals rather than grams carbon of oyster per square meter. By modeling individual oysters we can introduce new formulations that explore the relationships among oyster size, morphology, and emergent oyster reef structural characteristics on particle trapping and growth dynamics, creating a dynamic food supply variable that is a function of both individual characteristics and the environmental context of the oyster reef. We present this new model and a comparison of simulated oyster dynamics in aquaculture cages versus traditional restoration methods in the Potomac River.
Fortunato, C. S., University of Maryland Center for Environmental Science, Horn Point Laboratory, Cambridge, USA, cfortunato@umces.edu
Herfort, L., Center for Coastal Margin Observation and Prediction, Oregon Health and Sciences University, Beaverton, USA, herfortl@ebs.ogi.edu
Zuber, P., Center for Coastal Margin Observation and Prediction, Oregon Health and Sciences University, Beaverton, USA, pzuber@ebs.ogi.edu
Baptista, A. M., Center for Coastal Margin Observation and Prediction, Oregon Health and Sciences University, Beaverton, USA, baptista@stcsmop.org
Crump, B. C., University of Maryland Center for Environmental Science, Horn Point Laboratory, Cambridge, USA, bcрump@umces.edu

SPATIAL AND TEMPORAL VARIABILITY OF BACTEROIPLANKTON COMMUNITIES ACROSS A RIVER TO OCEAN GRADIENT ASSESSED WITH TAG PYROSEQUENCING

Bacterioplankton communities vary across a river to ocean gradient with estuaries as an intermediate environment where freshwater and marine bacteria mix. Spatial and temporal variability were assessed for bacterioplankton communities of the Columbia River, estuary, and coastal ocean using tag pyrosequencing of the 16S rRNA gene. 306 water samples, collected from the river, estuary, and coastal ocean in 2007-2008, were pyrosequenced. An additional 250 samples from 2009-2010 will be sequenced, totaling over 550 samples across four years. Analysis of 2007-2008 samples revealed bacterioplankton communities separated across salinity and depth gradients into seven groups: Columbia River, estuary, plume, epipelagic, mesopelagic, shelf bottom (depth<150 m), and slope bottom (depth>300 m). The great spatial variation of the dataset overwhelmed any seasonal trends as temporal variation was only observed within similar environment types. Community patterns will be compared to simultaneously collected environmental data to identify key environmental factors that strongly influence variability. Understanding how bacterioplankton communities change across a river to ocean gradient allows for better prediction of how these communities, and ecosystems as a whole, might be shaped by environmental change.

Fragoso, G. M., Smithsonian Environmental Research Center, Edgewater, USA, fragosog@si.edu
Neale, P. J., Smithsonian Environmental Research Center, Edgewater, USA, nealep@si.edu
Kana, T. M., University of Maryland Center for Environmental Science, Cambridge, USA, kana@umces.edu
Pritchard, A., Smithsonian Environmental Research Center, Edgewater, USA, pritchardal@si.edu

PHOTOSYNTHETIC AND PHOTOPROTECTIVE RESPONSES OF SYNCHOCOCCUS SP. TO ULTRAVIOLET AND VISIBLE IRRADIANCE

Ultraviolet (UV) induced impact on phytoplankton photosynthesis is mostly studied in areas affected by the ozone "hole"; whereas little is known about the sensitivity of species dominating the surface layer of central ocean basins, in particular Synchococcus. We investigated responses to moderate UV and PAR (Photobiologically Active Radiation) exposure in Synchococcus (WH8102) based on fluorescence kinetics and oxygen exchange. When Synchococcus cells were exposed to moderate UV and UV+PAR, the quantum yield drastically decreased (ca 65%) and rapidly recovered to almost the initial level in the dark. When exposed to UV+PAR, Synchococcus quantum yield reached a minimum then slightly increased, suggesting induction of additional photoprotection. Membrane Inlet Mass Spectrometry showed that oxygen uptake occurs when cells are exposed to higher levels of PAR, suggesting a sink of electrons (possibly an oxidase) located after the PSII complex, whereas oxygen evolution is inhibited under UV+PAR. Experiments using a cytochrome b6f electron transport inhibitor also supported electron flow to an oxidase, perhaps a plastoguinal terminal oxidase, located in between the b6f and PSII complexes when Synchococcus is exposed to high PAR levels.

Franz, B. A., NASA Goddard Space Flight Center, Greenbelt MD, USA, bryana.franz@nasa.gov

ACHIEVING GLOBAL OCEAN COLOR CLIMATE DATA RECORDS

Ocean color, or the spectral distribution of visible light upwelling from beneath the ocean surface, carries information on the composition and concentration of biological constituents within the water column. The CZCS mission in 1978 demonstrated that quantitative ocean color measurements could be made from spaceborne sensors, given sufficient corrections for atmospheric effects and a rigorous calibration and validation program. The launch of SeaWiFS in 1997 represents the beginning of NASA's on-going efforts to develop a continuous ocean color data record with sufficient coverage and fidelity for global change research. Achievements in establishing and maintaining the consistency of the time-series through multiple missions and varying instrument designs will be highlighted in this talk, including measurements from NASAs MODIS instruments currently flying on the Terra and Aqua platforms, as well as the MERIS sensor flown by ESA and the OCM-2 sensor recently launched by ISRO.

Freytes Ortiz, I. M., University of Puerto Rico, Rio Piedras Campus, San Juan, Puerto Rico, ileana.freytes@hotmail.com
Wahle, R., University of Maine, Walpole, USA, richard.wahle@maine.edu

INTEROCEANIC COMPARISON OF PREDATORY FISH RESPONSE TO PREY AVAILABILITY AFTER HABITAT DISTURBANCE

The response of fish assemblages to local disturbance can be a useful indicator of differences in predation pressure. Natural disturbances in cobble habitats, such as wave action, can overturn cobbles, and make infauna vulnerable to predators. Our home base in the Gulf of Maine (GOM), where demersal fish have been decimated by centuries of overfishing, and an NSF-funded project assessing recent tsunami impacts on Chilie's relatively pristine Robinson Crusoe Island (RCI) permitted us to compare the response of the demersal fish assemblage to prey availability. We used video surveillance to quantify resident demersal fish and their response to an experimental disturbance exposing infauna. Diver-based suction sampling served to quantify the infauna. Demersal fish density in RCI averaged ~40-fold greater and 2-3 times more diverse than in GOM. In both regions fish density doubled in response to the experimental disturbance.

Friedland, K. D., NMFS/NOAA, Narragansett, USA, kevin.friedland@noaa.gov
Todd, C. D., University of St Andrews, St Andrews, United Kingdom, cd@st-andrews.ac.uk

CHANGES IN ARCTIC AND SUBARCTIC CONDITIONS AND THE GROWTH RESPONSE OF ATLANTIC SALMON

There has been a systematic change in the weight at age of Atlantic salmon (Salmo salar) in the Northeast Atlantic that is related to climate variability. This relationship emerged from analyses of broad-scale measures of thermal habitat; to further elucidate the effect of environment on salmon growth, time series of sea surface temperature, sea ice coverage, chlorophyll concentration and net primary production were examined temporally and spatially in relation to changes in weight of salmon. SST data were extracted from in situ analyses whereas sea ice and chlorophyll based measures of productivity were collected with satellite sensors. Salmon growth was found to be unrelated to productivity at the base of the food chain and highly associated with thermal regime during winter and spring. Warming conditions during specific segments of the salmon life cycle have been associated with poor recruitment, yet warming during other segments are beneficial to salmon growth. Climate change will continue to erode the viability of populations while the proportional effects of warming on survivorship outweigh the benefits of any increase in reproductive output related to growth.

Frigstad, H., University of Bergen, Geophysical Institute, Bergen, Norway, helene.frigstad@ff.uib.no
Andersen, T., University of Oslo, Department of Biology, Oslo, Norway, tom.anderson@bio.uio.no
Hessen, D. O., University of Oslo, Department of Biology, Oslo, Norway, d.o.hessen@bio.uio.no
Bellerby, R. G., Bjerknes Centre for Climate Research, Bergen, Norway, richard.bellerby@uni.no

SEASONAL AND LONG-TERM VARIATIONS IN SESTON ELEMENTAL RATIOS IN TWO 20-YEAR TIME-.Series in the Norwegian Coastal Current

To improve the empirical basis for modelling variable stoichiometry, it is important to determine and understand the processes driving the natural variability in seston elemental ratios. We take advantage of two time-series on the Norwegian coast of Skagerrak—20 years of high-resolution observations of hydrographical, chemical and biological variables to address these questions. Using an ordination we identify salinity and chlorophyll as the most important drivers for C:N, while temperature and nutrient concentrations are most important for C:P and N:P. A statistical model is used to differentiate between live phytoplankton and non-autotrophic fractions of seston, showing that non-autotrophs dominated for both stations, with annual means of 24 and 42 % live phytoplankton. In addition we address how reductions in advected nutrients from the Southern North Sea and concurrent increase in local
river run-off has affected the seston stoichiometry over the 20-year period. This has importance for understanding the effect of changed nutrient loadings due to human perturbations and increased precipitation from the expected anthropogenic climate changes for this region, and forms basis for predicting effects also of future changes.

**Frischer, M. E.**, Skidaway Institute of Oceanography, Savannah, Georgia, USA, marc.frischer@skio.usg.edu

**Birsu, L. M.**, Skidaway Institute of Oceanography, Savannah, Georgia, USA, laura.birsu@skio.usg.edu

**Verity, P. G.**, Skidaway Institute of Oceanography, Savannah, Georgia, USA

**THE SKIDAWAY RIVER ESTUARY: THE CONTINUING SAGA OF AN ANTHROPOGENIC EUTROPHICATION PROCESS**

In 1986 when Peter Verity first arrived at the Skidaway Institute of Oceanography he initiated the Skidaway River Monitoring Program (SRiMP). Under the auspices of SRiMP a broad suite of hydrological, chemical, and biological parameters have been measured nearly weekly on high and low tides since its inception. Analysis of the first decade of data and published by Verity revealed clear signals of cultural eutrophication including increasing nutrient loading and resulting in dramatic shifts to the structure of the estuarine pelagic food web and incipient hypoxia. During this period (1986–1996) Skidaway Island, a subtropical Pleistocene barrier island to the Gulf of Mexico, with higher respiration (R) than production (P) in bottom waters is a common feature of the Louisiana-Texas continental shelf. In a large, land-based mesocosm experiment (March to May 2010) at the marine facilities of the University of Bergen in Espegrend, Norway, the impact of CO2 on the development of two commercially important fish species of the North Sea, cod (Gadus morhua) and herring (Clupea harengus), was tested. Newly fertilized eggs were reared for two months in twelve 2500L tanks in a flow-through system with natural seawater taken directly from the Norwegian fjord. Natural conditions such as light, temperature and salinity were maintained while the larvae were fed with natural zooplankton filtered from the fjord. Using a pH-controlled computer system, CO2 was bubbled into the tanks at three different treatment levels (860, 1400 and 4000ppm) plus control. Larvae were sampled once a week and analyzed for growth and performance, including morphometrics, biochemistry, enzyme activity, histology, and otolith microstructure and microchemistry. Results from this experiment will be presented with a comparison between the effects of CO2 on the different species.

**Fry, B.**, LSU, Baton Rouge, USA

**Justic, D.**, LSU, Baton Rouge, USA

**Wang, L.**, LSU, Baton Rouge, USA

**ESTIMATING SUMMERTIME PLANKTONIC PRODUCTIVITY AND RESPIRATION FOR THE LOUISIANA-TEXAS CONTINENTAL SHELF USING OXYGEN AND CARBON ISOTOPE TECHNIQUES**

Signs of phosphate limitation even when concentrations of orthophosphate are high, or silica deficiency can stimulate AP activity in this species. We also studied the effect of silica starvation on AP activity in two other marine diatoms: Thalassiosira pseudonana and Nitzschia pungens. All of the three species tested showed a different pattern of regulation of AP activity. All, however, showed activation of AP by silica starvation. This study suggests that AP may be involved in cellular processes related to external phosphate acquisition in microalgae, making it an unreliable indicator of external phosphate deficiency.

**Fuentes, V.**, Institut de Ciències del Mar-CSIC, Barcelona, Spain, vfuentes@icm.csic.es

**Atienza, D.**, Institut de Ciències del Mar-CSIC, Barcelona, Spain

**Lewinsky, I.**, Institut de Ciències del Mar-CSIC, Barcelona, Spain

**Tilves, U.**, Institut de Ciències del Mar-CSIC, Barcelona, Spain

**Gentile, M.**, Institut de Ciències del Mar-CSIC, Barcelona, Spain

**Olariaga, A.**, Institut de Ciències del Mar-CSIC, Barcelona, Spain

**Gili, J. M.**, Institut de Ciències del Mar-CSIC, Barcelona, Spain

**THE MEDIUSA PROJECT**, AN ESTABLISHED MONITORING NETWORK STUDYING JELLYFISH THROUGH THE MEDIUSA Project is a volunteer jellyfish-monitoring program developed by the Marine Science Institute (Barcelona, Spain) in collaboration with the Catalan Water Agency. Medusa Project volunteers, mainly people working at the beaches during summer, collect jellyfish presence/absence and abundance categories data daily from May to September, using standardized methods during their regular activities. The monitoring network involves the about 800 km (total length) of the Catalan Coast, including more than 300 beaches. A total of 314, 570, 847, 393 reports were submitted to Medusa Project initiative during the 2007, 2008, 2009 and 2010 summers, respectively, pertaining to 11 species of gelatinous plankton (cnidaria and ctenophores), some of which as Mnemiopsis leidyi and Phyllorhiza punctata constituted new records for the coastal areas of interest. In this paper we describe the characteristics of this project and show the most important obtained results. Advantages of citizen involvement in this research where not only adding large datasets to the ecological knowledge base but also in the environmental education of the public, which helped to mitigate the social impact of jellyfish proliferations in the area.

**Fueseld, J.**, Max-Planck-Institute for Marine Microbiology, Bremen, Germany, jfueseld@mpi-bremen.de

**Lam, P.**, Max-Planck-Institute for Marine Microbiology, Bremen, Germany, plan@mpi-bremen.de

**Lavik, G.**, Max-Planck-Institute for Marine Microbiology, Bremen, Germany, glavik@mpi-bremen.de

**Jensen, M. M.**, Max-Planck-Institute for Marine Microbiology, Bremen, Germany, mmj@biology.sdu.dk

**Kuypers, M. M.**, Max-Planck-Institute for Marine Microbiology, Bremen, Germany, m.kuypers@mpi-bremen.de

**HIGH NITRITE OXIDATION RATES IN THE NAMIBIAN OXYGEN MINIMUM ZONE**

Nitrate, the most abundant form of bioavailable inorganic nitrogen in the Ocean, is produced via nitrification, a two-step process oxidizing ammonia to nitrite and then to nitrate. Nitrite oxidation as a standalone process has rarely been investigated in

**Fuentes, M. S.**, NOAA/NMFS, Milford, USA, Maria.Soledad.Fuentes@noaa.gov

**Wildors, G. H.**, NOAA/NMFS, Milford, USA, Gary.Wildors@noaa.gov
oceanic settings. In oxygen deficient waters, nitrite is not only produced by ammonia oxidation but also by nitrate reduction, such that nitrite oxidation is not necessarily dependent on ammonia oxidation. In the Namibian oxygen minimum zone (OMZ), nitrite oxidation rates were determined directly in 15N-incubation experiments. 15NO3—production was detected throughout the OMZ (403 ± 66 nM d−1), spanning from the oxycline to the benthic boundary layer. The potential nitrite oxidizers Nitrospina and Nitrococcus were found to constitute up to ~9% of total microbial community at depths where high nitrite oxidation rates were measured. Parallel measurements showed much lower rates of ammonia oxidation than nitrite oxidation in most samples, while nitrate reduction supplied substantial amounts of nitrite (16-365 nM d−1). Our data show that nitrite oxidation is an important nitrogen-cycling process which returns reduced nitrogen back to nitrate in the Namibian OMZ.

**FUBIYASHI, M.**, Tohoku University, Sendai, Japan, fubiyashii@eco.civil.tohoku.ac.jp

**SHIN, W. S.**, Tohoku University, Sendai, Japan

**NAGAHAMA, Y.**, Tohoku University, Sendai, Japan

**NAKANO, K.**, Tohoku University, Sendai, Japan

**NISHIMURA, O.**, Tohoku University, Sendai, Japan

**A SYMBIOTIC RELATIONSHIP BETWEEN POND SNAIL, BELLMAMYA CHINENSIS AND ATTACHED ALGAE ON THEIR SHELL**

The shell of pond snail Bellamyia cipangopaludina is generally covered with attached algae. In this study, the interaction between B. chinensis and the attached algae was investigated. Mixing model with stable carbon isotope ratio revealed that the main carbon source of B. chinensis was the attached algae not sediment and suspended matter. Mesocosm experiment showed that a snail which was allowed to graze attached algae on other snails showed higher growth rate than a snail which isolated from other snails. These results indicated attached algae was an important food source for B. chinensis. On the other hand B. chinensis had positive effects on attached algae. The species of attached algae was not found in sediment and water column. The shell of B. chinensis seemed to be suitable hard substrate for attached algae. We also found the pedal mucus by B. chinensis could stimulate the growth of attached algae. This study showed there is a symbiotic relationship between B. chinensis and attached algae on the shell.

**FUKUDA, Hideki, H., Atmosphere and Ocean Research Institute, The University of Tokyo, Iwate prefecture, Japan, hfukuda@aori.u-tokyo.ac.jp**

**OGAWA, Hiroshi, H., Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa city, hogawa@aori.u-tokyo.ac.jp**

**NAGATA, Toshi, T., Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa city, Japan, nagata@aori.u-tokyo.ac.jp**

**EFFECTIVE DENSITY AND FRACTAL DIMENSION OF SUSPENDED PARTICLES IN THE SURFACE LAYER OF THE WESTERN PACIFIC**

Despite increasing recognition that sinking flux of POC is related closely with that of biominerals (opal and calcite), which act as ballast of settling particles, variability of biominerals (opal and calcite) which act as ballast of settling particles, variability of sinking velocity of particles in oceanic environments.

Grassle, J. P., Rutgers University / Institute of Marine & Coastal Sciences, New Brunswick, NJ 08901, USA, igrassle@marine.rutgers.edu

Fuchs, H., Rutgers University / Institute of Marine & Coastal Sciences, New Brunswick, NJ 08901, USA, hfuchs@marine.rutgers.edu

**ROLE OF BOTTOM ROUGHNESS IN RECRUITMENT AND SURVIVAL OF SURFCLAMS, SPISULA SOLIDISSIMA, ON THE CONTINENTAL SHELF**

Settlement habitat plays a critical role in recruitment success and can impact growth and survival of benthic species. We conducted a field study to examine the effects of bottom roughness on recruitment, growth, and survival of the surfclam, Spisula solidissima. A 12 m² patch of shell valves, a common habitat and roughness feature on the New Jersey shelf, was established on a sandy bottom at 11 m depth off Tuckerton, NJ. Samples for surfclam abundance and size, and sediment chlorophyll and phaeopigment concentrations, were taken inside and outside of the shell patch beginning in June 2010 and periodically throughout the summer. Initial densities of recently settled surfclams were high (~8-10 surfclams m⁻²). Within the shell patch, we observed an increase in sediment chlorophyll and phaeopigment concentrations in the sediments, anoxic sediments, and potential predators (e.g. hermit crabs, moon-snails). It is possible that these conditions contributed to higher surfclam mortality in the shell patch (96% reduction in initial abundance after 45 d) compared with the ambient, sandy sediments (75% reduction in abundance).

Fuller, C., Clarkson University, Potsdam, USA, cfuller900@gmail.com

Islam, M. S., Beacon Institute for Rivers and Estuaries, Beacon, USA, islam@bire.org

Bonner, J. S., Clarkson University, Potsdam, USA, jbonner@clarkson.edu

Ojo, T., Clarkson University, Potsdam, USA, tojo@clarkson.edu

Kirkey, W., Clarkson University, Potsdam, USA, wkirkey@clarkson.edu

**FIELD EVALUATION OF THE APPLICABILITY OF USING ACOUSTIC BACKSCATTER DATA FOR SURROGATE SUSPENDED SOLIDS CONCENTRATION MEASUREMENTS**

Use of acoustic backscatter data to measure suspended solids concentrations (SSC) has potential benefits including less susceptibility of bio-fouling and non-intrusive high resolution measurements over traditional technology. Previous controlled laboratory studies have shown that Acoustic Backscatter (ABS) intensity has a log-linear relationship to solids volume concentration over variable particle size distributions. To evaluate use of ABS in determining SSC in natural systems, the techniques applied in the laboratory were applied to co-located, with respect to time and depth, field measurements of ABS and total volume concentration with a 1200 kHz Acoustic Doppler Current Profiler (ADCP) and particle size analyzer (LISST-100X) deployed in the Hudson River, NY as part of the River and Estuary Observatory Network (REON). The field-collected data demonstrated log-linearity between ABS and total particle volume concentration. However, regression analysis of datasets collected at different time periods showed variable slopes. Additionally, residual errors between volume concentrations measured with the LISST-100X and predicted from log-linear regressions was proportional to volume concentration. This suggests that ABS intensity may be significantly affected by variable SSC properties (i.e. concentration, geometry, density).

Fulweiler, R. W., Boston University, Boston, USA, rfw@bu.edu

Heiss, E. M., Boston University, Boston, USA, emheiss@bu.edu

Morgan, E. J., Boston University, Boston, USA, ericmorgan@gmail.com

**HITTING A MOVING TARGET – SEDIMENT HETEROTROPHIC ACTIVITY IN A CHANGING COASTAL OCEAN ECOSYSTEM**

Coastal systems are subjected to local (e.g., nutrient loading) and global (e.g., climate change) anthropogenic forcings. How these changes interact to impact sediment heterotrophic activity and fundamental nutrient cycling is an important and critical question in biogeochemistry. As part of a larger project aimed at understanding these interactions, we measured sediment denitrification as well as N₂O and CH₄ fluxes at seven stations along an estuary-to-shelf nutrient loading gradient. N₂O and CH₄ fluxes were highest at shelf sites while denitrification exhibited a wide range (~5 to 130 µmol N·m⁻²·h⁻¹). Despite differences in water column productivity, depth, and sediment oxygen demand, denitrification rates at the offshore sites were unexpectedly consistent (mean: 40 µmol N·m⁻²·h⁻¹). For the first time we report that, over the past twenty-five years shelf denitrification rates appear to have decreased by almost 20%. Preliminary analysis suggests that over this same time period, N₂O fluxes are also significantly lower. We hypothesize these decreases in sediment heterotrophic activity may be due to a climate-induced decline in shelf system primary productivity.
ABBIOTIC RELEASE OF LABILE NITROGEN FROM EFFLUENT ORGANIC NITROGEN

Wastewater treatment plants are major contributors of eutrophication in coastal systems. Most wastewater treatments plants are capable of removing much of the dissolved inorganic nitrogen, yet dissolved organic nitrogen (DON) is not easily removed and thus makes up a substantial portion of effluent nitrogen. DON can be taken up by microorganisms and abiotically release low molecular weight nitrogen (LMW-N) compounds to the surrounding waters. In this study, a factorial design was used to test the effects of photochemistry and salinity on effluent organic nitrogen (EON). Effluents exposed to chlorine and UV disinfection were also tested to determine if the amount of LMW-N released differs between the two methods. Results suggest that both high salinity and UV radiation significantly increase the concentration LMW-N, defined here as nitrate, ammonium and dissolved primary amines, in surrounding waters. Further, the amount of LMW-N concentrations released differed for effluents treated with the two disinfection methods. These results indicate that although some fraction of EON may be refractory it can still contribute to eutrophication when exposed to saline water and UV in the environment.

**Gallagher, K. L.** University of Connecticut, Groton, CT, USA, kgallaga@gmail.com

**Kading, T.** Woods Hole Oceanographic Institute, Falmouth, MA, USA, tkading@whoi.edu

**Brassaint, O.** University Basel, Basel, Switzerland, olivierbrassaint@gmail.com

**Przekop, K. M.** University of Connecticut, Groton, CT, USA, kgallaga@gmail.com

**Visscher, P. T.** University of Connecticut Center for Integrative Geosciences, Storrs, CT, USA, pieter.visscher@uconn.edu

**INFLUENCE OF SULFATE-REDUCING BACTERIAL METABOLISM ON MINERAL PRECIPITATION IN MODERN MICROBIALITES; LABORATORY AND IN SILICO MODELING OF ALKALINITY AND PH**

Sulfate-reducing bacteria (SRB) are correlated with layers of precipitating calcium carbonate in modern microbialites, but their specific role is not known. In the presence of sufficient calcium, net precipitation requires a carbonate ion concentration that exceeds the threshold for precipitation (saturation index, SI) to occur. We show that while SRB metabolism can increase carbonate alkalinity, pH increase does not occur without external drivers (such as degassing or complementary microbial metabolisms) and therefore carbonate ion concentration may not be increased. Here, we present laboratory data on the effect of SRB metabolism on alkalinity and pH using SRB from lithifying layers in modern microbialites, and compare these to modeled mineral saturation indices using Geochemists Workbench. Finally we will discuss pH- and alkalinity data from field sites in the Bahamas (Big Pond and Salt Pan) and propose possible scenarios where the SRB metabolism could be tipping the balance toward net precipitation.

**Gallegos, C. L.** Smithsonian Environmental Research Center, Edgewater, USA, gallegosc@si.edu

**Pederisen, T. M.** ENSPAC Roskilde University, Roskilde, Denmark, tmp@ruc.dk

**Nielsen, S. L.** ENSPAC Roskilde University, Roskilde, Denmark, tmp@ruc.dk

**EUTROPHICATION, SEDIMENTS, AND TURBIDITY IN COASTAL SYSTEMS**

Increased water column light attenuation is a common consequence of increased organic loading that accompanies anthropogenic eutrophication in coastal systems. Frequently, the best water quality correlate of attenuation coefficient is total suspended solids, even in systems in which nutrient loading occurs primarily by groundwater input, that is, without strong river inputs of sediment. Alteration of bottom sediment texture, organic content, and bulk density by organic loading has been well documented. Here we documented the effect of sediment resuspension on near-bottom light attenuation using an array of in situ light sensors with very close spacing near the sediment-water interface and radiative transfer modeling (RT) with Hydrolight. We found that the light attenuation coefficient over 4.5 cm near the bottom exceeded that in the water column by a factor of ranging from 1.6 to >40. RT modeling indicated that the light received at the bottom could be overestimated by a factor >5 by extrapolating measurements made to within 0.5 m of the bottom. The results may help explain the wide range of seagrass light requirements observed in different systems.

**Gallegos, S. C.** Naval Research Laboratory, Stennis Space Center, USA, sgallegos@nrlssc.navy.mil

**Teng, J.** Naval Research Laboratory, Stennis Space Center, USA, jteng@nrlssc.navy.mil

**Iurriaga, R.,** University of Southern California, Los Angeles, USA, petspec@asol.com

**Arnone, R. A.** Naval Research Laboratory, Stennis Space Center, USA, arnone@nrlssc.navy.mil

**CHLOROPHYLL INCREASES IN THE GULF OF MEXICO DURING THE DEEP WATER HORIZON OIL SPILL**

The Deep Water Horizon oil spill, the largest accidental marine oil spill in the history of the petroleum industry, resulted from the April 20, 2010 explosion of the Macondo well in the Gulf of Mexico. It has been calculated that over 4.9 million gallons of oil were leaked into the Gulf of Mexico, and 1.69 million gallons of the dispersant Corexit were used to ameliorate its impact on the coast. Data from the Moderate Resolution Imaging Spectroradiometer (MODIS) was acquired and processed to level 3 chlorophyll products from May to July of 2010 over the area of the Macondo Prospectus, where large increases in chlorophyll were observed. To confirm that these increases were caused by the oil spill and did not belong to seasonal occurrences of the area, MODIS data was processed and analyzed for the previous 10 years. The results of these analyses are presented in this study.

**Gniru, N. K.** U.S. Geological Survey, Woods Hole, USA, nganju@usgs.gov

**Dickhudt, P. J.** U.S. Geological Survey, Woods Hole, USA

**Sherwood, C. R.,** U.S. Geological Survey, Woods Hole, USA

**Hayn, M.,** Cornell University, Ithaca, USA

**Howarth, R. W.** Cornell University, Ithaca, USA

**OBSERVATION AND MODELING OF NUTRIENT LOADING AND HYPOXIA IN A SHALLOW, GROUNDWATER-INFLUENCED ESTUARY**

The ecology and oxygen dynamics of West Falmouth Harbor, Massachusetts, have recently been modified by nitrate-rich groundwater fluxes from a contaminated aquifer. Management changes are expected to reduce nitrate loads, but the effects on ecology and hypoxia are unknown. We continuously monitored velocity, salinity, chlorophyll, and dissolved oxygen at three stations; an optical nitrogen sensor was also deployed at the landward station. Data indicated a landward-to-seaward gradient of dissolved oxygen, with occasional hypoxia in the landward station, where nutrient inputs are largest. At the landward station, dissolved oxygen had a diel signal (due to photosynthesis and respiration) that was modulated by the input of groundwater at low tide. Vertical salinity stratification exceeded 50 m during neap tides. The surface layer contained the highest nitrate levels. A 1D-vertical biogeochemical model was used to explore the relationship between nitrate inputs and oxygen concentration; a 3D hydrodynamic model was used to test the implementation of groundwater fluxes in a shallow, intertidal environment. Once confirmed, the biogeochemical model will be applied in the 3D context to evaluate ecological response to nutrient input scenarios.

**Gao, J.** Stony Brook University, Stony Brook, USA, jingao@life.bio.sunysb.edu

**Munch, S.,** Stony Brook University, Stony Brook, USA, smunch@notes.cc.sunysb.edu

**Gallegos, S. C.** Naval Research Laboratory, Stennis Space Center, USA, sgallegos@nrlssc.navy.mil

**Deten, J.** Naval Research Laboratory, Stennis Space Center, USA, jteng@nrlssc.navy.mil

**Iurriaga, R.,** University of Southern California, Los Angeles, USA, petspec@asol.com

**Arnone, R. A.** Naval Research Laboratory, Stennis Space Center, USA, arnone@nrlssc.navy.mil

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**Gniru, N. K.** U.S. Geological Survey, Woods Hole, USA, nganju@usgs.gov

**Dickhudt, P. J.** U.S. Geological Survey, Woods Hole, USA

**Sherwood, C. R.,** U.S. Geological Survey, Woods Hole, USA

**Hayn, M.,** Cornell University, Ithaca, USA

**Howarth, R. W.** Cornell University, Ithaca, USA

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Photosynthesis by marine phytoplankton requires bioavailable forms of several trace elements that are found in extremely low concentrations in the open ocean. We compared the concentration, lability and size distribution of a suite of trace elements that are thought to be limiting to primary productivity in two High Nutrient Low Chlorophyll (HNLC) regions using a dynamic speciation technique. Diffusive Gradients in Thin-film (DGT) probes were used to detect and track the differential expression of genes putatively involved in copper for Pseudomonas putida. Differences in Cu concentrations were used to assess the metabolic status of E. coli. We measured the effect of Cu on the production of enzymes that degrade Cu in the ocean. How will these organisms respond to ocean acidification in a rapidly changing climate? We examined cell-specific growth, N2 and CO2 fixation rate responses to a range of irradiance (25-300 mmol quanta m-2 s-1) and pCO2 (~190-750 ppm) levels in Crocosphaera watsonii. The Monod fit (r2=0.95) indicated that one Atlantic strain had a high maximum growth rate (~0.85-d) and a low half-saturation constant (Km) with respect to light (Km=54 mmol quanta m-2 s-1). Another Atlantic strain and a Pacific strain had lower maximum growth rates (~0.6-d) and higher Km values. Future research will include measurement of the effect of Cu. The function of a novel isolate of Mastigocoleus testarum in the mechanism of excavation, unknown, represents a geochemical paradox, because some cyanobacteria bore into carbonates, becoming global players in the erosive reworking of limestones, coral reefs and carbonate sands. In spite of their importance, some aspects of their biology are poorly understood. Some cyanobacteria bore into carbonates, becoming global players in the erosive reworking of limestones, coral reefs and carbonate sands. In spite of their importance, some aspects of their biology are poorly understood.
Garcia-Robledo, E., University of Cadiz, Puerto Real, Spain, emilio.garcia@uca.es
Corzo, A., University of Cadiz, Puerto Real, Spain, alfonso.corzo@uca.es
Morris, E. P., University of Cadiz, Puerto Real, Spain, edward.morris@uca.es
Papasprou, S., Associated Unit Univ. Cadiz - Inst. Ciencias Marinas de Andalucia, Puerto Real, Spain, sokratis.papasprou@uca.es

PHOTOSYNTHETIC ACTIVITY OF DIATOM- AND CYANOBACTERIA-DOMINATED MICROPHYTOBENTHOS COMMUNITIES BELOW ULVA SP. CANOPIES

Macroalgae blooms in coastal areas are a frequent consequence of eutrophication. Macroalgae canopies have been shown to inhibit the photosynthetic activity of microphytobenthos and favour an increase of the relative dominance of cyanobacteria. One possible explanation is that the light quality below the macroalgal canopy favours the photosynthetic performance of cyanobacteria due to a relative increase in the irradiance of “green window” wavelengths. Light spectra, steady state microprofiles of oxygen and gross photosynthesis rates were measured in diatom-dominated and cyanobacteria-dominated communities shaded by increasing numbers of Ulva sp layers. Light quality below the macroalgal canopy was relatively enriched in “green” photons with respect to “blue” and “red” photons. Photosynthetic activity of the diatom-dominated community was suppressed with 5 layers of Ulva, whereas up to 8 layers were needed for the cyanobacteria-dominated community. In addition, photic depth within the sediment was deeper in the cyanobacteria-dominated community than in diatom-dominated one. Diatom-dominated communities maintained below 2-6 layers of Ulva for 3 weeks changed to a cyanobacteria-dominated community.

Corzo, A., Dto.Biology. Universidad de Cadiz, Cadiz, Spain, emilio.garcia@uca.es
Olivié, I., Dto.Biology. Universidad de Cadiz, Cadiz, Spain, irene.olive@uca.es
Papasprou, S., Dto.Biology. Universidad de Cadiz, Cadiz, Spain, sokratis.papasprou@uca.es
Corzo, A., Dto.Biology. Universidad de Cadiz, Cadiz, Spain, alfonso.corzo@uca.es
Hernandez, I., Dto.Biology. Universidad de Cadiz, Cadiz, Spain, ignacio.hernandez@uca.es

EFFECTS OF ULVA SP. IN THE PRODUCTION AND ACCUMULATION OF SULFIDE ON CYMODOCEA NODOSA MEADOWS: A MESocosm EXPERIMENT

Green macroalgal blooms are a frequent event in coastal environments affecting other ecosystems compartment like seagrass meadows. Reduction in light and water dynamics, in addition to the increase of organic matter produced by macroalgae can produce hypoxic or anoxic conditions at the sediment surface. Undisturbed C. nodosa meadows (0.24 m2) were collected from Cadiz Bay and introduced in six mesocosms. Tubular Ulva sp. (210 g DW m-2) was added to 3 of them and the evolution of the mesocosms was followed for 6 weeks. Sulfide production was measured as sulfate reduction rates (SSR) in the sediment using radiolabeled sulfate. Vertical distribution of oxygen and free sulfide concentrations were measured in the water column and the sediment using needle microsensors. Hypoxic conditions developed within the macroalgal canopy and anoxic conditions in the sediment. The concentration of free sulfide increase significantly inside the sediment respect to the control and high concentration was also detected inside the macroalgal canopy, despite that SSR were just slightly modified. This suggests a reduction in the capacity to oxidize free sulfide in the presence of macroalgae.

GARCIA-SAIS, J. R., UNIVERSITY OF PUERTO RICO, MARYGUEZ, Puerto Rico, goingdeep49@gmail.com
Sabater-Claveil, J., UNIVERSITY OF PUERTO RICO, MARYGUEZ, Puerto Rico
Castro, R., UNIVERSITY OF PUERTO RICO, MARYGUEZ, Puerto Rico
Esteves, R., UNIVERSITY OF PUERTO RICO, MARYGUEZ, Puerto Rico
Carlo, M., UNIVERSITY OF PUERTO RICO, MARYGUEZ, Puerto Rico

MESOPHOTIC REEF HABITATS AND ASSOCIATED FISH COMMUNITIES AT BAJO DE SICO SEAMOUNT, MONA PASSAGE

Bajo de Sico, a seamount located in Mona Passage was explored to document benthic habitats and associated fish communities at depths of 30-50 m. Four predominate benthic habitats were identified and quantitatively characterized: 1) reef tops; at 25-35 m over rock prominences; 2) drop-off walls, vertically sloping sections of the rock prominonties at 30-40m; 3) rubble/rohdolith slopes, underlying rocky prominonories at 35-50m; and 4) the deep terrace reef, an extensive flat hard ground platform covered by colonized algal rhodoliths at depths between 45–90 m. Biotic cover over 90% prevailed at all benthic habitats except at the rubble/rohdolith slopes, which was mostly abiotic. Benthic algae, comprised by mixed assemblages of turf, fleshy and calcareous algae was the dominant benthic component at the reef top, drop-off reef wall, and deep terrace. Sponges, represented by a highly diverse assemblage of species were the dominant benthic taxa at the reef top, drop-off reef wall, and deep terrace habitats. Symbiotic corals were observed down to the maximum depth of the reef platform at 90 m. Dominance of substrate cover by coral species varied with depth. Aposymbiotic corals, dominated by several species of antipatharians were most prominent on the drop-off reef wall. The fish community was comprised by a combined assemblage of shallow reef and mesopelagic species. Abundance and taxonomic structure varied between benthic habitats and depths.

Garcia-Bonet, N., IMEDEA (CSIC-UIB), Esplugues, Spain, neus@imedea.ubc.csic.es
Arrieta, J. M., IMEDEA (CSIC-UIB), Esplugues, Spain, txetxu@imedea.ubc.csic.es
Marco-Noales, E., IVIA, Valencia, Spain, emarco@ivia.es
Duarte, C. M., IMEDEA (CSIC-UIB), Esplugues, Spain, carlosduarte@imedea.ubc.csic.es
Marbà, N., IMEDEA (CSIC-UIB), Esplugues, Spain, nmbar@imedea.ubc.csic.es
AFLYING PLANKTON? COPEPODS TAKE TO THE SKY IN EFFORT TO AVOID PREDATORS

Planktonic copepods are important prey items for a wide variety of aquatic organisms including fish. As a result these minute crustaceans have developed a strong escape behavior in response to active predators. Until now, studies on the behavior and escape kinematics of copepods have been performed in a liquid environment, however, we have observed copepods within the genera Labidocera and Anomalocera exhibiting escapes where individuals frequently broke the surface tension of the water and traveled many times their own body length through air in an effort to avoid fish predators in situ. We used a lab based high speed video system to record and analyze the detailed kinematics of this novel behavior, including speed and the rate of rotation during escapes (which can exceed 1000 mm/sec and 7500 rpm) which allowed us to estimate force and energy requirements for this behavior. We found that these neutonic copepods are able to move a greater distance from a predator by travelling through air, than water, and we illustrate how this may be an adaptive defense mechanism against surface feeding visual predators.

GARDNER, W. S., The University of Texas at Austin, Port Aransas, TX, USA, wayne.gardner@mail.utexas.edu
Lin, X., East China Normal University, Shanghai, China, Lin Xiao [xhawi1983@gmail.com]
McCarthy, M. J., The University of Texas at Austin, Port Aransas, USA, Mark McCarthy [markm@mail.utexas.edu]
Souza, A., The University of Texas at Austin, Port Aransas, USA, Afonso Souza [szafo2244@gmail.com]
Liu, J., The University of Texas at Austin, Port Aransas, USA, Jieqing Liu [jieqing.liu@mail.utexas.edu]
Liu, Z., The University of Texas at Austin, Port Aransas, Zhanfei Liu [zhanfei.liu@mail.utexas.edu]

OXYGEN PROFILES AND AMMONIUM CYCLING DYNAMICS IN MAY AND AUGUST 2010 AT TWO GULF OF MEXICO SITES CONTAMINATED BY THE DEEPWATER HORIZON OIL SPILL OF APRIL 2010

Oxygen concentrations and ammonium cycling rates were examined at two oil-contaminated sites north of the Deepwater Horizon oil spill (CT, previously normoxic, depth 28 m, and more offshore OS, depth 100 m) in May and August 2010. CT had low-oxygen bottom waters in May (ca. 0.5 ppm) and August (ca. 2.0 ppm). May ammonium regeneration (R) and potential uptake rates (PU) (µM N h⁻¹) 1 m above sediments were R = 0.013±0.002 (SE) and PU = 0.044±0.002 at CT versus R = 0.005±0.003 and PU = 0.016±0.002 at OS. May CT rates in water 1 cm above sediments were R = 0.030±0.003 and PU = 0.142±0.008. Higher PU than R implies ammonium limitation of bacterial activity, despite sediment ammonium release (100 + 23 µmol N m⁻²) at CT. Higher R at CT than OS indicates higher metabolic rates at CT than OS. Ammonium supply rates, driving bacterial dynamics, may increase oil degradation and O2 removal in bottom waters of coastal regions. Sediment analysis for oil contamination is in progress.

GEES, E. M., The University of Melbourne, Melbourne, Australia, egee@pgrad.unimelb.edu.au
Western, A. W., The University of Melbourne, Melbourne, Australia
Swearer, S. E., The University of Melbourne, Melbourne, Australia
Williams, J., The University of Melbourne, Melbourne, Australia

CAN PASSIVE TRANSPORT EXPLAIN THE DISPERSAL PATTERNS OF EGGS AND LARVAE IN A STRONGLY STRATIFIED ESTUARY?

The estuarine dependent species black bream (Acanthopagrus butcheri) is an important commercial and recreational fish in temperate Australia. Decreased catches of black bream in the Gippsland Lakes have coincided with drought and decreased river flows, raising questions about a possible spatial disconnect between larval and juvenile habitats. This study links the hydrodynamics of a tributary, The Mitchell River, to dispersal of the early-life stages of black bream. A 3-dimensional, salinity stratified, hydrodynamic model of the estuarine reach of the Mitchell River was developed. The model was calibrated and confirmed using water level and salinity data collected during a field monitoring program across two independent time periods. An individual based model of black bream eggs and larvae was coupled to the hydrodynamic model. A passive drift scenario was compared to field observations of the distribution of eggs and larvae to investigate the extent to which passive drift can explain the distribution of eggs and larvae in this strongly stratified estuary. Ongoing model development will incorporate larval abilities and habitat preferences to investigate their influence on connectivity of larval and juvenile habitat.

REEF, P., DLR, Wessling, Germany, peter.reef@dlr.de
Pinnel, N., DLR, Wessling, Germany, nicole.pinnel@dlr.de

SPECTRAL VARIABILITY OF DOWNWELLING IRRADIANCE IN WATER INDUCED BY WAVE FOCUSING

If the water surface is not perfectly flat, the downwelling irradiance in water is highly variable due to focusing and defocusing of the sun and sky light. The time scales and intensity variations caused by this wave focusing effect are well-studied. Much less is known about the induced spectral variability. We have developed a spectral model which describes the wave focusing effect by two parameters that can be determined for each irradiance measurement, and applied it to a large data set from three German lakes to study the spectral variability in the depth range from 0 to 5 m. It was found that the variance of spectral irradiance can be described quantitatively by a “geometry factor” which has a smooth spectral shape in the range 400 to 700 nm. For our data set the average variability across that range was 5%; for 9% of the data the spectral changes were > 15%.

GEMMELL, B. J., University of Texas at Austin, Port Aransas, USA, bgemmell@mail.utexas.edu
Jiang, H., Woods Hole Oceanographic Institute, Woods Hole, USA, bjiang@whoi.edu
Buskey, E. J., University of Texas at Austin, Port Aransas, USA, ed.buskey@mail.utexas.edu

COMPARATIVE ECOLOGY OF K VENT AND P VENT ALONG THE EAST PACIFIC RISE

Hydrothermal vents along the East Pacific Rise (9°30N) have always boggled scientists with the question: how do vent organisms manage to colonize new vents once an old one shuts down? When an eruption occurred between 9°46N-9°56N, it provided an excellent opportunity to gain more insight about this question. The experiment was set up at two vents, P vent (9°50N) and K vent (9°30N), that had distinct faunal assemblages positioned along strong thermal gradients. The main goal of this project was to compare the colonists of K vent, a vent that was not disturbed by the eruption, to the colonists of P vent, a vent that was disturbed by the eruption. To determine the colonists of each vent, sieve samples were analyzed from each of the vents in two temperature zones. There were two distinct species assemblages at K vent and P vent. This may be due to temperature, larvae source, time, and predation; however, more research is needed to come to a definite conclusion.

GEORGE, A. M., University of South Florida, St. Petersburg, USA, adrienneg@mail.usf.edu
Mills, S. W., Woods Hole Oceanographic Institution, Woods Hole, USA, smills@whoi.edu
Mullineaux, L. S., Woods Hole Oceanographic Institution, Woods Hole, USA, lmullineaux@whoi.edu

TIME SERIES FLUXES TO SEDIMENT TRAPS AT NORTHERN GULF OF MEXICO DEEP-WATER CORAL AND COLD SEEP SITES, SEPTEMBER 2009-DECEMBER 2010

In September 2009, two time-series sediment trap moorings were deployed in the northern Gulf of Mexico to investigate biogenic fluxes to the seafloor at sites of deep-water coral and chemosynthetic tubeworm communities. Each trap, set just above the seabed, collected one sample every two weeks from September 2009 until July 2010. In April 2010 it was recognized that these traps were located close to the Deep Water Horizon (DWH) incident and so we deployed a second pair of sediment trap moorings in June 2010 to continue the time series at each location until December 2010. Our program will recover the last of our sediment traps in Dec 2010. Upon recovery, all samples will be analyzed for standard biogeochemical contents and subsets will be further analyzed for larval studies. Additionally, we will quantify the bulk oil content present in all samples and determine the concentrations of select hydrocarbons using a combination of conventional and two-dimensional gas chromatography (GCxGC) to provide greater insight into the molecular composition of any oil present.
Gibson, P. J., University of North Carolina at Chapel Hill, Chapel Hill, USA, gibsonp@email.unc.edu
Martens, C. S., University of North Carolina at Chapel Hill Institute of Marine Sciences, Morehead City, USA, cmartens@email.unc.edu
Popp, B. N., University of Hawaii at Manoa, Honolulu, USA, poppb@hawaii.edu
Hench, J. L., Duke University Marine Lab, Beaufort, USA, jlh82@duke.edu

IMPACT OF BIOLOGICAL AND PHYSICAL PROCESSES ON BENTHIC WATER QUALITY OF A CORAL REEF ECOSYSTEM
Coral reef ecosystems are known for their physical and biological complexity. Worldwide, reef ecosystems are under threat from a variety of local and global environmental impacts. Principal among these threats are ocean acidification and eutrophication. This study investigated variability in coral reef benthic boundary layer water quality as a function of both physical processes and benthic habitat type. Data was acquired via a cabled observatory system using state-of-the-art in situ instrumentation including underwater membrane inlet mass spectrometry, spectrophotometric autoanalyzers, oxygen optode sensors and a variety of physical and environmental monitoring equipment. Research focused on the impact of extensive sponge populations now dominating the Florida Keys reef ecosystem. Massive sponge pumping rates combined with rapid respiration of particulate and dissolved organic matter results in localized O2 depletion, nitrification, and acidification. Other benthic populations yield different effects. These effects and their ensuing chemical gradients are strongest during periods of weak vertical mixing. The impact of sponge respiration is sufficient to drive aragonite saturation state of the BBL, well below 3.0, enough to stress carbonate organisms including hard corals.

GIBSON, R. E., UNIVERSITY OF EAST ANGLIA, NORWICH, United Kingdom, R.GIBSON@UEA.AC.UK
Toseland, A., UNIVERSITY OF EAST ANGLIA, NORWICH, United Kingdom, A.TOSELAND@UEA.AC.UK
Durkin, C., University of Washington, SEATTLE, USA
Truong, T., University of Washington, SEATTLE, USA
Moutlon, V., UNIVERSITY OF EAST ANGLIA, NORWICH, United Kingdom
Armbrust, E. V., University of Washington, SEATTLE, USA
Mock, T., UNIVERSITY OF EAST ANGLIA, NORWICH,
A CONSERVED NUCLEAR PROTEIN REGULATES BLOOM FORMATION IN MARINE CENTRIC DIATOMS *

Abstract withheld

Gilbert, J. J., Dartmouth College, Hanover, USA, John.J.Gilbert@Dartmouth.edu
DUAL INDUCED DEFENSES IN A ROTIFER
Keratella tropica has two distinct, predator-induced defenses. Kairomone from the rotifer Asplanchna induces development of a very long right posterior spine and a reduction or loss of the left posterior spine. Kairomone from Daphnia (as well as other cladocerans and copepods) induces a moderate elongation of both posterior spines. This unique dual-response system is of interest regarding the fitness benefits of the two responses, the sensitivity of the responses to predator density, and the response priority when both predators are present. Recent experiments support three hypotheses and conclusions. (1) The predator density inducing a 50% maximal spine-development response is much lower for the Asplanchna response than the Daphnia response (~2 vs. 450 µg dry weight/L). (2) When both predators are present, the response to Asplanchna is expressed. These two results are consistent with the greater fitness benefit of the response to Asplanchna. (3) The sensitivity of K. tropica's response to Asplanchna density is similar to that of Brachionus calyciflorus's response to this predator, and much greater than that of induced responses of other zooplankton taxa to their predators.

Gilbert, M. L., Oregon Health and Science University, Beaverton, USA, gilbertm@ohsu.edu
Needoba, J. A., Oregon Health and Science University, Beaverton, USA, needoba@ohsu.edu
Koch, C., WET Labs, Philomath, USA, corey@wetlabs.com
Barnard, A., WET Labs, Philomath, USA, andrew@wetlabs.com
Baptista, A., Center for Coastal Margin Observation & Prediction, Beaverton, USA, baptista@ccoep.org

HIGH RESOLUTION IN SITU STUDY OF NUTRIENT LOADING AND ESTUARINE RESPONSE IN THE COLUMBIA RIVER
Nutrient inputs to the Columbia River estuary (USA) are difficult to quantify owing to the large spatial extent of the watershed and multiple sources of nutrients. We present results from one of the first high resolution, in situ observational studies of nutrient loading and estuarine response. Three autonomous nutrient sensors (Satlantic SUNA, SubChem APNA, Wetlabs Cycle-P04), together provide measurements of nitrate, nitrite, ortho-phosphate, silicic acid and ammonium. Sampling occurred from a fixed platform located in the lower estuary (SATURN-03). Tidal exchange, river discharge, and coastal ocean influences contribute to the nutrient fluxes, element ratios, and temporal dynamics of the ecosystem. Observatory data from 2010 illustrate the importance of phosphorus limitation of primary production and high fluxes of ammonium from the estuary during the productive season. In addition, comparisons of nutrient loading to the estuary from winter storms, the spring freshet, and seasonal upwelling indicate that anthropogenic nutrient inputs are likely to be an important flux during periods of the year when runoff from the watershed is high.

Gilbert, W., Iowa State University, Ames, USA, wgilbert@iastate.edu
Fisher, T., University of Maryland Horn Point Laboratory,
DETERMINING DENITRIFICATION THROUGH THE MEASUREMENT OF EXCESS N2 IN UPWELLING GROUNDWATER IN CHOPTANK RIVER STREAMS
This study was designed to determine whether denitrification was occurring in stream beds within the Choptank River Basin. Denitrification was measured by the amount of excess N2 found in the groundwater flowing into piezometers installed 20-60 cm below the stream bed of an agricultural stream. I hypothesized that the groundwater flowing into the stream from adjacent lands was the primary source of excess N2 in the stream sediments, meaning denitrification is primarily occurring in soils and groundwater distant from the stream. My alternate hypothesis was that denitrification is occurring within the stream sediments and augments the vertical distribution of excess N2 entering the stream from groundwater. Sampling in July 2010 produced results which showed significant inverse correlations between NO3, O2 and excess N2 that indicated an environment suitable for denitrification. However, excess N2 concentrations decreased from 40 cm to the surface of the stream bed, suggesting that advective loss to the surface waters flowing above influenced the vertical distribution of excess N2 concentrations. Thus, denitrification was only concluded to be occurring in the deeper layers at one sampling site.

Gilbes, F., Department of Geology, University of Puerto Rico at Mayaguez, Mayaguez, Puerto Rico, fernando.gilbes@upr.edu
Hernandez, W., Department of Marine Sciences, University of Puerto Rico at Mayaguez, Mayaguez, Puerto Rico, william.hernandez@upr.edu

UNDERSTANDING BIOLUMINESCENT BAYS USING WEB-BASED TOOLS
The rapid development of web-based tools is allowing worldwide scientists to publish, visualize, process, and interpret complete databases. A new internet database is described and used to demonstrate the power of having these tools open to any researcher. The database is being called GERSVIEW and it is a Web Mapping Interface...
using ArcGIS Server version 10.0. Data from two well-recognized bioluminescence bays (biobays) in Puerto Rico were developed and used to prove the concept; they are La Parguera Bay in Lajas and Puerto Mosquito Bay in Vieques. A website was established as the launch site for the Web Mapping Interfaces (http://gsvmaps.ucar.edu). It provides access to different parameters, including heavy metals, benthic habitats, topography, soils, geology, surface hydrology, land-use, satellite imagery, and aerial photography. A testing was performed in order to prove its potential as on-line scientific analytical tool. The interface provided a good analytical comparison and has proven successful in providing the users a web based GIS application to interact, query, and obtain vector and imagery data from important ecosystems like bioluminescence bays of the world.

Gilerson, A. A., City College of New York, New York, USA, gilerson@cuny.edu
Gitelson, A. A., University of Nebraska-Lincoln, Lincoln, USA, agitelson2@unl.edu
Ahmed, S. A., City College of New York, New York, USA, ahmed@cuny.edu
ESTIMATION OF CHLOROPHYLL A IN COASTAL AND INLAND WATERS USING REMOTE SENSING ALGORITHMS BASED ON RED AND NEAR INFRARED BANDS
Recent improvements of atmospheric correction models has made possible further development of retrieval algorithms for turbid productive waters which employ red and NIR bands of reflectance spectra. By analysis of the HydroLight simulated datasets of TOC and reflectances and field data from several regions we recently developed an advanced version of such algorithms for the estimation of chlorophyll-a (Chl) which use 2 and 3 bands centered at 666, 708 and 753 nm available on the MERIS satellite sensor. These algorithms are based only on the water absorption coefficients at these bands as well as on the generalized relationship between the specific phytoplankton absorption and Chl at 665nm and thus should not require regional tuning for different water areas. Possibility of the expansion of these algorithms to turbid waters with the concentrations of minerals above previously tested limit of 10 mg/l will be explored by the generation of the new synthetic datasets. Results of the validation of these algorithms on the available field data from various water areas around the world will be also presented.

Giovannoni, S. J., Oregon State University, Corvallis, USA, steve.giovannoni@oregonstate.edu
SAR11 INTERACTIONS WITH DISSOLVED ORGANIC CARBON
Surveys of microbial diversity in seawater broadly attest to the global dominance of the alphaproteobacterial clade SAR11. These aerobic, heterotrophic microorganisms have very small genomes (ca. 1.3 Mbp), raising the question, how do they succeed oxidizing highly complex DOC with a limited metabolic repertoire? This question is being addressed by experimentally testing specific hypotheses emerging from genome observations. Studies of SAR11 cells in culture show that they have unusual nutritional requirements related to genome reduction. Many strains lack a glycolysis operon and have a limited ability to oxidize carbohydrates. They require vitamins, reduced sulfur compounds such as methionine, and glycine for growth in a defined artificial seawater medium, but can assimilate amino acids, organic acids and osmolytes such as DMSP, glycine betaine, and taurine. The emerging perspective is that during evolution nutritional versatility was sacrificed in favor of streamlined metabolism that targets some of the most abundant small molecules found in plankton cells. Cell cultures that replicate in natural seawater, and mass spectrometry, are being used to extend experimental observations from controlled studies to the environment.

Glaz, P. N., Université du Québec à Rimouski and centre d’études nordiques, Rimouski, Canada, Patricia.Glaz@uqar.qc.ca
Nozais, C., Université du Québec à Rimouski and centre d’études nordiques, Rimouski, Canada, christian_nozais@uqar.ca
Sirois, P., Université du Québec à Chicoutimi, Chicoutimi, Canada, Pascal_Sirois@uqar.ca
USING STABLE ISOTOPE ANALYSIS TO IDENTIFY DIETARY CHOICE AND TROPHIC POSITION OF BROOK TROUT IN EASTERN CANADIAN BOREAL SHIELD LAKES
Brook trout (Salvelinus fontinalis) is known to be a generalist carnivore that feeds on zooplankton, zoobenthos and terrestrial insects but little have been examined about its selective foraging in Boreal Shield lakes. We measured carbon and nitrogen stable isotopes for primary producers, detritus, benthic invertebrates and brook trout in order to assess dietary choice and trophic position of brook trout and its prey in eight Eastern Canadian Boreal Shield oligotrophic lakes. Benthic primary producers and terrestrial organic matter appeared to be the most important sources supporting consumers in all lakes. Mixing models showed that brook trout derived 80% of its carbon from benthic invertebrates. We also observed size-related diet shift of brook trout, indicating a change in fish foraging strategy related to its size. Our study highlights the importance of carbon originating from benthic habitats to support consumers in small oligotrophic lakes. Moreover, stable isotopes data suggest that carbon originating from terrestrial habitat may significantly contribute to the food web in these lakes, challenging the view that food webs in lakes are primarily supplied by autochthonous carbon.

Gledhill, D. K., NOAA AOML/CIMAS, Miami, USA, dwight.gledhill@noaa.gov
Salisbury, J., University of New Hampshire, USA, dwight.gledhill@noaa.gov
VANDERMARK, D., University of New Hampshire, Durham, USA, dwight.gledhill@noaa.gov
WANNINKHOF, R., NOAA AOML, Miami, USA, dwight.gledhill@noaa.gov
REUL, N., IFREMER/Center de Bret, USA, dwight.gledhill@noaa.gov
APPLICATION OF AMSR-E DERIVED SALINITY FIELDS TO ENHANCING ESTIMATES OF OCEAN ACIDIFICATION WITHIN THE CARIBBEAN SEA
Ocean acidification represents a direct chemical response to rising levels of atmospheric CO2 apart from any possible affects of CO2 on the climate system. A number of laboratory experiments have revealed effects on biocalcification rates commonly attributed to changes in carbonate mineral saturation state. The NOAA Ocean Acidification Product Suite (OAPS) was developed to merge satellite, modeled, and in situ environmental datasets to derive synoptic regional maps of the distribution of carbonate mineral saturation states throughout the greater Caribbean region. Salinity impacts an important control on total alkalinity distributions, CO2 solubility, carbonate equilibrium, and calcium concentrations each of which impact carbonate mineral saturation state. As such, the OAPS exhibits a strong dependence upon HYCOM + NCO DA 1/12 degree GLBAt0.08 mapped salinity fields. To improve the OAPS product, we investigate if monthly 0.5 degree mapped salinity fields derived using the Advanced Microwave Scanning Radiometer – Earth Observing System (AMSR – E) can be applied to reduce observed biases between the HYCOM salinity fields and ship observations throughout the eastern Caribbean Sea [70W,10N,60W,20N].

Glenn, S. M., Rutgers University, New Brunswick, USA, glenn@marine.rutgers.edu
Thoroughgood, C., University of Delaware, Newark, USA, ctgoode@udel.edu
Boicourt, W., University of Maryland, Cambridge, USA, boicourt@umces.edu
Brown, W., University of Massachusetts Dartmouth, New Bedford, USA, wbrown@umassd.edu
Atkinson, L., Old Dominion University, Norfolk, USA, latkinso@odu.edu
IOOS CONTRIBUTIONS TO COASTAL AND MARINE SPATIAL PLANNING IN THE MID ATLANTIC
The Mid-Atlantic Bight (MAB) continental shelf extends 1000 km alongshore, encompassing 10 states from Cape Cod, MA to Cape Hatteras, NC. High population densities exert pressure on and competing demands for marine and coastal resources, waterborne commerce, and offshore energy development. The MAB is also the dynamic boundary between cooler arctic waters and warmer tropical waters, with complex seasonal physical dynamics. These dynamics structure shellfish and migratory fish habitats that support commercial and recreational fisheries. The long-term impacts of global climate change include the warming of bottom water temperatures that affect fish and shellfish habitats, and new rainfall patterns with more frequent extremes that impact homes, farms and reservoirs. The Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) has designed, deployed and now operates a regional coastal ocean observing system that informs scientists and decision makers including Coastal and Marine Spatial Planning activities by sustained sampling of the environment at scales relevant to the ecosystem. The challenge for Marine Spatial Planners is how to best incorporate diverse and dynamic data sets into their existing planning structures and activities.

Gilbert, P. M., Univ MD Center for Envir Sci/Horn Point Laboratory, Cambridge, USA, gilbert@umces.edu
EUTROPHICATION, ECOLOGICAL STOICHIOMETRY AND THE LOWER FOOD WEB OF THE SACRAMENTO-SAN JOAQUIN ESTUARY, CALIFORNIA
While eutrophication has resulted in increasing nutrient loads to coastal systems, nutrient reduction efforts have resulted in large changes in the relative loadings of nitrogen (N) and phosphorus (P). In the Sacramento-San Joaquin Estuary, California,
nitrogen loads have continued to increase, while phosphorus loads have declined over the past several decades. Ecological stoichiometry predicts that changes in the food web are a consequence of changes in N:P due to the varying requirements by different types of organisms for different elements. The lower food web of the San Francisco Estuary has changed as the proportions of N:P have changed over time. Not only has the phytoplankton community shifted from diatoms to cyanobacteria, but the zooplankton have changed from calanoids to cyclopoids, tracking their different N:P demands. These changes in copepods have previously been interpreted as a function of invasive species. The interpretation herein suggests that these changes were a consequence of changes in nutrients; the cyclopoid proliferated when nutrient loading changed. Nitrogen reductions are required for the N:P balance to be restored and for a productive food web to recover.

Gloel, J., University of East Anglia, Norwich, United Kingdom, j.gloel@uea.ac.uk
Tilstone, G., Plymouth Marine Laboratory, Plymouth, United Kingdom, ght@pml.ac.uk
Robinson, C., University of East Anglia, Norwich, United Kingdom, c.robinson@uea.ac.uk
Kaiser, J., University of East Anglia, Norwich, United Kingdom, j.kaiser@uea.ac.uk

TIME-SERIES OBSERVATIONS OF BIOLOGICAL OXYGEN FLUXES AT THE WESTERN ENGLISH CHANNEL OBSERVATORY: DETERMINED FROM O2/AR MEASUREMENTS

Physical and biological measurements have been taken at the Western English Channel Observatory (WECO) for more than 100 years. In 2009/2010, O2/Ar ratios, measured using a membrane inlet mass spectrometer, were incorporated into this well-characterised coastal observatory. This method enables us to derive the biological oxygen flux (Fbio) as a proxy for net community production (NCP). Biological O2 undersaturation prevailed during the late autumn and winter months, whereas WECO was supersaturated in biological O2 for the rest of the year. As sampling occurred on a weekly basis, even short-term episodic changes in Fbio could be detected. Biological oxygen undersaturation of up to 13 % was observed during a bloom of Phaeocystis at approximately 25–50 m. An undersaturation of 30 % was measured at 50 m depth during a Karenia bloom in August 2009 that preceded an anoxic event along the Cornish coast. The biological oxygen flux derived from gas budgets correlated best with instantaneous 14C primary productivity measurements using a phase lag of 1 week. This has important implications for productivity measurements done in situ compared with bottle incubations.

Gluchowska, M., Institute of Oceanology Polish Academy of Sciences, Sopot, Poland, m.gluchowska@iopan.gda.pl
Kwasniewski, S., Institute of Oceanology Polish Academy of Sciences, Sopot, Poland
Jakubas, D., University of Gdańsk, Gdańsk, Poland
Wojczenals-Iakubas, K., University of Gdańsk, Gdańsk, Poland
Walszewski, J. M., Institute of Oceanology Polish Academy of Sciences, Kornovsky, N., Pomona College, USA
Blachowiak-Samolyk, K., Institute of Oceanology Polish Academy of Sciences, Sopot, Poland
Stempniowski, L., University of Gdańsk, Poland

MORE WORK IN SHORT TIME - BEHAVIOURAL RESPONSE OF LITTLE AUK (ALLE ALLE) TO CLIMATE CHANGE IN THE EUROPEAN ARCTIC

Little auks are the most numerous seabirds in the Arctic. Studies performed in large colonies in Spitsbergen show that birds respond to climate changes in different ways. Increasing influx of warm Atlantic waters that bring boreal zooplankton may have negative impacts on little auks’ time and energy budgets and eventually on their breeding success and range of breeding distribution. In spite of Atlantic conditions on Magdalenefjorden shelf, there were similar numbers of preferred Arctic Calanus glacialis in the plankton, as on Hornsund shelf, influenced by Arctic waters. In both colonies parents fed their chicks mainly on C. glacialis. Longer duration of foraging trips and higher number of feedings in Magdalenefjorden could result from less favorable feeding conditions close to the colony as indicated by lower rate of valuable C. glacialis to Atlantic C. finnarchicus (1:14) than observed near Hornsund (1:1). Selecting for the preferred food items is most probably time-consuming and create problem with object recognition and decision taking. As Arctic birds are having very tight time budgets, such new behavioral situation may impact the feeding efficiency seriously.

Gloed, R. N., University of Southern Denmark & Scottish Association for Marine Science & Greenland Climate Research, Odense, Denmark, rongo@biology.au.dk
Wenzhoefer, F., Alfred Wegener institute & Max Planck Institute for marine Microbiology, Bremen, Germany, fwenzho@mpi-bremen.de

SMALL TO MESO- SCALE O2 DYNAMICS IN MARINE SEDIMENTS: A NEW VIEW ON AN OLD TOPIC

In recent years it has gradually become evident that marine sediments are much more dynamic than previously anticipated. Micro scale topography, particulate sedimentation, short and long term changes in hydrodynamic are all factors that induce temporal and spatial variations in the distribution of electron donors and acceptors. Further, macro and meio fauna activity constantly affect the distribution of microbial microniches and are themselves affected by the O2 availability. Overall the intense dynamic affect the microbial interactions and ecology, putting high demands on metabolic versatility and/or mobility in a constantly changing environment. Recent advances in quantifying in situ O2 exchange from micro to meso scale using different microsensors and eddy correlation principles confirm this, and challenge our conceptual understanding of how marine sediment functions.

Godwin, C. M., University of Minnesota, Saint Paul, MN, USA, godwin018@umn.edu
Coltner, J. B., University of Minnesota, Saint Paul, MN, USA, coltno2g@umn.edu

PHOSPHORUS STOICHIOMETRY OF BACTERIAL ASSEMBLAGES: DO SPECIES' SHIFTS INFLUENCE HOMEOSTASIS?

When an organism's elemental composition differs from that of its environment, it can either maintain its stoichiometry or alter it in response to resource availability. Because individuals respond to resource imbalance through physiological acclimation and communities respond through an interaction of physiology and abundance, the response of assemblages may be different from that of a population of a single species. Heterotrophic bacteria isolated from lakes exhibit variable phosphorus (P) content and a range of stoichiometric P regulation. When cultured under similar conditions, assemblages of bacteria alter their P content in kind with the supply, suggesting shifts in species abundance. We hypothesize that the response of assemblages to resource availability is the result of selection among stoichiometric strategies. Our preliminary experiments with assemblages of heterotrophic bacteria indicate that strong P homeostasis is prevalent under high P availability, whereas flexible P composition is competitive under P limitation. We will present a model framework that explicitly combines resource competition theory with ecological stoichiometry to predict the aggregate response of assemblages to resource stoichiometry.

Goebel, N. L., University of California, Santa Cruz, USA, n.goebel@ucsc.edu
Edwards, C. A., University of California, Santa Cruz, USA, c.edwards@ucsc.edu
Zehr, J. P., University of California, Santa Cruz, USA, zehr@ucsc.edu
Follows, M. J., Massachusetts Institute of Technology, Cambridge, USA, mick@ocean.mit.edu

THE RELATIONSHIP BETWEEN MODELED PHYTOPLANKTON PRODUCTION AND BIODIVERSITY IN THE CALIFORNIA CURRENT SYSTEM

We investigate mechanisms underpinning the emergent relationship between primary production and phytoplankton biodiversity from a large-dimensional, self-assembling ecosystem model applied to the California Current System (CCS). Along the prominent environmental gradients that characterize the CCS, of the 78 stochastically generated phytoplankton physiologies, between 1 and 10 types typically account for 99.9% of total biomass. This measure of diversity was found to vary unimodally with phytoplankton biomass and production: there was low diversity in regions characterized by both high and very low productivity, and high diversity in regions of intermediate productivity. In the context of resource competition theory, diagnostic growth and loss processes are used to explain the modeled temporal and spatial patterns in the productivity-biodiversity relationship in the CCS.

Goldberg, S. J., Scripps Institution of Oceanography, La Jolla, USA, sgoldberg@ucsd.edu
Carlson, C. A., University of California Santa Barbara, Santa Barbara, USA, carlson@lifesci.ucsb.edu
Brzezinski, M., University of California Santa Barbara, Santa Barbara, USA, mark.brzezinski@lifesci.ucsb.edu
Aluwihare, L. I., Scripps Institution of Oceanography, La Jolla, USA, laululu@ucsd.edu
Nelson, N. B., University of California Santa Barbara, Santa Barbara, USA, norm@ucsd.edu
Siegel, D. A., University of California Santa Barbara, Santa Barbara, USA, davey@eri.ucsb.edu

PREDICTABLE GLUCOSE ENRICHMENT IN “AGED” OCEANIC DOM

Concentrations of glucose, mannose + xylose, and galactose account for the majority of dissolved combined neutral sugar (DCNS) concentrations throughout the ocean. Previous studies have assessed preferential utilization of neutral sugars after normalization to total DCNS concentrations (i.e. mol DCNS %). The net bioavailability of these three dominant neutral sugars can also be determined from the change in their mol % relative to one another. The relative change in the mol % glucose, mannose + xylose, and galactose was examined along large temporal and spatial data sets from the Bermuda Atlantic Time Series (BATS) site and the Climate Variability (CLIVAR) Repeat Hydrography transects in the North Atlantic and South Pacific. Changes in the mol % of each sugar follow a remarkable consistent trajectory with the change in the mol % glucose: mannose + xylose: galactose of between 1.70:-0.70:-1.00 and 2.12:-1.12:-1.00, indicating that processes controlling the relative abundance of these sugars are similar between basins. Mannose + xylose and galactose are preferentially removed over time (i.e. decrease with p(CFC-12) age) leading to glucose enrichment in waters that have not been recently ventilated.

Goldman, E. A., University of South Carolina, COLUMBIA, USA, goldmaea@email.sc.edu

SPECTRAL FLUOROMETRIC CHARACTERIZATION OF PHYTOPLANKTON GROUP-SPECIFIC Fv/FM USING THE ALGAE ONLINE ANALYZER

The Algae Online Analyzer (AOA), a commercially-available fixed-wavelength spectral fluorometer, provides values for photosynthetic efficiency (Fv/Fm) of multiple phytoplankton groups from a mixed assemblage. We compared the output of the AOA to estimates of group-specific Fv/Fm from a Phyto-PAM fluorometer in cultures of three phytoplankton species (the diatom Thalassiosira weissflogii, the chlorophyte Dunaliella tertiolecta, and the dinoflagellate Amphidinium carterae). At low light intensity (~20 μmol/m2/s), AOA-measured Fv/Fm for T. weissflogii agreed well with PhytoPAM measurements (both ~ 0.45). For D. tertiolecta and A. carterae, however, AOA measurements did not agree with those of the PhytoPAM (0.55 vs. 0.35, AOA vs. PhytoPAM respectively for D. tertiolecta, 0.3 vs. 0.42, AOA vs. PhytoPAM for A. carterae). When cultures were shifted to high light intensity, a decline in Fv/Fm occurred for all species but the time-dependence of the decline varied between instruments for the diatom. Future work will examine the group-specific Fv/Fm response for mixed species assemblages.

Gómez, M., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, mgomez@dibo.ulpgc.es
Fernández-Urruzola, I., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, iruruzaolagmail.com
Herrera, A., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, o2flosole@hotmail.com
Maldonado-Urife, F., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, federico.maldonado101@doctorandos.ulpgc.es
Martínez, I., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, imartinez@becarios.ulpgc.es
Osmar, N., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, nat.osma@gmail.com
Packard, T., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, tedpackard@dibo.ulpgc.es

THE RESPIRATORY ETS IS A CASUAL BASIS FOR THE ALLOMETRIC RELATIONSHIP IN KLEIBER’ S LAW

Why does the biomass-respiration relationship in Kleiber’s Law work? We argue that because potential respiration is the respiratory Vmax, because, through stoichiometry, potential respiration is equivalent to the activity of the respiratory electron transport system (ETS), and because the ETS is constitutive, both ETS and potential respiration would track biomass better than respiration. To investigate this, zoo plankton samples from the Canary Islands Transition Zone and from cultures of artemia, mysids and protozoa were analysed for agreement with Kleiber’s Law. The results show that in upwelled waters, in cyclonic eddies, and in rapidly growing organisms, ETS activity tracks biomass better than respiration (b = 0.89-0.98). In coastal stations this relationship diminishes (b = 0.79) and is closer to Kleiber’s Law (b = 0.75). In offshore stations or in starved organisms ETS-biomass relationship is weaker than Kleiber’s Law (b = 0.64). When we analyze the total number of samples (around 10000), we find an ETS-biomass slope of 1. We conclude that Kleiber’s Law works because biomass packages the ETS so well.

Gonzales, I. C., NOAA Graduate Sciences Program, Oxford, MD, USA, lonnaigon5salves@yahoo.com

MINORITY RECRUITMENT, EDUCATIONS, AND COMMUNITY OUTREACH: GRADUATE STUDENTS TO THE RESCUE

Government agencies and private institutions have provided unprecedented amounts of support for research and education activities at minority-serving institutions in order to increase minority recruitment into science fields. While these programs continue to grow, students who currently benefit from these resources can play a vital role in increasing the effectiveness of their institution’s recruitment and outreach efforts. This presentation highlights the efforts of students from the University of Maryland Eastern Shore as we have worked to introduce marine science to high school and undergraduate students as well as participate in environmental education endeavors in our community. These efforts have utilized activities as simple as fishing trips to more organized classroom visits and field sampling exercises. We have been able to steer multiple undergraduate students into marine science degree programs while our volunteer work in the community has allowed us to play an active role in educating tomorrow’s cadre of young scientists. These endeavors stand as a testament to the positive impact of student involvement in established outreach programs and have provided our students with valuable training in education and communication.

Gonzalez, J. O., University of Puerto Rico, Mayaguez, Puerto Rico, ocean.gonzalez@gmail.com
Mercado, A., University of Puerto Rico, Mayaguez, Puerto Rico
Capella, J., University of Puerto Rico, Mayaguez, Puerto Rico
Morelli, J., University of Puerto Rico, Mayaguez, Puerto Rico
Canals, M., University of Puerto Rico, Mayaguez, Puerto Rico

OPTIMUM MESH RESOLUTION FOR WAVE AND STORM SURGE MODELING OVER A STEEP AND COMPLEX-FEATURED SHELF USING AN UNSTRUCTURED CIRCULATION-WAVE COUPLED MODEL.

The steep and complex bathymetry off the southwestern coast of Puerto Rico poses a challenge regarding the determination of optimal mesh resolution for modeling hurricane waves and storm surge. Here, gradients in excess of 1:1 at the shelf break rapidly step into a shallow shelf with numerous bathymetric features of diverse spatial scales. This abrupt progression from deep to shallow waters brings to attention wave propagation and transformation phenomena at scales that are relevant to hurricane waves but not circulation modeling. The advent of a tightly-coupled unstructured circulation-wave model thus imposes new conditions on the resolution needed to model the processes between hurricane waves, currents and storm surge. A tightly-coupled Hurricane Georges simulation using an unstructured mesh previously optimized for wind driven storm surge is compared to a loosely-coupled simulation using a 30-meter resolution structured wave model. Results show that the structured model better represents the wave phenomena, leading to more accurate storm surge water levels. Two dimensional wave spectra and water level observations are analyzed to show the effects of spatial resolution and its implications for unstructured mesh optimization.

Gonzalez, J. E., The City College of New York, New York, USA, gonzalez@me.ccny.cuny.edu
Comarazamy, D., The City College of New York, New York, USA, dcomarazamy@ccny.cuny.edu

LARGE-SCALE LONG-TERM CLIMATE CHANGE (1950-2000) IN THE MID TROPICAL ATLANTIC AND ITS IMPACTS ON THE HYDROLOGICAL CYCLE OF PUERTO RICO

Large-scale climate data for the North Tropical Atlantic (NTA) region show that air temperatures have increased during the past 50 years (1955-59 to 2000-04) with moderate warming near the Caribbean islands to considerable heating in the northern region. This pattern may be driven by SST anomalies that in the same region of study follow relatively small changes in the Caribbean basin to stronger anomalies in the northeast. These changes might be associated with changes in the long-term pattern of the NTA High Pressure System that drives climate in the region. A series of mesoscale numerical experiments were designed to study the regional impacts these large-scale changes have on the hydrological cycle of the island of Puerto Rico. Results indicate increased in easterly surface winds for the 1950-2000 timeframe that disrupts a pattern of inland moisture advection, increasing cloud base heights and reducing the total column liquid water content over high elevations. This combina-
tion of factors produces a reduction in precipitation over the Central and Eastern Mountains of Puerto Rico.

González, R., Humboldt State University, Arcata, USA, rosie.gonzalez@gmail.com
Caldwell, T. J., University of Idaho, Moscow, USA, cald5105@vandals.uidaho.edu
Wilhelm, F. M., University of Idaho, Moscow, USA, fwillhelm@uidaho.edu

THE VERTICAL AND SPATIAL HETEROGENEITY OF ZOOPLANKTON IN LAKE PEND OREILLE, NORTHERN IDAHO, WITH THE PRESENCE OF MYSSI DILUVIANA

Human-induced disturbances can profoundly alter ecosystems and their functions. The introduction of the opossum shrimp, Myysis diluviiana, in lakes of the pacific northwest of North America has resulted in the collapse of fish populations, and displaced bears and eagles. Here we examine the species composition and distribution of zooplankton in Lake Pend Orellie, the 5th deepest lake in north America, in which mysids were introduced 40 yrs ago resulting in the collapse of kokanee and native trout populations. Specifically, we test the hypothesis that zooplankton are limited to the epilimnion, and that Cladoceran species are rare. Results indicated that the distribution of zooplankton was highly heterogenous, with variation between time (day/night), site (north/south), and depth (0-25 m, 25-50m, 50-90m). The majority of plankton occurred in the 0-25 m stratum; but were also present in the 50-90m stratum. Cladoceran density was lowest while copepods were most abundant. Zooplankton above 50 m likely provide a food source for mysids allowing them to survive in this deep lake (352 m) without having access to sediments during diel vertical migrations on a regular basis.

González-Lagoa, J. G., University of Puerto Rico, Mayagüez, Puerto Rico, drj.gonzalez@gmail.com

THE BIOLUMINESCENT BAYS OF PUERTO RICO: RESEARCH ENDEAVOR (INVITED LECTURE)*

Research in the bioluminescent bays of Puerto Rico dates back to the early part of the 1950s. With the establishment of the Institute of Marine Biology by the University of Puerto Rico, facilities were provided at the Marine Station to attract scientists to do research in tropical marine ecosystems. Particular interest was devoted to the Bioluminescent Bay at La Parguera, near the marine station, in an effort to understand its magnificent display of luminescence. Pioneering work by Margalef and González (1956) showed that the unusual concentration of the dinoflagellate Pyrodinium bahamense responded to the physiographic features of the region in addition to the evapo-transpiration processes taking place in coastal areas, thus resulting in a progressive densification of the organisms. Subsequent researchers have added valuable information such as the importance of nutrients, tides, and climatic effects. Two other bays in the area, showing more ecological stability, have been also the object of study in recent years. Comparative studies of two of the bay have not shown significant differences in their chemistry, yet their dinoflagellate dynamics are, indeed, different.

González-Marrero, R. L., University of Puerto Rico, Rio Piedras, Puerto Rico, rgonzalezmarrero@yahoo.com
Yoshioka, P. M., University of Puerto Rico, Mayagüez, Puerto Rico, paul.yoshioka@upr.edu

DYNAMICS OF HAEMULID SETTLEMENT AND RECRUITMENT

Settlement usually refers to a rapid transition between the planktonic and benthic life stages at a given location in the life history of many marine organisms. Analyses of fish recruitment patterns on experimental modules of Mysis diluviiana indicated that settlement of grunts (Haemulidae) involves an indistinct and gradual transition from the planktonic to benthic (demersal) life stages. Lloyd's Index showed no significant differences in patchiness among recruit size-classes. Non-significant differences in recruit abundances with respect to vectorial factors (e.g. upstream/downstream position of treatments) indicate that schooling behavior is a major determinant of recruit patchiness. Schooling behavior is also supported by the upstream/downstream position of treatments) indicate that schooling behavior is a significant difference in patchiness among recruit size-classes, these results suggest that schooling behavior is relatively well-developed during the plankonic/benthic transition, hence that settlement is indistinct and gradual.

Gooding, B. A., University of British Columbia, Vancouver, Canada, gooding@zoology.ubc.ca
Harley, C. D., University of British Columbia, Vancouver, Canada, harley@zoology.ubc.ca
Ingram, T. H., University of British Columbia, Vancouver, Canada, ingram@zoology.ubc.ca

MULTIPLE CLIMATE VARIABLES INDIRECTLY AFFECT MUSSEL ABUNDANCE AND SIZE VIA INCREASED GROWTH AND FEEDING OF A KEY STONE ECHINODERM

Ocean temperatures and [CO2] are changing simultaneously with anthropogenic climate change. The combined effects of these variables on organisms lacking calcified shells or skeletons are poorly understood, as are the indirect effects on other species via altered species interactions. We manipulated water temperature and [CO2] to determine the effects on the seastar Pisaster ochraceus. We found that seastar growth and feeding rates increased with moderate increases in both water temperature and [CO2], a finding that contrasts with studies on heavily calcified species. We then studied the effect of these climate variables on feeding rates, conversion efficiency, and prey size preference of seastars at different life stages on the mussel Mytilus trossulus. Using a coupled demographic matrix model that incorporated seastar responses, we found that mussel abundance and size distributions will likely decrease under future climate scenarios. This could drastically alter diversity patterns on temperate rocky shores. More broadly, our findings suggest that predictions of responses to climate change should consider how different types of organisms respond to changing climatic variables, as well as how these responses will alter interspecific interactions.

Goodman, A. M., The University of Adelaide, Adelaide, Australia, abigail.goodman@adelaide.edu.au
Ganz, G. G., The University of Adelaide, Adelaide, Australia, george.ganz@adelaide.edu.au
Maier, H. R., The University of Adelaide, Adelaide, Australia
Dandy, G. C., The University of Adelaide, Adelaide, Australia

PREDICTING PROBABILITY OF OCCURRENCE OF WETLAND PLANTS UNDER ELEVATED SALINITY REGIMES

To combat water logging and secondary salinisation in the South East of South Australia a drainage system has been constructed which collects surface and shallow ground water with salinities that range from <1000 to >20000 μS/m at the drains run adjacent to hundreds of wetlands which have the potential to become more saline and drier. To investigate the link between salinity and the probability of occurrence of aquatic plants, a survey of 18 affected wetlands was undertaken in 2009 – 2010. A comparison between information collected prior to 2000 and after 2009 showed that wetlands changes to the salinity and water regime altered the floristic composition of the wetlands. The habitat changes favoured the more salt tolerant species such as Lepilaena spp. and Ruppia spp and mitigated against salt sensitive species such as Lemnisca stricta, and Ulcricularia australis. Bayesian Markov Chain Monte Carlo (MCMC) methods were used to construct preference curves that relate the probability of occurrence of macrophytes to salinity and enabled the prediction of the composition of future communities if changes in salinity and water regime continue. Synechococcus

Goodson, A., College of Charleston, Charleston, USA, goodsona@dnr.sc.gov
Greenfield, D. J., University of South Carolina, Charleston, USA, dggreenfield@belle.baruch.sc.edu

PRELIMINARY INSIGHT TO THE GEOGRAPHIC DISTRIBUTION OF PSEUDO-NITTSCHIA SPP ALONG THE SOUTHEAST COAST OF THE UNITED STATES

Certain diatoms of the genus Pseudo-nitzschia are known to produce domoic acid, a toxin that causes amnesic shellfish poisoning and strandings and deaths of marine mammals and seabirds. Recently, domoic acid has been detected in pygmy and dwarf sperm whales in southeastern U.S. waters, suggesting that Pseudo-nitzschia spp. occur in this region. While several studies have focused on Pseudo-nitzschia spp. bloom dynamics along the U.S. west coast and in the Gulf of Mexico, the distribution and abundances of Pseudo-nitzschia spp. are poorly understood for the southeast. This prompted a pilot study that is part of a broader initiative to determine the population structure and distribution of Pseudo-nitzschia spp. along the southeast coastline. Opportunistic water samples were obtained from the coast of North Carolina, South Carolina, Georgia from survey cruises. Both live and preserved samples were reviewed for presence or absence of Pseudo-nitzschia
Goransson, P., Municipality of Helsingborg, Helsingborg, Sweden, Peter.Goransson@helsingborg.se

SEASONAL AND ANNUAL DYNAMICS OF PHYTOPLANKTON PHOTO-PHYSIOLOGY FROM MODIS/AQUA-DERIVED FLUORESCENCE QUANTUM YIELDS

A new fluorescence quantum yield product, derived from reprocessed MODIS/Aqua fluorescence line height (FLH) measurements, provides an important window into the phytoplankton photosynthetic apparatus and physiological variability. In open ocean waters, FLH values are not significantly influenced by suspended material or CDOM; comparison with field data offers a means to validate the new product and resolve known complexities with FLH measurements. Recent research has demonstrated the effects of both nutrient stress and photoaclimation on fluorescence quantum yield. Photoacclimation reflects physiological responses aimed at minimizing the influence of changes in growth irradiance, thus merging incident irradiance levels, in-water light attenuation and vertical mixing dynamics. The work presented here explores seasonal and annual patterns in phytoplankton photooophysiological responses to varying growth irradiances across a range of locations, ecological regimes and time scales. Changes in photoaclimational state in advance of the North Atlantic spring phytoplankton bloom are also examined. Increased understanding of algal physiological responses to photosynthesis forcing factors (including light, nutrient status and water column structure) will help decrease uncertainties in future ocean primary production estimates.

Goodwin, D. S., University of New Hampshire, Durham, USA, deb.goodwin@unh.edu

SEASONAL AND ANNUAL DYNAMICS OF PHYTOPLANKTON PHOTOPHYSIOLOGY FROM MODIS/AQUA-DERIVED FLUORESCENCE QUANTUM YIELDS

Goodwin, D. S., University of New Hampshire, Durham, USA, deb.goodwin@unh.edu

Results from the project shows that eutrophication and persistent toxic substances have decreased in the environment while benthic fauna at basically all stations has been impoverished. Results will be presented and the reasons for the seen changes discussed. One hypothesis is that occasional hypoxia, measured at several occasions, might play a significant role.

Goto, D., Purdue University, West Lafayette, USA, dgoto@purdue.edu

The structure and function of freshwater, estuarine, and marine environments are affected by surrounding and upstream terrestrial ecosystems. Researchers, policy makers and natural resource managers must often consider a complex landscape matrix to understand the functioning of ecosystems and to develop conservation management plans that maintain those functions. We are addressing conservation issues in the terrestrial-aquatic landscape matrix with an integrated GAP analysis project. We are developing a comprehensive set of databases on Puerto Rico and the US Virgin Islands’ freshwater and marine resources — including habitat description and mapping, species distributions and conservation status, and protected areas and conservation priorities — combined with existing Puerto Rico and USVI terrestrial GAP databases, to conduct integrated analyses of gaps in conservation protection.

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colonies of Trichodesmium

PERTURBATIONS USING GAS BUBBLING AND ACID/BASE APPROACHES. COMPARISON OF N2 FIXATION RESPONSE BY TRICHODESMIUM TO PCO2

Letelier, R. M., Oregon State University, Corvallis, USA, letelier@coas.oregonstate.edu
Church, M. J., University of Hawaii at Manoa, Honolulu, USA, mjchurch@hawaii.edu
Smyth, W., Oregon State University College of Oceanic and Atmospheric Sciences, Corvallis, USA
Hoecker-Martinez, M. S., Oregon State University College of Oceanic and Atmospheric Sciences, Corvallis, USA
Geyer, R., Woods Hole Oceanographic Institution Applied Ocean Physics and Engineering, Woods Hole, USA
Gountanis, S., Oregon State University College of Oceanic and Atmospheric Sciences, Corvallis, USA

FLOW MODELING OF THE CONNECTICUT RIVER ESTUARY

Kelvin-Helmholtz billows, formed from shear flow instability, play a major part in the mixing of adjacent water masses. However, new data collected from the Connecticut River estuary shows that contrary to older models, the main area of mixing in the billow might be in the braid rather than the core. Water covers about seventy percent of planet Earth and its unique properties regulate everything from the nutrients in an estuary to the climate of the Earth, hence, understanding how stratified water mix is of significance. The Connecticut River estuary will be computer modeled using Kelvin-Helmholtz theory to simulate the growth of shear instability into a billow. Observations taken from the Connecticut River estuary will provide a basis of comparison for the numerical flow model, allowing the model's predictions to be tested for accuracy.

Gradinger, R., University of Alaska Fairbanks, Fairbanks, USA, rgradinger@ims.uaf.edu
Bluhm, B. A., University of Alaska Fairbanks, Fairbanks, USA, bluhm@ims.uaf.edu
Ikien, K., University of Alaska Fairbanks, Fairbanks, USA, ikien@ims.uaf.edu

SEDIMENTATION PROCESSES UNDER THE SEASONAL SEA ICE OF THE BERING SEA

We investigated the sedimentation rates under seasonal sea ice in the Bering Sea south of St. Lawrence Island in spring 2008, 2009 and 2010. Sediment traps were deployed in two water depths (5m and 20m) for time periods of 4 to 6 hours. We observed in both depth strata a strong seasonal increase in sedimentation rates with season. In 5 m depth mean sinking rates were 3.6 mg chl a m-2 d-1, which increased over time from <0.5 mg chl a m-2 d-1 in early March to maximum values of up to 27.2 mg chl a m-2 d-1 by end of April. Our data demonstrate that the significant concentrations of Bering sea ice algae are released mainly during periods of advanced ice melt while particle flux during periods of growing ice cover are low.

Graddville, M. R., Oregon State University, Corvallis, USA, rgradravi@coas.oregonstate.edu
Watkins-Brandt, K. S., Oregon State University, Corvallis, USA, kwatkins@coas.oregonstate.edu
White, A. E., Oregon State University, Corvallis, USA, awwhite@coas.oregonstate.edu
Church, M. J., University of Hawaii at Manoa, Honolulu, USA, mjchurch@hawaii.edu
Letelier, R. M., Oregon State University, Corvallis, USA, letelier@coas.oregonstate.edu

COMPARISON OF N2 FIXATION RESPONSE BY TRICHODESMIUM TO PCO2 PERTURBATIONS USING GAS BUBBLING AND ACID/BASE APPROACHES. Recent studies have found that di-nitrogen fixation rates by laboratory cultures of Trichodesmium (strain IMS101) increase when exposed to elevated pCO2 concentrations. Contrary to these findings, experiments conducted by our research group on a recent cruise in the North Pacific subtropical gyre found the opposite trend: increased pCO2 concentrations produced lower rates of nitrogen fixation for isolated colonies of Trichodesmium. While the previous laboratory studies have manipulated pH by bubbling cultures with CO2, our shipboard experiment manipulated pH through acid/base additions. Both approaches are accepted by the scientific community as methods to control pCO2 concentrations in sea water; however, it is essential to explore whether Trichodesmium cultures respond differently to these two acidification methods. We will present results from laboratory experiments designed to compare nitrogen fixation rates by Trichodesmium (strain IMS101) over a range of pCO2 concentrations manipulated through CO2 bubbling and acid/base additions. These results will be discussed in the context of our recent field observations.

Graff, J. R., University of Rhode Island, Graduate School of Oceanography, Narragansett, RI, USA, jgraff@goi.uri.edu
Menden-Deuer, S., University of Rhode Island, Graduate School of Oceanography, Narragansett, RI, USA, smenden@goi.uri.edu
Forschner, S., University of Rhode Island, Department of Biomedical and Pharmaceutical Sciences, Kingstion, RI, USA, srforsch@gmail.com

Rowley, D., University of Rhode Island, Department of Biomedical and Pharmaceutical Sciences, Kingston, RI, USA, drowley@uri.edu

VIBRIO CHOLERAE ALTERS ITS MOTILITY IN RESPONSE TO SUB-LETHAL CONCENTRATIONS OF A COMPETITOR-PRODUCED ANTIBIOTIC

Vibrio cholerae is a human pathogenic marine bacterium that inhabits coastal communities and increasing outbreaks of cholera have been attributed to global climate change. The pathogen is vectored into human food supplies via attachment to particles including detritus, phytoplankton, and zooplankton. The diversity of particle-associated bacteria not only has human health implications, but also influences element cycling in the world's oceans. Particle colonization by the pathogen is inhibited by an antagonistic interaction with the particle-associated bacterium Vibrio natriegens (SWAT3), a producer of the antibiotic andromid. By analyzing the individual movement behaviors of V. cholerae in response to a gradient of andromid, we show that V. cholerae has a concentration dependent avoidance response to sub-lethal concentrations of pure andromid and to the metabolites produced by a growing colony of SWAT3. These modulations in movements are effective in increasing the flux of V. cholerae away from the andromid source. The behavioral response of colonizing bacteria to sub-inhibitory concentrations of competitor-produced antibiotics can influence microbial diversity on particles, affecting human health in coastal communities and element cycling in the ocean.

Graham, E. R., Temple University, Philadelphia, USA, erin.r.graham@temple.edu

TEMPERATURE EFFECTS ON CARBONIC ANHYDRASE ACTIVITY IN SYMBIOTIC AND APOSYMBIOTIC CNIDARIANS

Associations between cnidarians and photosynthetic symbiotic dinoflagellates (zooxanthellae) are prevalent in tropical waters, and zooxanthellae primary production plays a major role in tropical and temperate communities. Zooxanthellae perform photosynthesis using carbon dioxide as a substrate for carbon fixation, however, CO2 makes up < 1% of the dissolved inorganic carbon (DIC) pool. Moreover, DIC must pass through several host cell membranes before reaching zooxanthellae. In symbiotic cnidarians, the enzyme carbonic anhydrase regulates DIC supply to zooxanthellae. Located primarily in host tissue, carbonic anhydrase allows utilization of HCOC3-, the prominent form of DIC in seawater, by facilitating the interconversion of HCO3- and CO2 and delivering CO2 to zooxanthellae. This study examines carbonic anhydrase activity in symbiotic and aposymbiotic Prototaxidya grandiflora, Zoanthus sociatus, and Aiptasia pallida maintained in different temperature regimes. Preliminary data suggest that carbonic anhydrase activity and symbiont density may not be correlated in some cnidarians, and temperature increases approaching thermal tolerance limits do not inhibit enzyme activity. Identifying factors that affect carbon acquisition in symbiotic cnidarians is necessary to predict additional physiological responses to projected changes in temperature and pH.

Graneli, W., Lund University, Ecology dept, Lund, Sweden, wilhelm.graneli@limnol.lu.se

CAN ECOTECHNOLOGICAL MEASURES SAVE THE BALTIC SEA?

The Baltic Sea is a semi-enclosed, brackish-water basin in N Europe. It has a permanent halocline at 60-80 m depth. Water masses below the halocline are anoxic for extended periods (years) and blooms of cyanobacteria occur regularly. Massive efforts have been made to reduce loads of N and P, but there are few signs of improvement. It is thought that any recovery will be slow (decades), due to the store of phosphorus in deep waters and sediments. Ecotechnological measures have therefore been proposed to decrease cyanobacteria blooms, e.g. manipulation of the N/P ratio in sewage, addition of nitrate to surface waters, injection of air into deep waters, artificial mixing of water masses, removal or chemical treatment of P-rich sediments and food-chain manipulations (e.g. through removal of planktivorous fish), applied to many lakes with variable success for 50 years. Some of these methods are currently tested in sub-basins of the Baltic Sea. I will discuss the potential to apply ecotechnological measures to the whole Baltic Sea, and the prospects for success.

Grant, S. R., University of Hawaii, Honolulu, USA, sgrants@hawaii.edu
Laws, E. A., Louisiana State University, Baton Rouge, USA, edlaws@lsu.edu
Bienfang, P., University of Hawaii, Honolulu, USA, bienfang@soest.hawaii.edu

GROWTH RATE DEPENDENT KINETICS OF ALGAL PHOSPHATE TRANSPORT

Dissolved inorganic orthophosphate uptake rates were determined as a function of growth rate in continuous cultures of phytoplankton species. The calculated growth rate dependent kinetic parameters were used to test for accuracy. Preliminary data suggest that carbonic anhydrase activity and symbiont density may not be correlated in some cnidarians, and temperature increases approaching thermal tolerance limits do not inhibit enzyme activity. Identifying factors that affect carbon acquisition in symbiotic cnidarians is necessary to predict additional physiological responses to projected changes in temperature and pH.
steady-state ambient orthophosphate concentrations indicate non-Monod type relationships, and phosphate uptake rates show malleable kinetic forms that vary both between species and within a single species as a function of growth rate. These results indicate that care should be taken in both the measurement of ambient orthophosphate in continuous cultures as well as the modeling of algal growth and nutrient uptake rates by the standard use of constant, canonical Monod and Michaelis-Menten parameters.

Grantz, E. M., University of Arkansas, Fayetteville, USA, egrantz@uark.edu

Scott, J. T., University of Arkansas, Fayetteville, USA, jts004@uark.edu

DIINITROGEN GAS ACCUMULATION IN THE HYPOLIMNIA OF THREE SHALLOW RESERVOIRS DETERMINED USING N2:AR RATIOS

Landscape-level models of nitrogen (N) cycling in aquatic ecosystems are incomplete without reliable estimates of net dinitrogen (N2) gas release from denitrification and anaerobic ammonium oxidation (anammox). Water impoundment reservoirs are potential hotspots for these microbiologically-mediated processes because they typically receive large N loads and experience seasonal hypolimnetic hypoxia or anoxia. However, using intact sediment core incubations to quantify dinitrogen gas fluxes at the sediment-water interface often results in high measurement variability which creates problems for scaling up to ecosystem rates. In this study, we utilized membrane-inlet mass spectrometry to measure in-situ hypolimnetic N2:Ar ratios through time following the onset of stratification in three shallow reservoirs in Northwest Arkansas. All three reservoirs experienced strong hypolimnetic anoxia, but the onset of anoxia was different among reservoirs. Dinitrogen gas concentration increased throughout the summer at all sites and was most pronounced at deepest depths. Ammonium concentrations followed a similar pattern to N2:Ar ratios, suggesting that seasonal N2 accumulation may represent an effective estimate of total N2 production below the thermocline.

Green, S. R., Hampton University, Hampton, USA, shadasha.green@h hamptonu.edu

EFFECTS OF LAND USE, WATERSHED SIZE, AND SOIL TYPES ON THE CONCENTRATIONS OF N AND P IN COASTAL PLAIN STREAMS

Land uses, watershed sizes, and soil properties affect nutrient concentrations (N and P) in streams of the Choptank basin in the Mid-Atlantic coastal plain region. Non-tidal streams draining non-point sources (agriculture and septic) account for a large portion of the nutrients that drain into the Choptank estuary. This research uses these variables (land use, watershed size, and soil properties) to attain a better understanding of concentrations of N and P in five watersheds in the Choptank basin. Aerial photographs and GIS were used to estimate and determine land uses in subwatersheds (0.1-10 km2) within 5 gauged watersheds of 10-50 km2. N and P concentrations in the subwatersheds showed a relationship with agriculture and forest similar to that of larger watersheds, although a broader range of NO3 levels was present in smaller subwatersheds due to denitrification (indicated by excess N2).

Fore, R. H., Agri-Environment Branch (AEB), Agri-Food and Biosciences Institute (AFBI), Belfast, Belfast, Ireland

Taylor, D., University of Dublin, Trinity College, Dublin, Ireland

AN EVALUATION OF THE EFFECTIVENESS OF PHOSPHORUS MITIGATION USING LOAD APPORTIONMENT IN THE LOUGHEELEN CATCHMENT, IRELAND.

Functional relationships between different mechanisms of phosphorus (P) discharge and concentration were explored using a load apportionment model (LAM) developed for use in a freshwater catchment. The aim of the model conceptualisation was to infer changes in point and diffuse sources from catchment P loading during a P mitigation programme. The research used a dataset comprised of geographic and water quality data from the Lough Sheelin catchment in the intensively farmed drumlin belt of north-central Ireland. The model was calibrated using river Total P, molybdate reactive P and runoff data from seven independent subcatchments. Temporal and spatial heterogeneity of P sources existed within and between subcatchments; these were attributed to differences in agricultural intensity, soil type and anthropogenically-sourced effluent P loading. The catchment was sensitive to flow regime, which can result in eutrophication of rivers during low-flow periods and lake enrichment during extreme runoff events. The model was successfully calibrated with lower P export rates that followed P mitigation measures and it offers a means for assessing the effectiveness of further measures to implement P recovery in these subcatchments.

Greggsmoor, C. L., University of Washington Tacoma, Tacoma, USA, cgreen@u.washington.edu

Masura, J. E., University of Washington Tacoma, Tacoma, USA, jmasura@u.washington.edu

WATER QUALITY IN QUARTERMASTER HARBOR, PUGET SOUND, WA

Quartermaster Harbor (QMH), in central Puget Sound, WA, has historically had elevated levels of nitrate and low dissolved oxygen in the water column. UWT has been monitoring the marine environmental conditions in the bay since October 2006 along a seven station transect consisting of CTD profiles and water samples for dissolved oxygen, nutrients, chlorophyll and phytoplankton. In addition, a mooring is located in the outer harbor to record near surface and near bottom temperature and salinity. Starting in 2009, UWT and WADOE have teamed up with King County to do an EPA funded watershed wide study of QMH nitrogen loading and dissolved oxygen concentrations, with the goal of developing, recommending and incorporating Best Management Practices (BMPs) for improving water quality in the bay into the King County Comprehensive Management Plan for this watershed. Initial results indicate that flushing of the bay may be slow due to its geographic configuration relative to physical forcing conditions and a hydrodynamic model is being developed to estimate flushing rates for the bay. Results of this study to date will be presented.

Gregory-Eaves, I., McGill University, Montreal, Canada, irene.gregory-eaves@mcgill.ca

Beisner, B. E., University of Quebec at Montreal, Montreal, Canada, beisner.beatrix@uqam.ca

PALEOLIMNOLOGICAL AND PALEOEARTHANOGIC INSIGHTS FOR BIODIVERSITY SCIENCE:

Biodiversity declines are now considered a form of global change. Given the grave nature of this issue, rapid advances in understanding are needed to mitigate further impacts to threatened communities. We argue that paleolimnological and paleo-oceanographic studies have important contributions to make to biodiversity science. We will examine the work to date and the benefits of taking a long view. Long-term community data with large geographic coverage are sparse, limiting understanding of biodiversity dynamics. Paleoecological approaches are particularly insightful because they can be applied to many aquatic habitats and provide long time series of both physico-chemical and biological components. To date, quantitative paleoecological studies addressing biodiversity questions have focused on the following: species richness drivers, strengths and limitations of different biodiversity metrics, and how metacommunity interactions influence biodiversity-ecosystem functioning. Initial studies demonstrate that paleoecological approaches can address both similar and novel questions as those of contemporary studies, but over much expanded temporal scales. There are numerous exciting applications of paleoecology to biodiversity science and we expect this session to catalyse the creation of synergies between contemporary aquatic ecologists and paleoecologists.

Gregoszewa, M., Inst. of Analytical Chemistry of the ASCR, v.v.i., Brno, Czech Republic, gregoszews@iach.cz

Doeckel, R., Inst. of Analytical Chemistry of the ASCR, v.v.i., Brno, Czech Republic

DETERMINATION OF URANIUM IN SEDIMENTS BY MODIFIED DIFFUSIVE GRADIENT IN THIN FILMS TECHNIQUE

As a new alternative to the conventional Chelex 100 exchanger, chelating cation exchanger with 8-hydroxyquinoline functional groups was employed in preparation of selective resin gel useful in interference free determination of uranium by diffusive gradients in thin film technique (DGT). This interference of common ions of environmental systems, i.e. alkali, alkali earth elements, chlorides, sulfates and nitrates, can be reduced. Conventional constrained probe, used in diffusive equilibrium in thin films technique (DET), was packed in slots with agarose resin gel containing imbedded 8 hydroxyquinoline exchanger and with bare agarose gel as a cover diffusive layer. Performance tests with metal ions proved that this modification of probes can provide representative results. Utilization of this segmentated probe enables to characterize depth profiles in sediments by a simple procedure providing millimeter resolution. Labor intensive slicing of conventional strips of DGT resin gels can be omitted. This modified probe was used as a new “segmented” sediment DGT-probe in depth profiling of uranium in river sediments. Acknowledgement: This work was performed within the Institutional research plan AVO Z40310501 and project P503/10/2002 of the Czech Science Foundation.
Grim, S. L., University of Delaware, Lewes, USA, slgrim@udel.edu

Fecal indicator bacteria are monitored by public health agencies to protect swimmers from potential pathogens, but lack speed and specificity. In this study, we employed over 40 culture-based and molecular assays to simultaneously measure a wide range of bacterial indicators of fecal contamination, source specific markers, and human pathogens within the context of an epidemiology study. Beaches were chosen based on historically poor water quality and their disparate non-point sources of contamination. Water samples were collected in the morning and afternoon at three California beaches (Doheny State Beach, Avalon Bay, and Surfrider Beach in Malibu). Water quality measurements exhibited a strong temporal trend with highest levels observed in the morning. Avalon Bay exhibited consistently poor water quality throughout the study, with upwards of 30% of samples failing standards. Water quality at Doheny and Malibu beaches was generally good and no relationship between measured parameters and incidence of illness in swimmers was observed except following a rain event, which caused San Juan Creek to flow. Then, multiple fecal indicators exhibited a strong relationship with health effects and markers for human contamination were also detected. Our results suggest that differences in sources of fecal contamination to beaches not impacted by treated wastewater may require use of a suite of source specific assays to characterize risk at these locations.

Kirchman, D. L., University of Delaware, Lewes, USA, kirchman@udel.edu

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with the Caribbean corals Montastraea faveolata, Porites astroidea, and Porites divaricata indicate that the coral and algal physiological responses are sometimes more extreme and other times less extreme after repeat bleaching than after a single bleaching. In this talk, we will explore how coral species – algal symbiont type combinations vary between single and repeat bleaching events, and how these combinations are related to coral animal physiology, algal physiology, and resilience.

Gruber, R. K., NSW Dept. of Environment, Climate Change, and Water, Sydney, Australia, renee.gruber@environment.nsw.gov.au
Scanes, P., NSW Dept. of Environment, Climate Change, and Water, Sydney, Australia
Ferguson, A. J., NSW Dept. of Environment, Climate Change, and Water, Sydney, Australia

SEASONAL AND SPATIAL VARIATION OF PHOSPHORUS ATTENUATION IN A TIDAL RIVER SYSTEM

Substantial cycling of nutrients occurs in aquatic ecosystems, which have an inherent capacity to transform and attenuate inputs through various biotic and abiotic pathways. Although some previous work has focused on streams and estuaries, little is known about processing as nutrients pass through the intermediate region: the tidal river. In order to quantify magnitudes of nutrient attenuation and transformation, we conducted a long-term study in the Hawkesbury River (NSW, Australia), a nutrient budget was coupled with seasonal measurements of sediment and water column fluxes of dissolved phosphorus. Of the ~670 tons of phosphorus this system receives annually from its catchment, 30-70% was exported to the estuary depending on season. Additionally, phosphorus inputs were transformed along the tidal river and became increasingly dominated by particulates with distance downstream. These processes were not longitudinally uniform, however, and showed greatest magnitude and variability at the salt front. Additionally, measurements after a flood event showed apparent production of phosphorus within the tidal river. These results demonstrate that tidal rivers have a large capacity for phosphorus attenuation, but seasonal and spatial variability must be recognized in plans for ecosystem management.

Grundt, D. S., University of Victoria, Victoria, Canada, dgrundt@uvic.ca
Juniper, S. K., University of Victoria, Victoria, Canada, sjuniper@uvic.ca
Lomas, M. W., Bermuda Institute of Ocean Sciences, St. George’s, Bermuda, michael.lomas@bios.edu
Giesbrecht, K., University of Victoria, Victoria, Canada, karinag@uvic.ca
Guelzow, N., University of Victoria, Victoria, Canada, guecker@uvic.ca

EUPHOTIC ZONE NITRIFICATION IN THE NE PACIFIC AND SARGASSO SEA: IMPLICATIONS FOR MEASUREMENTS OF NEW PRODUCTION

Oceanographic time-series studies have played a crucial role in our understanding of marine carbon cycling. While a number of methods have been employed to estimate carbon export via the biological carbon pump, the new production paradigm is one which has received considerable attention over the past several decades. This paradigm relies upon the fundamental assumption that, because nitrification is photoinhibited, all euphotic zone nitrate is "new" nitrogen. However, more recent evidence indicates that nitrification can occur throughout the euphotic zone, thus implying that new production, and marine biological carbon export, may have been overestimated. This presentation will report on euphotic zone nitrification rates measured at two long-standing oceanographic time-series study regions (Line P: NE Pacific; BATS, Sargasso Sea) during 2009. Results will be discussed in the context of concurrent phytoplankton nitrate uptake rates, and we will highlight the degree to which new production is underestimated when euphotic zone nitrate regeneration is not considered. These results have important implications for the way in which we interpret historical ship-board measurements of new production along Line P and at BATS.

Guecker, B., Federal University of São João del-Rei, São João del-Rei, Brazil, guecker@ufsj.edu.br
Boechat, J. I., Federal University of São João del-Rei, São João del-Rei, Brazil, boechat@ufsj.edu.br

INFLUENCES OF AGRICULTURAL LAND USE ON STREAM ECOSYSTEM FUNCTIONING IN THE BRAZILIAN CERRADO SAVANNA

More than half of the Brazilian Cerrado – the world’s most bio-diverse savanna – has been transformed into pasture and cropland and the agricultural expansion in the Cerrado is expected to continue. Here, we investigated whether first-order Cerrado streams in pristine and agricultural catchments differ in functional ecosystem characteristics. We estimated gross primary production (GPP) and community respiration (CR) using the diel DO change technique and whole-stream nitrate and phosphate uptake using kinetic nutrient addition experiments. Agricultural streams exhibited higher GPP and lower CR than pristine streams. Agricultural and pristine streams did not differ in ambient nutrient uptake rates, maximum nutrient uptake rates, and half-saturation concentrations, due to antagonistic responses of the biological community to eutrophication and higher bottom shear stress in agricultural streams. However, agricultural streams had higher nutrient concentrations and higher specific discharges, and accordingly higher nutrient uptake lengths than pristine streams. In conclusion, functional ecosystem characteristics of agricultural streams differed markedly from those of pristine streams, pointing to land-use impacts on stream ecosystem functioning and matter processing, and subsequent effects on downstream aquatic ecosystems. Financial support: Leopoldina, FAPERN, CNPq.

Guadasc, C., Uppsala University, Uppsala, Sweden, cristian.guadasc@ebc.uu.se
Sobek, S., Uppsala University, Uppsala, Sweden, sebastian.sobek@ebc.uu.se
Bastviken, D., Linköping University, Linköping, Sweden, david.bastviken@liu.se
Tranvik, L. J., Uppsala University, Uppsala, Sweden, lars.tranvik@ebc.uu.se

SIMILAR LONG-TERM TEMPERATURE SENSITIVITY OF THE ORGANIC CARBON MINERALIZATION IN CONTRASTING LAKE SEDIMENTS

It has been shown that temperature alone can explain a great amount of the variation in sediment organic carbon (OC) mineralization and that contrasting lake sediment types exhibit similar temperature sensitivities. However, most of the reported measurements span over short time periods. Over long-term, a number of processes can hamper the overall temperature response, which might result in decreasing mineralization rates at higher temperatures. Here we show that during 5 months of continuous incubation in contrasting boreal lake sediments, temperature sensitivity was remarkably similar, and comparable to what previously was observed during short-term incubations. The efflux of DIC from eutrophic lake sediments was about 3 fold higher compared to humic sediments. Our results suggest that also at the seasonal time scale, temperature has a very strong effect on OC, and support previous suggestions of increasing carbon dioxide release from boreal lake sediments in response to a warmer climate.

Gueguen, C., Trent University, Peterborough, Canada, celine.gueguen@trentu.ca
Clarisse, O., Université de Moncton, Moncton, Canada, Olivier.Clarisse@umoncton.ca
Perroud, A., Trent University, Peterborough, Canada, antoine.perroud@gmail.com

ASSESSING THE CONCENTRATION, SPECIATION AND BIOAVAILABILITY OF DISSOLVED METALS IN RIVER WATERS AFFECTED BY ALBERTA'S OIL SAND

The Alberta's oil sands deposits are located in the boreal forest, a sensitive and critical region for carbon storage and climate regulation. Over the past years, Athabasca oil sands development has been intensified and presents new challenges for the environmental management in Alberta. At present, crude oil production from oil sands account for more than 25% of the Canada’s annual oil production and is expected to rise to over 50% in the next few years. Despite tar sand deposits contain large amounts of heavy metals (e.g. Al, Fe, Ni, V), little is known on their potential impacts on the natural biogeochemical cycles in the natural waters. In this study, DGT samplers have been deployed in Athabasca River and its tributaries to assess the effects of the oil sands industry on water quality. Dissolved metal fractions were significantly greater in tributaries with watershed disturbed by development than in less disturbed watersheds. However the DGT-labile fractions were lower near developed areas than upstream of development. Up to 30% of dissolved metals were DGT-labile at less disturbed sites. Change in concentration and composition of dissolved organic carbon may explain the significant change in metal speciation observed in disturbed watersheds. The DGT measurements agreed well with the distribution of metal species predicted by WHAM at most sites. These results suggest that environmental conditions at sites closed to the oil sand development have affected metal speciation.

Guelzow, N., ICBM - Wilhelmshaven/Oldenburg, Wilhelmshaven, Germany, nils.guelzow@uni-oldenburg.de
Ptacnik, R., ICBM - Wilhelmshaven/Oldenburg, Wilhelmshaven, Germany, ptacnik@icbm.de
Hillebrand, H., ICBM - Wilhelmshaven/Oldenburg, Wilhelmshaven, Germany, hillebrand@icbm.de

SPATIAL EXTENT OF DISTURBANCE CONSTRAINS RESILIENCE IN AQUATIC METACOMMUNITIES

The diversity – stability debate is a long-standing issue in ecology, asking whether more diverse communities show higher stability over time and more rapid recovery from disturbance. Recent studies showed that disentangling the mechanisms for local and regional diversity requires the analysis of spatial and temporal dynamics.
embedded in a metacommunity framework. We tested the link between dispersal, disturbance, and stability using an experimental marine phytoplankton metacommunity. Our metacommunities consisted of three connected microcosms (local patches), which were connected by tubes allowing for different dispersal rates by manipulating openness of the tubes. Each patch was inoculated by 15 marine phytoplankton species isolated from the same habitat. Disturbance was exerted on the patch or metacommunity scale, where we either removed 75% of the algal biomass in one randomly chosen local patch or 25% or 75% of the algal biomass in each local patch. Resilience was measured through comparison to an undisturbed control. We found that both the scaling of disturbance and dispersal rate affected resilience, which was further related to diversity. Spatial dynamics contribute to the recovery of communities to disturbance and affect diversity – stability relationships.

Cécile, C., Laboratoire d’Océanographie de Villefranche CNRS-UPMC, Villefranche-sur-mer, France, guieu@obs-vlfr.fr
Ridame, C., Université Pierre and Marie Curie LOCÉAN-IPSL, Paris, France, ridame@courriel.upmc.fr
Pulido-Villena, E., Laboratoire d’Océanographie de Villefranche CNRS-UPMC, Villefranche-sur-mer, France, pulido-villena@obs-vlfr.fr
Blain, S., LOMIC (UMR CNRS UMP), Banyuls, France, stephanie.blain@obs-banyuls.fr
Wagener, T., Laboratoire d'Océanographie Physique et Biogéochimique CNRS/Université de la Méditerranée (AIX3 MARS, Marseille, France, thibaut.wagener@univmed.fr)
Dulac, F., LSCE / CEA CNRS UVSQ & LSIA / UPEL UPTDD CNRS, Gif-sur-Yvette, France, francois.dulac@cea.fr
Desboeufs, K., LSIA (Univ. Paris VII and XII), Creteil, France, Karine.Desboeufs@lisa.u-pec.fr
Obernesterer, I., LOMIC (UMR CNRS UMP), Banyuls sur Mer, France, ingridibernosterer@obs-banyuls.fr
Dominici, J., Parc Naturel Régional de Corse, Galéria, France, pmrc.scandola-jm@wanadoo.fr

DUST INPUTS AND MARINE CARBON CYCLE: NEW INSIGHTS FROM MESOCOSMS STUDY
In the frame of the DUNE project (a DUsite experiment in a low-Nutrient, low-Chlorophyll (LNLC) Ecosystem) a new experimental setup based on large, clean mesocosms and simulated dust deposition was successfully developed. In 2008 a seeding experiment was conducted during the stratification period in a coastal, LNLC area of the Mediterranean Sea. The seeding mimicked a wet deposition and was conducted with a dust analogue (the treatment simulated cloud cycling, reproducing the mixing between dust and anthropogenic pollution). A strong response of the ecosystem at different trophic levels was observed. Both autotrophs and heterotrophs (bacteria, zooplankton) were significantly impacted by the dust addition. This new methodology allows to estimate the export of carbon which constitutes a major improvement towards the understanding of the complex link between atmospheric deposition, surface ocean ecosystem structure and the biological carbon pump. Moreover, large mesocosms can be considered as 1-D ecosystem models, offering a unique opportunity for the validation of processes developed into these models and allowing the quantitative assessment of the impact of atmospheric chemical forcing on the ocean carbon budget.

Gugliini, K., University of Gent (UGent), Gent, Belgium, katia.gugliini@gmail.com
Van Oevelen, D., Netherlands Institute of Ecology, Centre for Estuarine and Marine Ecology (NIOO-CEME), Yerseke, Netherlands, D.VanOevelen@nioo.knaw.nl
Soetaert, K., Netherlands Institute of Ecology, Centre for Estuarine and Marine Ecology (NIOO-CEME), Yerseke, Netherlands, K.Soetaert@nioo.knaw.nl
Middelburg, J. I., Faculty of Geosciences, Utrecht University, Utrecht, Netherlands, j.middelburg@geo.uu.nl
Vanreusele, A., University of Gent (UGent), Gent, Belgium, Ann.Vanreusel@ugent.be

THE NUTRITIONAL IMPORTANCE OF BENTHIC BACTERIA FOR DEEP-SEA NEMATODES STUDIED BY MEANS OF AN ISOTOPE TRACER EXPERIMENT.
A stable isotope (13C)-labeling experiment was performed to quantify the incorporation of deep-sea nematodes. Bacterial functional groups were isotopically enriched with 13C-glucose, 13C-acetate, 13C-bicarbonate, and 13C-amino acids injected into sediments collected from 1280 m depth, west of Svalbard. Incorporation of the 13C label into bacterial phospholipid-derived fatty acids (PLFAs) and nematodes was monitored over a 7-day period. The 13C dynamics of nematodes was fitted with a simple isotope turnover model to derive the importance of the different bacterial functional groups as carbon source for the nematodes. The different substrates clearly labeled different bacterial groups as evidenced by differential labeling of the PLFA patterns. The deep-sea nematode community incorporated a very limited amount of the label and the isotope turnover model showed that the dynamics of the isotope transfer could not be attributed to bacterivory. The low enrichment of nematodes suggests a limited passive uptake of injected 13C labeled substrates. Since earlier studies with isotopically enriched algae also found limited uptake by nematodes, the food sources of deep-sea nematodes remain unclear.

Guillenette, F., Université du Québec à Montréal, Montréal, Canada, guillenette.francois@gmail.com
del Giorgio, K. A., Université du Québec à Montréal, Montréal, Canada, del.giorgio.paul@uqam.ca

BACTERIOPLANKTON PRODUCTION AND CONSUMPTION OF SPECIFIC DISSOLVED ORGANIC CARBON POOLS: LINKS TO ORGANIC MATTER ORIGIN AND BACTERIAL METABOLISM
Recent evidence suggests a key role of bacterioplankton in shaping the composition of the dissolved organic matter (DOM) pool in aquatic systems, not only through consumption but also through production of specific compounds. The regulation and dynamics of this production in natural waters is to date not well understood. Using the spectrofluorometric characterization of the DOM, we tracked the change in concentration of various fluorescent DOM fractions in long-term regrowth experiments conducted with lake and stream samples. Whereas some fractions were clearly a metabolic product of bacteria (i.e., net production in all incubations), others exhibited no net production or consumption among the different systems sampled. Based on the δ13C of the DOM pool, we found that a shift from production to consumption of these latter fractions occurs as the tergioneous share of the total DOM pool increases. Further, we found evidence for a modulation of this production or consumption by the physiological state of the bacterial community, with an increase in production of certain fluorescent compounds at lower levels of metabolic activity.

Guinasso, N. L. Texas A&M University, College Station, USA, guinasso@tamu.edu
Mullins, R. L. Texas A&M University, College Station, USA, rmullins@ocean.tamu.edu
Delmarco, S. F. Texas A&M University, College Station, USA, dimarco@tamu.edu
Li, B. Texas A&M University, College Station, USA, acelibo@neo.tamu.edu
Chapman, P. Texas A&M University, College Station, USA, piers.chapman@tamu.edu
Walpert, J. N. Texas A&M University, College Station, USA, walpert@tamu.edu

COMPARISON OF TWO OXYGEN SENSORS ON A TOWED CTD TO STUDY HYPOXIA IN THE GULF OF MEXICO
August 2-6, 2010 we deployed an Sea Sciences Acrobat tow fish configured with both a SeaBird Electronics SBE 43 oxygen sensor and a JFE Alec Co. Ltd. Rinko III oxygen sensor connected to a SeaBird SBE-19 CTD. We ran 18 onshore-offshore transects using an automated program to raise and lower the tow fish. Transects lasted 2-3 hours. At survey speeds of 2-2.6 m/s we were able to lower and raise the CTD every 2-3 minutes achieving measurements of oxygen concentrations near the sea floor with very high spatial resolution over a wide area. The relationship between oxygen measured by the SBE 43 and the Rinko was examined by treating each transect as a separate experiment. The covariance between the Rinko measurements and the SeaBird measurements indicated that the SeaBird measurements lagged the Rinko by 1.08 s (N=18, sd=0.73 s). After offsetting the measurements we fit a linear relationship between the Rinko and SeaBird which had a slope of 1.087 (N=18, sd=0.13) and an offset of -1.87 m3 (N=18, sd=0.025). After adjusting the measurements by these parameters, the mean difference was 0.000 m3/l and the standard deviation of the residuals was 0.097 m3/l. Some high frequency details were seen in the Rinko data that was not seen in the SeaBird observations. We suspect that the offsets between the sensors decrease the signal in the water column, and increase the signal near the sea floor. The signal in the water column is as high as the signal near the sea floor.

Guzien, K., CNRS, FRE3350 LECOB, Observatoire Océanologique, Banyuls/mer, France, guizien@obs-banyuls.fr
Belharet, M., UPMC, FRE3350, LECOB, Observatoire Océanologique, Banyuls/mer, France, mokrane.belharet@gmail.com
MORITZ, C., CNRS, FRE 3350, LECOB, Observatoire Océanologique, Banyuls/mer, France, moritz@banyuls.fr
GUARINI, J. M., UPMC, FRE3350, LECOB, Observatoire Océanologique, Banyuls/mer, France, guarini@obs-banyuls.fr

ACCOUNTING FOR SPATIAL CONNECTIVITY DUE TO LARVAL DISPERAL WHEN DESIGNING MARINE PROTECTED AREA
A methodology for designing marine protected area is proposed based on regional and local retention rates as well as exchange rates computed from realistic dispersal distribution. Dispersal distribution of idealized marine larvae are obtained from a Lagrangian stochastic particles tracking model forced by a three-dimensional (3D) Eulerian numerical model for realistic wind-driven coastal circulation. The methodology when applied to benthic invertebrate species in the Gulf of Lions evidence the difficulty in solving the compromise between self-sustaining reserve and positive impact on fisheries.

GUILECAL, Y., ISTANBUL UNIVERSITY, ISTANBUL, Turkey, yasegulecal@gmail.com
MEYER-DOMBARD, D., UNIVERSITY OF ILLINOIS AT CHICAGO, CHICAGO, USA, drm@uic.edu
TEMEL, M., ISTANBUL UNIVERSITY, ISTANBUL, Turkey, temelm@istanbul.edu.tr
WATER QUALITY MONITORING USING PHYTOPLANKTON COMMUNITY IN BUYUKCEKEME WATERSHED, TURKEY
Buyukcekmece Lake located north of the Marmara Sea coast of Turkey is the third largest water resources among the six main reservoirs of a megacity Istanbul, providing 17% water demand. This study aims to investigate the water quality monitoring using phytoplankton community in Buyukcekmece Watershed and to classify it in accordance to Turkish Water Pollution Control Regulation for inland surface waters. The phytoplankton composition, density and some physical - chemical parameters of Buyukcekmece Watershed were investigated between January 2008 and December 2009. In total, 69 taxa belonging to 6 divisions were recorded: Bacillariophyta, Chlorophyta, Cyanophyta, Euglenophyta, Dinophyta and Cryptophyta. The phytoplankton group that was richest in terms of species diversity in all stations was found to be the Bacillariophyta division. Bacillicrema's stream has an important effect on water quality of the lake, due to its higher flow and contaminant load. In addition, Karasu, Hamza and Ahtab streams were found to be rich in nitrate and phosphate, due to inputs of untreated domestic wastewaters and animal wastes. Results from this study demonstrate that relationships between phytoplankton community and water quality concentrations of total nitrogen, total phosphorus and chemical parameters. Key words: Water quality, Phytoplankton, Buyukcekmece Lake.

Gyory, J., Woods Hole Oceanographic Institution, Woods Hole, USA, jgyory@mit.edu
Pineda, J., Woods Hole Oceanographic Institution, Woods Hole, USA, jamesp@whoi.edu
TURBIDITY AS A CUE FOR SYNCHRONOUS REPRODUCTION IN THE BAR-NACLE SEMILUNIS BALANOIDES
The barnacle Semilunis balanoides is thought to release larvae in response to phytoplankton blooms, which provide a high-food environment for the larvae. Our high-frequency observations revealed that early-stage larval abundance was related to storms. We hypothesized that adults might be using turbidity, not phytoplankton abundance specifically, as a cue for release. We conducted field observations and experiments to study the effect of turbidity and phytoplankton on larval release response. Release coincided with increased turbidity at three sites along the northeast coast of the United States. A three-year time series of phytoplankton and zooplankton data showed that larval release was not consistently related to phytoplankton abundance (total or single species). We exposed gravid barnacles to phytoplankton or synthetic beads, and they released in response to both, suggesting that presence of particles is more important than identity of particles. Feeding experiments showed that adult cannibalism on newly released larvae is lower in highly turbid conditions. We suggest that Semilunis balanoides synchronizes its reproduction with the onset of phytoplankton blooms, but turbidity may fine-tune the timing if it provides predation refuge for larvae.

Habeyran, K. A., Northwest Missouri State University, Maryville, USA, khaber@mwsu.edu
Haddock, G. D., Northwest Missouri State University, Maryville, USA, haddock@mwsu.edu
DIFFERENTIAL DISTRIBUTION OF DIATOMS ON COVERSILPS: A WARNING FOR PALEOLIMNOLOGISTS
We investigated the effect of frustule morphology on the distribution of diatoms on microscope slides. Eight morphotypes from the genera Acanthidium, Aulaco-

seira, Chaetoceros, Stephanopyxis, Surirella, and Thalassiosira was processed in nitric acid (or Lugol's for Chaetoceros), mixed into a single assemblage, dried on a coverslip, and mounted in Naphrax. We recorded the location of all 1664 valves in 844 groups, and used GIS software to assess distribution. Analysis revealed that six of the morphotypes were randomly distributed, but two tended to be non-random (0.05 < p < 0.10): Acanthidium exiguum clustered in groups across the entire slide, and Chaetoceros mulleri was found predominantly near the margins, perhaps due to its long spines. These clumped distributions caused distal and central transects to misrepresent the overall assemblage; of the 43 transects, Transects 13 and 29 were the most representative (proportional similarity ≥ 89%). Consequently, we conclude that diatom morphology can influence diatom distribution, and can result in serious errors of enumeration and of interpretation. Investigators must not assume that all taxa are randomly distributed on slides.

Haddock, S. H., MBARI, Moss Landing, USA
THERE'S NO SUCH THING AS A JELLYFISH*
By all accounts, jellyfish are creatures that kill people, eat microbes, grow to tens of meters, filter phytoplankton, take over ecosystems, and live forever. Because of the immense diversity of gelatinous plankton, jelly-like creatures can individually have each of these properties. However this way of looking at them both overstates and underestimates their true diversity. Taxonomically, they are far more varied than the handful of exemplars that are used to represent jellyfish or especially the so-called “true” jellyfish. Ecologically, they are even more adaptable than one would expect by looking only at the conspicuous bloom forming families and species that draw most of the attention. In reality, the most abundant and diverse gelatinous groups in the ocean are not the ones that anyone ever sees. This talk will investigate the evolutionary origins and successes of “jellies” and present some of the little-known species that have dominated marine ecosystems for millions of years.

Hadley, K. R., Queen's University, Kingston, Canada, hadleyk@queensu.ca
Paterson, A. M., Ontario Ministry of the Environment, Dorset, Dorset, Canada, andrew.paterno@ontario.ca
Reid, R. A., Ontario Ministry of the Environment, Dorset, Dorset, Canada
Snol, J. P., Queen's University, Kingston, Canada, smolj@queensu.ca
MULTI-PROXY INVESTIGATION OF CRAYFISH DECLINE IN ALGONQUIN PARK, ONTARIO, CANADA
Several lakes in Algonquin Park are part of an ongoing regional limnological investigation to address the health of crayfish populations in South Central Ontario. Due to their relative isolation from large human populations, Cradle, Delano, Pincher and Westward lakes lack significant direct anthropogenic impacts from roads, cottages and other recreational use. Several of these lakes have shown recent marked declines in crayfish populations, which are known to respond sensitively to changes in lake water pH and calcium concentration. Here, we use a multi-proxy paleolimnological approach (diatom and zooplankton fossils) to reconstruct historical lake water pH, and to approximate the timing of Ca decline, both of which may contribute to recent crayfish population changes. Changes from a Daphnium dominated to non-Daphnium dominated zooplankton species assemblage would be expected in a situation where calcium concentration has become a limiting factor, because of their higher calcium demand. Down core diatom profiles indicate recent pH changes within several study lakes. However, based on diatom data pH alone cannot explain the observed crayfish decline, which may result from the interaction of multiple environmental stressors.

Haiy, H. A., Queen's University, Kingston, Canada, Shah@queensu.ca
Laig, R., Queen's University, Kingston, Canada, rlaiq@queensu.ca
Laird, K. R., Queen's University, Kingston, Canada, lairdk@queensu.ca
Kingsbury, M., Queen's University, Kingston, Canada, 7MK18@queensu.ca
Cumming, B. F., Queen's University, Kingston, Canada, Brian.Cumming@queensu.ca
DIATOM- AND CHRYSOPHYTE-INFERRED CHANGES IN EFFECTIVE MOISTURE OVER THE PAST TWO MILLENNIA FROM NORTHWESTERN ONTARIO, CANADA
As a consequence of human-induced climate changes, fluctuations in effective moisture are predicted to intensify, thereby influencing the hydrology of watersheds throughout the Boreal region. To assess lake-level changes over the past two millennia, sediment cores were obtained from the ecotone between pelagic and benthic diatom assemblages (P:B boundary) from a headwater lake in northwestern Ontario, Canada. P:B boundary shifts were reconstructed using a diatom-based inference model developed from surface samples collected across a water-depth transect. A

(*) represents Invited presentations
multi-proxy approach using changes in diatom and scaled chrysophyte assemblages were used to reconstruct changes in the P:B boundary associated with drought. Chrysophyte analysis provided insight on stratification related to the movement of the P:B boundary. The P:B boundary shift of largest magnitude and duration was characterized by increased benthic diatoms, substantially greater diatom richness and diversity (rarefied), and lower abundances of colonial chrysophytes. This change occurred during the Medieval Climate Anomaly, a well-known period of exceptionally low effective moisture. These substantial shifts in the P:B boundary exceed observed changes based on the instrumental record suggesting this region is climatically-sensitive.

Hallock, P., University of South Florida, St Petersburg, USA, pmuller@marine.usf.edu
WHAT DO REEF-DWELLING FORAMINIFERA REVEAL ABOUT STRESSORS OF CORAL REEFS?
Reef-dwelling benthic Foraminifera include species with algal symbionts. Bleaching was discovered in Florida populations of *Amphistegina* in summer 1991 and subsequently was documented worldwide. During the 1990s, bleaching began each spring, peaked with the summer solstice and was declining by late summer temperature highs. Acute bleaching tended to be fatal, while chronic bleaching often resulted in microbial infestations or attack by parasites and predators. Over the past decade, *Amphistegina* populations have rebounded; Keys-wide surveys revealed highest abundances and diversities in the clearest offshore waters, even though chronic bleaching is still prevalent. *Amphistegina* exhibits less bleaching on patch reefs and on offshore reefs where outflow from Florida Bay reduces water transparency, though population densities are generally lower than at clearer sites. In contrast, the Florida Keys Coral Reef Evaluation and Monitoring Project has reported that coral cover declined most dramatically on the offshore reefs and more slowly on inshore patch reefs, at least until cold events in winter 2009-10. The solution to this apparent paradox provides hope for the future of Florida reefs and has implications for coastal resource management.

Halsey, K. H., Oregon State University, Corvallis, USA, lamothek@science.oregonstate.edu
Carter, A., Oregon State University, Corvallis, USA, cartera9088@gmail.com
Giovannoni, S. J., Oregon State University, Corvallis, USA, steve.giovannoni@oregonstate.edu
OBOLATE METHYLOTROPHY AND METHYLOVORY IN OM43: THE SPECIALIZED METABOLIC STRATEGY OF AN ABUNDANT CLADE OF COASTAL BACTERIOPLANKTON
The 1.3Mbp genome of HTCC2218, a member of the abundant OM43 clade of coastal bacterioplankton, suggested it is an obligate methylotroph that obtains all its carbon and energy from a single substrate - methanol. Atmospheric deposition and phytoplankton metabolism have been implicated as sources of methanol in marine systems. The apparent extreme substrate restriction in HTCC2218 was investigated in culture and field-based experiments. In pure culture, growth rate and yield of HTCC2218 increased with methanol concentrations ranging from 0-50μM. In contrast, no growth was observed in the presence of methylated compounds including methyl chloride, dimethylamine, DMAO and DMSOP. However, growth rate and yield were significantly enhanced with any of these methylated compounds in the presence of methanol. Substrate utilization pathways for biomass accumulation via the RuMP pathway (methylotrophy) and energy generation via the tetrahydrofolate-dependent pathway for methyl group oxidation (methylotrophy) were distinguished using radionucleotide compounds. Resultant allocation patterns were remarkably similar in cultures of HTCC2218 and seawater collected off the Oregon coast. These experiments suggest that C1 specialization is a key metabolic strategy in some bacterioplankton, particularly in coastal ecosystems.

Hamilton, S. K., Michigan State University, Hickory Corners, USA, hamilton@lbs.msu.edu
BIOGEOCHEMICAL TIME LAGS THAT MAY DELAY RESPONSES OF STREAMS TO ECOCLOGICAL RESTORATION
Evidence for the efficacy of non-point source pollution reduction (including best management practices on land) has proven elusive for streams and rivers, and eutrophication of downstream lakes and coastal waters continues to be a problem despite successful mitigation of point-source pollution. Several biogeochemical processes delay the responses of streams and rivers to a decrease in nutrient and sediment sources in their catchments, potentially for many years: 1) The slow movement and turnover of groundwater reservoirs in many catchments, which is particularly important with respect to nitrate, the form of nitrogen that tends to be transported via groundwater; 2) Sediment movement through river networks can be protracted due to storage and remobilization processes involving stream beds as well as fringing bars and floodplains; and 3) Phosphorus (P) availability is subject to time lags because P tends to associate with minerals, resulting in a potentially large yet exchangeable phosphorus reserve in upland soils as well as in alluvial and stream-bed sediments. These time lags in response to restoration may not be well appreciated by restoration ecologists, regulators, or the broader stakeholder community.

Hammerschmidt, C. R., Wright State University, Dayton, USA, chad.hammerschmidt@wright.edu
Bowman, K. L., Wright State University, Dayton, USA, bowman.49@wright.edu
VERTICAL DISTRIBUTION OF METHYLMERCURY IN THE SUBTROPICAL NORTH PACIFIC
Accumulation of monomethylmercury (MMHg) in fish consumed by humans is the principal concern related to mercury in the environment. Primary sources of MMHg to the ocean are suggested to include continental margins, deep-sea hydrothermal vents and sediments, and production in low-oxygen regions of the water column; however, inability to measure MMHg in seawater at levels less than about 50 fM has precluded our understanding of its distributions and cycling. By use of a new analytical technique during the 2009 GEOTRACES Interlaboration in the North Pacific, we report the first fully resolved (i.e., all species detected), high-resolution vertical profile of MMHg and dimethylmercury (DMHg) in seawater of a major ocean basin. Vertical distributions of MMHg and DMHg suggest that both are synthesized in low-oxygen and oxic strata of the water column and that the deep sea is not an important source of MMHg to surface-dwelling organisms. These results imply that MMHg in seafood is derived from zones of the ocean that are impacted by anthropogenic mercury inputs and thus may be affected by future changes in mercury emissions to the atmosphere.

Hammond, J. D., Hampton University, Hampton, USA, jdmhammond2110@aol.com
BOAT GENERATED TURBULENCE ACCOUNTS FOR COPEPOD CARCASSES
A laboratory experiment and field study were conducted to determine if turbulence generated from boats kills copepods. Copepods were collected in Fall 2009 and Spring 2010 from three sites with low, medium, and high boat traffic in the Hampton River. The levels of boat traffic were chosen to simulate three corresponding levels of turbulence. The samples were stained using pre-prepared neutral red stock solution and counted for further analysis. During Summer 2010, copepods were collected and placed inside of a container and a drill was used on different speeds to simulate turbulence generated from boats. There were three different speeds used to simulate the turbulence (low, medium, and high). Neutral red stock solution was used to count the copepods in order to ascertain whether or not the turbulence was killing copepods. The field experiments illustrated that the highest number of carcasses were found at the site with higher boat traffic. The laboratory experiments helped to demonstrate that the higher turbulence contained higher numbers of carcasses. The data compiled from these experiments confirmed that boat generated turbulence kills copepods.

Hampton, S. E., National Center for Ecological Analysis & Synthesis, Santa Barbara, USA, hampton@nceas.ucsb.edu
Scheef, L. P., National Center for Ecological Analysis & Synthesis, Santa Barbara, USA, scheef@nceas.ucsb.edu
Pendleton, D. E., Northwest Fisheries Science Center, Seattle, USA, dan.pendleton@noaa.gov
Holmes, E. E., Northwest Fisheries Science Center, Seattle, USA, eli.holmes@noaa.gov
Schueerreill, M. D., Northwest Fisheries Science Center, Seattle, USA, mark.schueerreill@noaa.gov
Ward, E. J., Northwest Fisheries Science Center, Seattle, USA, eric.ward@noaa.gov
CHALLENGES AND SOLUTIONS TO ANALYZING MARINE COMMUNITIES WITH MULTIVARIATE AUTOREGRESSIVE (MAR) MODELS
Multivariate autoregressive (MAR) models have a long history of use in economics, and have been used successfully to understand trophic interactions and community stability in freshwater plankton communities. Uses of MARs in marine ecosystems have been limited, however, possibly due to several challenges that arise with marine data. For example, many marine monitoring programs 1) use less consistent sampling locations, 2) have more variable time intervals, 3) may have higher observation error, and 4) include highly mobile or transient taxa. Comparison of results from standard MARs applied to point and transect data suggested that information loss
in applying standard MARs to transect data can be substantial. Additionally, MAR results typically indicate more trophic links in freshwater communities than comparable marine communities, suggesting that modifications to MARs are necessary when analyzing typical marine data. Development of state-space MARs may help elucidate patterns in marine data by explicitly estimating species interactions in light of both process and observation errors. Extension of Bayesian methods also allows for probabilistic statements about parameters. We demonstrate these improvements in MARs via analyses of several plankton datasets.

Hansell, D. A., University of Miami, Miami, USA, dhansell@rsmas.miami.edu
ENERGIZING BIOGEOCHEMICAL PROCESSES IN THE OCEANIC CARBON CYCLE: CONNECTIONS BETWEEN THE SURFACE AND DEEP OCEAN

The deep sea, a vast, layered and dark realm, serves as a massive reservoir of carbon and nutrients. These deep layers, connected to the surface ocean by overturning circulation and the biological pump, are characterized by significant decomposition, recycling, and repackaging of particulate and dissolved organic matter. Deep biota adapt with unique metabolisms and capabilities, driving still cryptic biogeochemical processing of the elements. The distributions and variability of bioactive elements, and novel measures of elemental processing, have resulted in newly emerging knowledge and questions on the functions and sensitivities of the ocean interior. This tutorial will introduce some of the new insights and findings developed in that system, including reactivity of dissolved organic matter, responsiveness of microbes to export, DOM/POM interactions, and evolving oxygen fields.

Hansen, A. T., University of Minnesota, Minneapolis, USA, hanse782@umn.edu
Hondzo, M., University of Minnesota, Minneapolis, USA, mhnondzo@umn.edu
INFLUENCE OF EPIPHYES ON MOMENTUM EXCHANGE AND NUTRIENT AVAILABILITY TO FILAMENTOUS ALGAE

Macroalgae depend on the surrounding water to supply the nutrients needed for growth. When water concentrations of essential nutrients are low, algal growth can be limited by the rate of transfer of the nutrients from the water to the plant surface; a process strongly influenced by the water’s movement. This process is further mediated by the presence of epiphytes, or organisms living on the algal surface. We investigated the effects of various epiphyte communities on momentum transfer near Cladophora glomerata, a common filamentous freshwater macroalga. Results from a microscopic scale laboratory experiment, using particle image velocimetry to quantify flow characteristics near epiphyte covered filaments of C. glomerata, were compared with theoretical predictions based on flow rate and surface roughness. To ensure the experimental flow environment was a reasonable representation, vertically resolved velocity measurements were taken from dense stands of C. glomerata in the nitrogen limited El River in northern California. Laboratory results and field measurements of dissolved inorganic nitrogen were used to predict the effect epiphyte communities have on the supply of dissolved inorganic nitrogen to C. glomerata.

Hansen, B. W., Roskilde University, Roskilde, Denmark, b Hansen@ruc.dk
ENERGETICS AND ECOLOGICAL SIGNIFICANCE OF A SPIONID POLYCHAETE LARVAE (POLYDORA CILIATA) IN A EUTROPHIC ESTUARY

In the laboratory larval feeding saturated at 2 μg C mL-1 on Thalassiodora weissflogii and 5 μg C mL-1 on Rhodomonas salina. Maximum specific growth rate was 0.2 d-1, and GGE were 0.29 and 0.16 during larval development. Total meroplankton biomass was frequently similar to or exceeded that of holoplankton in the estuary. In situ specific growth rates (~0.10 d-1) were always lower than in R. salina enriched natural food suspensions (~0.21 d-1). Using a simple swimming model we estimated a critical larval length at 1 mm above which the buoyancy corrected weight of the larva exceeds the propulsion force generated by the swimming apparatus and thus forces the larva to the bottom. Larvae retain a minimum prey size of 4 μm and an ontogenetic increase in maximum prey size which add to a reduction in weight in intraspecific competition among the various larval stages. Not only do larval morphology and behaviour govern larval feeding, prey behaviour such as swimming speed also influence the feeding efficiency. The food covers the microplankton size fraction including non-motile as well as motile prey.

Harezlak, V., Deltares, Delft, Netherlands, Valeca.Harezlak@deltares.nl
Dionisio Pires, M., Deltares, Delft, Netherlands, Miguel.Dionisio@deltres.nl
EFFECT OF EXTREME DRY YEARS ON THE DISTRIBUTION OF THE SEA-GRASS ZOSTERA MARINA IN THE DUTCH WADDEN SEA.

Climate change gradually alters abiotic and biotic conditions. Nonetheless, nowadays the idea that the most profound effects of climate change are not brought about by gradual change but by so-called extreme events. Extreme events can be defined as the 10 and 90 percentile of the occurrence of climatic factors. However, the impact of an extreme event depends on the resilience of the ecosystem: low resilience ecosystems are likely to be more vulnerable to the effects of extreme events than high resilience ecosystems. Estuaries are among the most vulnerable ecosystems to climate change and as such to extreme events. In this study, we looked at the effects of dry years on the distribution of the seagrass Zostera marina, a key species in estuaries of the Dutch Wadden Sea. The area’s environmental conditions are marked as stressing for Z. marina. Distinct changes in distribution of Z. marina in the Dutch Wadden Sea during a dry year are therefore expected. We modeled different scenarios: 1) the effect of a dry year, 2) alternating dry and normal years, and 3) succeeding dry years. We used the GIS based model HABITAT, which gives spatially explicit results. Results will be presented at the ASLO conference.

Harris, B. P., University of New South Wales, Sydney, Australia, b.harris@student.unsw.edu.au
Suthers, I. M., University of New South Wales, Sydney, Australia, isuthers@unsw.edu.au
Young, J., CSIRO, Hobart, Australia, j.young@csiro.au
Taylor, M. D., University of New South Wales, Sydney, Australia, matttaylor@unsw.edu.au
Everett, J. D., University of New South Wales, Sydney, Australia, jason.everett@unsw.edu.au
KRILL IN SUBTROPICAL AUSTRALIAN WATERS

Euphausiids (krill) are an unappreciated key species in subtropical waters, forming the link between phytoplankton and larger marine organisms. Many commercial fisheries are dependent on krill biomass, yet, there has been relatively little research on krill community dynamics outside of the polar regions. In 2008 a survey was performed in the subtropical waters off the New South Wales coast looking at both East Australian Current (EAC) and Tasman water masses for krill abundance and distribution. Pelagic habitats characterised by water mass traits such as SST are used to dynamically restrict access for the East Coast Tuna and Billfish long liners, which may have a more robust basis if tropically linked to krill. The survey focused on the top 100 m of the water column using an open/closing net to collect vertically stratified samples. With samples being taken in an offshore cold core eddy, a coastal eddy and in coastal upwelling. Six different krill species were identified with only three being in dominant populations. Krill were counted and sized, showing varying size distributions between sites. One species, Nematoscelis microps, was found in large numbers further south in comparison to previous studies during the 1950s and 70s where they were found in minimal numbers in waters off Queensland. Of concern for krill is the effect of climate shift and the increase in competition from gelatious zooplankton and the effect this may have on commercial fisheries.
Harris, L.-A., University of Maryland Center for Environmental Science, Solomons, USA, harris@cbi.umces.edu

APPLYING THE METABOLIC THEORY OF ECOLOGY TO ESTUARINE ANAEROBIC MICROBIAL COMMUNITIES

Metabolism is the basis of life and our understanding of individual organismal respiration and primary production is inherently linked to whole-system metabolism. The scaling of these rates and the thermodynamic dependency of metabolic reactions on temperature can tell us much about the relative autotrophic or heterotrophic status of an estuary, and how this metabolic balance may change with rising temperatures in the face of climate change. Using the Metabolic Theory of Ecology (MTE) we have been able to predict that a 4°C change in water temperature used for climate change predictions could result in a 20% increase in net primary production and a 43% increase in heterotrophic metabolism, thereby decreasing P:R ratios. However, we must still confront the challenge of understanding how these effects of temperature interact with nutrient availability, anaerobic metabolic processes, and coupling between microbial communities. Here we present a more complete picture of predictions from the MTE for anaerobic microbial communities and explore how changing temperature may interact with nutrient loading to coastal waters to impact trophic status and restoration trajectories for eutrophic estuaries.

Hartmann, J., Institute for Biogeochemistry and Marine Chemistry, KlimaCampus, University of Hamburg, Hamburg, Germany, jens.hartmann@zmaw.de
Lauerwald, R., Institute for Biogeochemistry and Marine Chemistry, KlimaCampus, University of Hamburg, Hamburg, Germany, ronny.lauerwald@zmaw.de
Moordorf, N., Institute for Biogeochemistry and Marine Chemistry, KlimaCampus, University of Hamburg, Hamburg, Germany, nils.moordorf@zmaw.de
Aumann, T., Institute for Biogeochemistry and Marine Chemistry, KlimaCampus, University of Hamburg, Hamburg, Germany, thorben.amann@zmaw.de
Weiss, A., Institute for Biogeochemistry and Marine Chemistry, KlimaCampus, University of Hamburg, Hamburg, Germany, andreas.weiss@zmaw.de

GLORICH: GLOBAL RIVER AND ESTUARY CHEMICAL DATABASE

Freshwater inputs through rivers influence biological and biogeochemical processes in coastal systems. Spatial and temporal variations of matter input can lead to significant changes of marine species composition and abundance. In the context of global change, it becomes increasingly important for scientists to access historical monitoring data of individual locations, or to compare data based on their regional characteristics. However, no globally representative and standardized database is available now, which could provide data to the scientific community researching land-ocean matter fluxes. A new global database is now under development (GLORICH) which is designed to collect available data on river chemistry. At present, it incorporates more than 10,000 sampling locations of water chemistry with monitoring data ranging back in some cases to the 1950s. For a number of monitoring locations, capture attributes have been calculated (e.g. average climatic and hydrologic data). For a number of monitoring locations, capture attributes have been calculated (e.g. average climatic and hydrologic data)

Hartwich, M., University of Potsdam, Potsdam, Germany, melanie.hartwich@uni-potsdam.de
Piepho, M., University of Potsdam, Potsdam, Germany, piepho@uni-potsdam.de
Straile, D., University of Constance, Konstanz, Germany, Dietmar.Straile@uni-konstanz.de
Gaedke, U., University of Potsdam, Potsdam, Germany, gaedke@uni-potsdam.de
Wacker, A., University of Potsdam, Potsdam, Germany, wacker@uni-potsdam.de

RE-OILIGOTROPHICATION REDUCES FOOD QUANTITY BUT IMPROVES FOOD QUALITY FOR HERBIVORES

During re-oiligotrophication phytoplankton biomass and taxonomic composition usually change, altering food quantity and food quality constraints of herbivores and their seasonality. To reveal consequences of the ongoing re-oiligotrophication of a large, deep lake (Lake Constance) for two major primary consumers, daphnids and copepods, we analyzed comprehensive data on phytoplankton taxonomic composition, fatty acid concentrations and C/P ratios. Phytoplankton species were categorized for ingehtibibility by the respective consumers, and for their measured content of short- and long-chained polyunsaturated fatty acids, as criterion for food quality. Egg ratios and crustacean biomasses, indicating gross and net productivity, were compared with seasonal and long-term changes in the biomass of different phytoplankton groups differing in quality and ingestibility for the period of 1979-2008. Overall, the food quantity decreased while the food quality improved during re-oiligotrophication. The absolute amount of high quality phytoplankton exhibited pronounced seasonal changes which decreased during re-oiligotrophication, whereas the proportion of low quality phytoplankton declined for both consumer groups. These changes in food quantity and quality contribute to understand the seasonal and long-term variability of zooplankton egg ratios, standing stocks and composition.

Harvell, C.D., Cornell University, Ithaca, USA, cdh5@cornell.edu
Ruiz-Moreno, D., Cornell University, Ithaca, USA
Willis, B., James Cook University, Townsville, Australia
Paige, C., James Cook University, Townsville, Australia
Weil, E., University of Puerto Rico, La Puegara, Puerto Rico
Croquer, A., University of Puerto Rico, La Puegara, Puerto Rico
Angel, B., NOAA, Honolulu, USA
Jordan, G., UNAM, Pto Morelos, Mexico
Dahlgren-Jordan, L., UNiversity of Guam, Guam, Guam

GLOBAL PATTERNS OF CORAL DISEASE AND POTENTIAL CLIMATE DRIVERS

Climate-driven temperature stress and disease outbreaks contribute to reef degradation. Using a standardized sampling methodology we combined surveys from 39 localities in the Caribbean Sea and the Pacific Ocean from 2005 through 2007. Indices to account for warm and cold anomalies were derived from remotely sensed Sea Surface Temperature (SST) data for each locality. We evaluated (a) which areas globally have unusually high coral disease prevalence, (b) the relationship between disease prevalence and environmental conditions, community structure and coral cover, (c) whether short term trends in disease prevalence and/or coral cover can reveal reef regions with either extreme vulnerability or strong coral resilience. Our survey revealed unusually high incidence of compromised reef health around the world, with many sites in the Caribbean Sea exhibiting higher disease prevalence and degradation relative to the Pacific. Using generalized linear models, we identified the factors that influence prevalence for the different diseases and coral families. When diseases are studied at the level of coral families, indicators of extreme temperature events from one year before combined with the presence of other infectious diseases in the same reefs exert significant influence on the current health status of coral assemblages.

Hartwich, M., MBARI, Moss Landing, USA, jharvey@mbari.org
Ryan, J. P., MBARI, Moss Landing, USA
Marin, R., MBARI, Moss Landing, USA
Robidart, J., UC Santa Cruz, Santa Cruz, USA
Preston, C., MBARI, Moss Landing, USA
Alvarado, A., MBARI, Moss Landing, USA
Zhang, Y., MBARI, Moss Landing, USA
McEwen, R. S., MBARI, Moss Landing, USA
Pye, E., MBARI, Moss Landing, USA
Bellingham, J. G., UC Santa Cruz, Santa Cruz, USA
Rajan, K., MBARI, Moss Landing, USA
Chavez, F., MBARI, Moss Landing, USA
Scholin, C. A., MBARI, Moss Landing, USA
Vrijenhoek, R. C., MBARI, Moss Landing, USA

TWO ROBOTIC PLATFORMS FOR MOLECULAR DETECTION OF MARINE ZOOPLANKTON, PHYTOPLANKTON, BACTERIOPLANKTON AND HAB PHYCOTOXINS: A MULTI-TROPHIC LEVEL APPROACH.

The Autonomous Underwater Vehicle (AUV) and the Environmental Sample Processor (ESP) are two robotic water-sampling platforms developed at the Monterey Bay Aquarium Research Institute (MBARI). The mobile AUV enables autonomous, near real-time observation of plankton blooms. The ESP is a stationary platform that conducts near real-time molecular analyses on water samples in situ. In both cases, the robust and highly sensitive sandwich-hybridization assay (SHA) is one of several molecular methods used for detection and monitoring of marine invertebrate larvae, copepods, bacteria, harmful micro-algae and harmful algal bloom (HAB) derived toxins. Multivariate statistical methods link biological signals to environmental parameters including concentrations of chlorophyll and nitrate. Our analyses reveal that certain zooplankton are associated with strong chlorophyll signals. These findings motivate targeted AUV sampling of chlorophyll maxima via a peak capture algorithm during simultaneous phytoplankton bloom tracking employing an adaptive, probabilistic algorithm.
A tiered water filtration system allows simultaneous detection of zooplankton, phytoplankton, bacterioplankton and domoic acid. The AUV and ESP enable novel characterization of ecological interactions including inter-trophic level toxin transfer.

Hatcher, S. M., University of North Carolina at Chapel Hill Institute of Marine Sciences, Morehead City, USA, hatcher.sarah@gmail.com
Bindee, E., University of North Carolina Charlotte, Charlotte, USA, eabinnde@unc-ecu.edu
Blackwood, A. D., University of North Carolina at Chapel Hill Institute of Marine Sciences, Morehead City, USA, adb@med.unc.edu
Conn, K. E., University of North Carolina at Chapel Hill Institute of Marine Sciences, Morehead City, USA, keconn@email.unc.edu
Helmy, T., University of North Carolina at Chapel Hill Institute of Marine Sciences, Morehead City, USA, helmy@unc.edu
Oliver, J. D., University of North Carolina Charlotte, Charlotte, USA, jdoliver@uncc.edu
Noble, R. T., University of North Carolina at Chapel Hill Institute of Marine Sciences, Morehead City, USA, rt1036@email.unc.edu

THE INTERPLAY OF ESTUARINE DYNAMICS AND PATHOGENIC MEMBERS OF THE VIBRIO GENUS

Estuarine dynamics play a critical role in the transport and fate of bacteria, including native members of the estuary (Vibrio sp.) with relevance to human health. The Neuse River Estuary (NRE) was studied to ascertain links between environmental attributes (e.g., salinity) and members of the Vibrio sp. including virulent forms Vibrio vulnificus and V. para-haemolyticus. Vibrios are native to the NRE and highly dependent on salinity and temperature. However, the ecology of Vibrio populations during normal conditions contrasts dramatically with that during hurricanes and tropical storms. We have also observed a shift from the prevalence of “environmental” genotypes of V. vulnificus during spring and summer conditions, to “clinical” (higher virulence) genotypes during periods of water warming and input from storms (early fall). Clinical genotypes also demonstrate a preference for mesohaline conditions (10-15 psu). Multiple regression analyses demonstrate that V. vulnificus behavior deviates strongly from that of the genus. The results of this study reinforce the importance of conducting in situ sampling during storms to understand potential health risk with increasing storm frequency and intensity due to climate change.

Hatje, V., Universidade Federal da Bahia, Salvador, Brazil, vhatje@ufba.br
de Souza, M. M., Universidade Federal da Bahia, Salvador, Brazil, mcmbns@hotmail.com

INORGANIC CONTAMINATION AND HUMAN HEALTH RISK ASSESSMENT DUE TO CONSUMPTION OF SHELLFISH IN TODOS OS SANTOS BAY, BAHIA, BRAZIL

This study determined the concentrations of major and trace elements in shellfish (oysters, clams and mussels) and conducted an assessment of the health risk due to consumption of contaminated seafood. Samples (n = 41) were collected along Todos os Santos Bay, Bahia, Brazil. The major and trace elements were determined by ICP OES. Relatively high concentrations of trace metals (Ag, Zn, Se and Cu) were found in seafood tissues, especially, in Aratu Bay, Subaé estuary and Madre de Deus island. Potential daily intake of As, Co, Se, Zn and Cu associated to shellfish consumption suggested relevant non-carcinogenic risk for all studied locations. Copper was the element that posed the greatest non-carcinogenic risk, while Pb posed the highest carcinogenic risk. Health risks for humans were greatest from consumption of mussels. Contaminated shellfish offer the greatest risk for children, suggesting that consumption of mussel from contaminated areas at Todos os Santos Bay, such as Subaé estuary and Aratu should be made with moderation.

Hauke, J., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, judith.hauke@awi.de
Hillenbrand, C. D., British Antarctic Survey, Cambridge, United Kingdom, hlk@bas.ac.uk
Hoppema, M., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, marino.hoppema@awi.de
Kuhn, G., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, gerhard.kuhn@awi.de
Nehrke, G., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, gernot.nehrke@awi.de

CARBONATE SEDIMENTS ON ANTARCTIC SHELVES AND IMPLICATIONS FOR A MECHANISM TO BUFFER OCEAN ACIDIFICATION IN THE SOUTHERN OCEAN

We study the link between rapid acidification and carbonate abundance on the Antarctic shelf and investigate whether and on which regional and temporal scale dissolution of sedimentary carbonates may buffer acidification in the Southern Ocean. The most important factors, determining the buffering capacity of Southern Ocean carbonates, are the amount of total carbonates in shallow surface sediments and their mineral composition (calcite, aragonite). We analyzed a total of 181 surface sediment samples from different regions of the Antarctic shelf that are archived at various core repositories in Europe and the U.S. In addition, we investigated samples collected during recent expeditions. We measured the carbonate content and the carbonate mineralogy of these sediment samples. The data were supplemented by literature data, amounting to nearly 400 data points. The carbonate content shows clear regional and bathymetric patterns. Two different mechanisms of carbonate preservation related to environmental factors are recognized. One is related to very shallow depths and benthic carbonate producing communities, whereas on the outer shelf currents can lead to accumulation of carbonates in the sand fraction.

Haupt, F., Ludwig-Maximilians-Universität München, Munich, Germany, haupt@zool.biologie.uni-muenchen.de
Stockenreiter, M., Ludwig-Maximilians-Universität München, Munich, Germany, stockenreiter@bio.lmu.de
Boersma, M., Alfred Wegener Institut for Polar and Marine Research, Helgoland, Germany, maarten.boersma@awi.de
Stibor, H., European Institute for Marine Studies, Brest, France, herwig.stibor@univ-brest.fr

THE EFFECT OF PHYTOPLANKTON COMMUNITY SIZE STRUCTURE ON THE RESPONSE TO DAPHNIA DIEL VERTICAL MIGRATION

Diel vertical migration (DVM) is a common behavior of pelagic zooplankton species, which is characterized by a twice daily habitat shift. This causes a discontinuous grazing regime with conspicuous consequences for phytoplankton communities. We investigated the influence of DVM of Daphnia hyalina on two different size structured phytoplankton communities, by the use of 10 m deep field enclosures. Therefore, epilimnetic water was filtered with two mesh sizes to obtain the differently size structured phytoplankton communities: the 11 µm filtered phytoplankton communities contained mainly small algae, while the 64 µm filtered communities had a broader range of phytoplankton sizes. DVM had positive effects on nutrient availability and total phytoplankton abundance within the two different phytoplankton communities. In treatments with a broader range of phytoplankton sizes, DVM resulted in an increase of phytoplankton abundance, whereas in treatments with mainly small algal sizes DVM resulted in a decrease of phytoplankton abundance.

Hawley, S. M., Northeast Fisheries Science Center, National Marine Fisheries Service, NOAA, Milford, CT, USA, Scott.Hawley@noaa.gov
Meseck, S. L., Northeast Fisheries Science Center, National Marine Fisheries Service, NOAA, Milford, CT, USA, smeseck@clam.mi.nmfs.gov
Wildors, G. H., Northeast Fisheries Science Center, National Marine Fisheries Service, NOAA, Milford, CT, USA, Gary.Wildors@noaa.gov

OCEAN ACIDIFICATION AND PHYTOPLANKTON: TESTING TWO WAYS TO DO SMALL VOLUME OCEAN ACIDIFICATION EXPERIMENTS

The effects of ocean acidification on plankton are largely unknown. Determining how ocean acidification will effect or shift plankton communities and change the primary production in the ocean is important for food web models. However, these experiments must be able to accurately reproduce the predicted values for 2100. According to the European Project on Climate Change “Best Practices in Ocean Acidification” there are a variety of methods that can be used to do ocean acidification experiments. Two methods, acid/bicarbonate addition and gas bubbling, were used on growing cultures of Thalassiosira weissflogii to determine which method would reproduce stable pH and the predicted ocean chemistry of 2100. The acid/bicarbonate addition trial was not able to maintain the various carbon dioxide treatments. Cultures that were bubbled with an air/carbon dioxide mixture were more stable. These results suggest that for phytoplankton experiments gas bubbling would mimic 2100 ocean conditions.

Hay, M. E., Georgia Inst. of Technology, Atlanta, USA, mark.hay@biology.gatech.edu
MARINE CHEMICAL ECOLOGY: CHEMICAL SIGNALS AND CUES STRUCTURE MARINE POPULATIONS, COMMUNITIES, AND ECOSYSTEMS

Chemical cues constitute much of the language of life in the sea. Understanding biotic interactions and their effects on marine ecosystems will advance more rapidly if this language is studied, understood, and used to deepen our insights into the
hoe chemical cues and signals regulate critical aspects of the behavior of marine organisms and their cascading effects on marine populations, communities, and ecosystems. Chemical cues determine foraging strategies, feeding choices, communal associations, selection of mates and habitats, competitive interactions, and transfer of energy and nutrients within and among ecosystems. In numerous cases, the indirect effects of chemical signals on behavior have as much or more effect on community structure and function as the direct effects of consumers and pathogens. Chemical cues are critical for understanding marine systems, but their omnipresence and impact is presently inadequately recognized.

Hayden, N. J., Texas A&M University, Wildlife and Fisheries Sciences Department, 2258 TAMU, College Station, Texas, USA, natanyahayden@yahoo.com
Roeke, D. L., Texas A&M University, Wildlife and Fisheries Sciences Department, 2258 TAMU, College Station, Texas, USA, droelke@tamu.edu
Brooks, B., Baylor University, Department of Environmental Science and Center for Reservoir and Aquatic Systems, Waco, USA
Grover, J. University of Texas at Arlington, Department of Biology and Program in Env. and Earth Science, Arlington, USA
Neisch, M., Texas A&M University, Wildlife and Fisheries Sciences Department, 2258 TAMU, College Station, Texas, USA
Valenti, M., Baylor University, Department of Environmental Science and Center for Reservoir and Aquatic Systems, Waco, USA
Prosser, K. Baylor University, Department of Environmental Science and Center for Reservoir and Aquatic Systems, Waco, USA
Gable, G., Texas A&M University, Wildlife and Fisheries Sciences Department, 2258 TAMU, College Station, Texas, USA
Umphres, G., Texas A&M University, Wildlife and Fisheries Sciences Department, 2258 TAMU, College Station, Texas, USA
Hewitt, N., Texas A&M University, Wildlife and Fisheries Sciences Department, 2258 TAMU, College Station, Texas, USA
THE EFFECT OF FLUSHING WITH DEEP LAKE WATER ON A PRYMNESIUM PARVUM BLOOM: RESULTS FROM IN-SITU MESOCHEM EXPERIMENTS
Prymnesium parvum blooms are increasingly detrimental throughout the United States. Texas alone has experienced a loss of 34 million fish, worth ≈ $13 million. Because natural inflow events can terminate these blooms, eliminating fish mortality and other toxic effects, we explored the efficacy of using inflows as a bloom mitigation tool by employing in-situ mesocosms and source water for flushing pumped from deeper waters. Samples were collected for P. parvum cell density; ambient toxicity; zooplankton composition, density and biovolume; phytoplankton biomass and assemblage composition; inorganic nutrients; and various abiotic factors. Preliminary analysis shows that P. parvum cell density and toxicity were greatly reduced at flushing rates of 0.1 and 0.3 d−1 with one inflow pulse occurring per week. Results indicate that the flushing treatment of 0.3 d−1 removed 85% of P. parvum cell density and completely eliminated toxicity. Chlorophyll a levels remained at the same level as surrounding lake samples for all treatments, indicating persistence and productivity of other phytoplankton species. Ultimately, this study may indicate an ecologically benign management technique for circumventing these deadly algal blooms.

Hayes, N. M., Miami University, Oxford, USA, hayesnm@muohio.edu
Vanni, M. J., Miami University, Oxford, USA, vannimj@muohioedu
Brownson, E. A., Miami University, Oxford, USA, brownsea@muohio.edu
PRECIPITATION MEDIATES THE IMPORTANCE OF LAND USE ON NUTRIENT LIMITATION AND CYANOTOXIN PRODUCTION
Total nitrogen (TN) and phosphorus (TP) concentrations, and their ratio, in lakes and impoundments are strongly influenced by watershed land use; however, precipitation is necessary for nutrient transport into waterbodies. We examined how land use and precipitation affected nutrient concentrations, nutrient limitation, TN:TP ratio, and cyanotoxin (microcystin-LR) concentrations in nine Ohio reservoirs monthly for an entire summer and 22 additional reservoirs a single time in late summer over multiple years. Watershed land use varied strongly among reservoirs from 85% agriculture to 92% forest. Nitrogen limitation decreased with the percentage of watershed land composed of agriculture, but this trend varied seasonally. Watershed land use explained 31% of the variance in nitrogen limitation during spring, when precipitation was high, but only 11% in late summer and fall when precipitation was low. Percent forest in the watershed explained 27% of the variance in microcystin concentration in 2006, a high precipitation year, but a non-significant amount in 2007 and 2009, both dry years. Our results indicate that precipitation and watershed land use interactively affect nutrient dynamics and water quality.

Hayes-Pontius, F. M., University of Vermont, Burlington, USA, ehayespo@uvm.edu
McCabe, D. J., Saint Michael’s College, Colchester, USA, dmc McCabe@smcvt.edu
EFFECT OF LAND USE ON BENTHIC MACROINVERTEBRATE COMMUNITY METRICS IN VERMONT STREAMS
Runoff from agriculture and urban development impacts streams, and one way to measure this impact is by examining benthic macroinvertebrate assemblages. Samples were taken from riffles in streams in accordance with EPA Rapid Bioassessment Protocols. Ecosystem was used to quantify taxonomic richness, probability of interspecific encounter, Hydropsychidae abundance and total macroinvertebrate abundance. Land use for each stream was determined by using analysis of GIS layers. As hypothesized, forested sites had significantly higher PIE, overall richness, and EPT richness, which indicates that their diversity is much higher than that of agricultural or urban-impacted streams. Community metrics from streams draining agricultural and urban areas did not differ statistically from each other. Lack of significant differences in total abundance and Hydropsychidae abundance among stream types could be due to small sample sizes of urban sites and the similar effects that urban and agricultural areas exert on streams. Further study will be required to discover what differences, if any, exist between agriculturally and urban impaired streams.

He, Z., USDA-ARS, Orono, USA, zhongq.he@ars.usda.gov
WATER EXTRACTABLE PHOSPHORUS IN SOILS AS IMPACTED BY CROP PATTERN, TILLAGE PRACTICE, AND AMENDMENT HISTORY
Water extractable phosphorus (P) is the most labile P pool in soil. Thus, the level of water extractable P is an important parameter in evaluating the runoff potential of soil P. This work compared the water extractable inorganic P (WEPi) and organic P (WEO) levels in three soils as impacts by crop management, tillage and long term poultry litter (PL) application. In a Caribou sandy loam soil, 3-y crop rotations of disease suppressive, soil conserving, and soil improving systems increased the level of WEPi. Irrigation increased WEPi in soil under continuous potato production. The distribution of pattern of WEPi was somewhat like that of WEPo, but on a smaller scale. In a Cecil sandy loam soil with cotton-corn production, 10-y application of PL increased WEPi and WEO by 6.3 and 8.5 mg per kg soil under conventional tillage, and by 8.3 and 10.0 mg per kg soil under no-tillage, respectively. Similarly, in a Hartsville soil under pasture, WEPi increased rapidly with increasing history of PL application, and reached 29.9 mg per kg soil following 20 years of PL application. Further correlation analysis indicated that the increase in water extractable P from PL was related more to the number of years of PL application, than annual application rate or cumulative amount of litter applied. This research showed that amendment history and management practices on a given soil must be considered for managing P in an environmentally responsible manner.

Heal, K. R., Woods Hole Oceanographic Institution REU, Woods Hole, USA, katherineheal@colorado.edu
Repeta, D. J., Woods Hole Oceanographic Institution, Woods Hole, USA, CONCENTRATION OF DISSOLVED ORGANIC PHOSPHORUS (DOP) IN SEA WATER USING MG(II)-MN(III) LAYERED DOUBLE HYDROXIDE
Phosphorous (P) is the ultimate limiting nutrient on a geological timescale, and total dissolved phosphorus (TDP) is often present in sub-micromolar concentrations, with the two main factions of TDP, dissolved inorganic phosphorous (DIP) and dissolved organic phosphorus (DOP), in nanomolar concentrations. Very little is known about the chemical composition. In order to move closer to chemical analysis of DOP, selective adsorption and subsequent desorption or dissolution of TDP to a Manganese/Magnesium double-layered hydroxide was tested. Seawater samples were analyzed for TDP and total reactive phosphorus (TRP). Samples were stirred with resin, dried resins were removed from filters and desorbed. Dried resins were extracted with hydroxylamine hydrochloride to dissolve the manganese oxides. The cloudy suspension was treated with HCl to pH 1 and solution turned clear after dissolution of mineral. We have concluded that desorption is ineffective at removing small amounts (less than 500 nmol) from 200 mg resin, but TRP recovery after dissolving the resin was very effective, indicating that all TDP is in solution and using the resin to concentrate the DOP in seawater is a successful approach.

Heathcote, A. J., Iowa State University, Ames, USA, aheathco@iastate.edu
Kendall, D. L., Iowa State University, Ames, USA, dlk@iastate.edu
Filstrup, C. T., Iowa State University, Ames, USA, cfilstrup@iastate.edu
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Heathcote, A. J., Iowa State University, Ames, USA, aheathco@iastate.edu
Kendall, D. L., Iowa State University, Ames, USA, dlk@iastate.edu
Filstrup, C. T., Iowa State University, Ames, USA, cfilstrup@iastate.edu
EVALUATING THE ECOLOGICAL PERFORMANCE OF NEARSHORE FISH HABITAT ENHANCEMENTS IN AN URBANIZED ESTUARY

Estuarine nearshore environments worldwide are ecologically important as productive habitats for resident and migratory organisms. Human impacts in these environments often drastically alter the physical form and ecosystem processes along the shoreline, resulting in impacts to valued ecosystem goods and services produced there. The objective of this study was to evaluate shoreline enhancements at the Olympic Sculpture Park in Seattle, WA, to test whether degraded shorelines can be improved as juvenile Pacific salmon (Oncorhynchus spp.) habitat. We evaluated several metrics of ecological performance at representative enhanced, nearshore space increased available fish habitat and observed feeding behaviors, and urban and unmodified Puget Sound beaches. We found that the addition of shallow productive habitats for resident and migratory organisms. 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TSS were statistically different among land use treatments (MANOVA). As expected, nitrogen levels were highest in residential and golf areas. Higher chlorophyll levels at golf sites were possibly due to the increased nitrogen levels. The results show that land use does impact the water quality of this watershed and management of land use may help further restore Boston Harbor.

Henry, K. M., Louisiana State University, Department of Oceanography and Coastal Sciences, Baton Rouge, USA, khen13@tigers.lsu.edu

Fulweiler, R. W., Boston University, Department of Earth Sciences, Boston, USA, rwf@bu.edu

Morgan, E. J., Boston University, Department of Earth Sciences, Boston, USA, ericjmorgan@gmail.com

Twilley, R. R., Louisiana State University, Department of Oceanography and Coastal Sciences, Baton Rouge, USA, rtwilley@lsu.edu

THE IMPACT OF THE DEEPWATER HORIZON OIL SPILL ON BIOGEOCHEMISTRY OF COASTAL LOUISIANA SEDIMENTS

The 2010 Deepwater Horizon oil spill released 4 million barrels of oil into the Gulf of Mexico making it history's largest marine oil spill. While the effects of this spill on higher trophic levels were extensively documented, its impact on sediment biogeochemistry is relatively unknown. We examined the effects of weathered crude oil on sediment net N2, NO3, CO2, and CH4, and dissolved inorganic nutrient fluxes on marsh habitats of Barataria Bay, Louisiana. The presence of oil increased the production of dinitrogen gas from 55 to 90 µmol N2 m-2 h-1 and the uptake of nitrate from -20 to -105 µmol NO3 m-2 h-1. Sediments were both a source and a sink of nitrous oxide, releasing a maximum of 440 nmol N2O m-2 h-1. Oil shifted marsh sediments from a net source of CO2 (4230 µmol CO2 m-2 h-1) to a sink (~610 µmol CO2 m-2 h-1). These results highlight the complex effects of oil on sediment biogeochemistry with oil toxicity negatively affecting some microbial communities, while serving as an alternative carbon source for others.

Henry, L. V., University of South Florida, St. Petersburg, USA, lhenry@mail.usf.edu

Torres, J. J., University of South Florida, St. Petersburg, USA, jjtorres@marine.usf.edu

METABOLISM OF AN ANTARCTIC SOLITARY CORAL, FLABELLUM IMPENSA, AND THE DEEP-SEA STONY CORAL, LOPHELIA PERTUSA

Oxygen consumption was measured for Flabellum impensa, collected off the Antarctic Peninsula, and for Lophelia pertusa, collected off the coast of Miami. Metabolic enzyme activities of lactate dehydrogenase (LDH), malate dehydrogenase (MDH), and citrate synthase (CS) were measured to determine aerobic/anoxic/aerobic poise. F. impensa consumed 0.41±0.44 µmol O2/g/h (mean ± S.D.), which was higher than expected for a polar coral. CS activity fell within normal range for cnidarians,averaging 0.67±0.05 units/g. LDH and MDH were undetectable, suggesting that these enzymes occur in low concentrations, underscoring the aerobic poise of F. impensa. Respiration for small pieces of L. pertusa averaged 0.44±0.66 µmol O2/polyhp.l Mass-specific rates are being determined. CS activity also varied, ranging from 0.00245–0.013173 units/g. LDH and MDH activities averaged 2.10±1.85 units/g and 2.92±2.14 units/g, respectively, indicating that L. pertusa is reasonably anaerobiically poised for a cnidarian. This study contributes much-needed knowledge of the basic biology of corals, so that effects of climate change and pollutants on corals can be studied on a physiological level and the effects of symbionts on coral metabolism may be elucidated.

Hermes, A. L., Rutgers University, New Brunswick, USA, alhermes@marine.rutgers.edu

Sikes, E. L., Rutgers University, New Brunswick, USA

Hunter, E., Rutgers University, New Brunswick, USA

SEASONAL CHANGES IN ORGANIC MATTER COMPOSITION AND PARTITIONING THROUGH THE DELAWARE ESTUARY

In the Delaware Estuary, complex sources of organic matter (OM), urbanization, as well as physical, chemical, and biological dynamics control the identity and fate of OM reaching the ocean. To examine how OM is partitioned in this system, we conducted seasonal axial surveys of physical and biological parameters (temperature, salinity, chlorophyll, and turbidity), and collected particulate organic matter (POM) from the surface and bottom water. Water column POM biomarker abundances elucidate variations in sources and sinks of OM; for example, analysis of δ-alkanes and fatty acids can distinguish between marine and terrestrial sources, while phospholipid-linked fatty acids provide insight into biological processes. Seasonal and episodic variations in physical dynamics were observed, with two-layer flow evident during periods of higher river discharge, and multiple turbidity maxima with decreased stratification during periods of lower river discharge. Preliminary n-alkane analyses show differences in POM sources between physical and biological regimes of the estuary (including the chlorophyll and turbidity maxima, and salinity end-members). Biomarker results also show differences between surface and bottom water samples, suggesting multiple dynamics contribute to the differential filtering of OM sources.

Hernández-Delgado, E. A., University of Puerto Rico, Center for Applied Tropical Ecology and Conservation, San Juan, Puerto Rico, coral_giac@yahoo.com

Hernandez-Pacheco, R., University of Puerto Rico, Center for Applied Tropical Ecology and Conservation, San Juan, Puerto Rico, rahi.hernandez@upr.edu

Cabrer, J., University of Puerto Rico, Center for Applied Tropical Ecology and Conservation, San Juan, Puerto Rico, jerrymar@gmail.com

Ruiz, T. M., University of Puerto Rico, Center for Applied Tropical Ecology and Conservation, San Juan, Puerto Rico, amoeba_blue@hotmail.com

Sabat, A. M., University of Puerto Rico, Department of Biology, San Juan, Puerto Rico, amsabat@gmail.com

SEA SURFACE WARMING, MASSIVE BLEACHING AND THE DEMISE OF CARIBBEAN CORAL REEFS: CASE STUDIES FROM PUERTO RICO

In 2005 the northeastern Caribbean experienced an unprecedented sea surface warming and massive bleaching event affecting 83 cnidarian species. It was followed during 2006 by a mass coral mortality that reshaped coral assemblages across many reefs. Corals from the eastern Puerto Rico (PR) shelf showed a 38-72% loss in % living cover and a significant community phase shift favoring macroalgal dominance after mass bleaching. The Montastrea annularis species complex suffered the most dramatic collapse with 70-99% loss in % living cover. Most large colonies were physiologically fragmented into dozens of small-sized fragments. Subsequent mortality has been significant for fragments <25 cm2. Colonies across other locations in southwestern PR and in Mona Island have also suffered significant mortality, with M. annularis species complex being decimated by yellow blotch disease. But reefs located under strong oceanographic conditions still remain largely unblemished by bleaching and mortality, suggesting a significant role as a biodiversity "reservoir" under climate change. However, based on forecasted increases in sea surface warming and recurrence of massive bleaching events, the future of many Caribbean reef communities may remain largely obscure.

Hernandez-Pacheco, R., University of Puerto Rico, San Juan, Puerto Rico, coral_giac@yahoo.com

Sabat, A. M., University of Puerto Rico, San Juan, Puerto Rico, amsabat@gmail.com

DEMOGRAPHIC EFFECTS OF BLEACHING IN THE PRINCIPAL CARIBBEAN REEF-BUILDING CORAL, MONTASTREA ANNULARIS

In 2005 the northeastern Caribbean experienced an unprecedented sea surface warming that resulted in a massive bleaching event. In this study, we (1) analyze
changes in the vital rates of a Montastraea annularis population before, during, and after the bleaching event; (2) stochastically projected the population with different bleaching regimes; and (3) quantified the population level effect of the event. 

Size-based transition matrices from 2001-2009 were constructed following 399 individual colonies located in Culebra Island, Puerto Rico. Variation in the population growth rate indicates a population that was in demographic equilibrium before the event, suffered a significant decline for two consecutive years after the event, and recovered three years after. Stochastic simulation indicates that an annual probability of bleaching > 6% would result in a decreasing population growth rate with a 54% reduction in colony abundance after 100 years. Our analysis indicates that survival of small colonies will determine the viability of the population. We conclude that the demography of M. annularis is highly susceptible to bleaching and that its viability is seriously comprised under the predicted global warming scenarios.

**HERNANDO-MORALES, V.**, Departamento de Ecología e Biodiversidad Animal, Universidad de Vigo, Vigo, Spain, vfernando@uvigo.es

**TEIRA, E.**, Departamento de Ecología e Biodiversidad Animal, Universidad de Vigo, Vigo, Spain, teiraev@uvigo.es

**ARBONES, B.**, CSIC, Instituto de Investigaciones Marítimas, VIGO, Spain, belen@iim.csic.es

**FIGUEIRAS, F. G.**, CSIC, Instituto de Investigaciones Marítimas, VIGO, Spain, paco@iim.csic.es

**ÁLVAREZ-SALGADO, X. A.**, CSIC, Instituto de Investigaciones Marítimas, Vigo, Spain, xsalgado@iim.csic.es

**IMPACT OF RAINWATER ON THE BACTERIOPLANKTON COMMUNITY IN A COASTAL EUTROPHIC ECOSYSTEM**

Although rainwater is recognized as a potentially important source of both inorganic and organic nutrients, the impact of wet deposition on microbial populations has been poorly assessed on marine planktonic systems. The effect of 2.5% (v/v) additions of rainwater collected at a marine, urban and rural site on bacterioplankton growth and community composition was evaluated in microcosm experiments with natural plankton populations from the Ría de Vigo (NW Spain) during three different seasons (spring, autumn and winter). Catalyzer Reporter Deposition-Fluorescence In Situ Hybridization (CARD-FISH) was used to follow the abundance of six bacterial phylogenetic groups (Roseobacter, SAR11, Betaproteobacteria, Gammaproteobacteria, SAR86, and Bacteroidetes) in the microcosms. A significant increase in total bacterial abundance (up to 1.3-fold) was observed after urban and marine rainwater addition. The magnitude of response was significantly higher in spring than in autumn and winter. By contrast, rural rainwater did not significantly affect bacterioplankton dynamics. The most responsive groups were Gammaproteobacteria and Bacteroidetes, which increased their abundance up to 2.4 and 1.4-fold, respectively.

**Herndl, G. J.**, University of Vienna, Vienna, Austria, gerhard.herndl@univie.ac.at

**Bochdansky, A. B.**, Old Dominion University, Norfolk, USA, ABochdan@odu.edu

**Baltr, F.**, University of Kalmar, Kalmar, Sweden, federico.baltar@gmail.com

**Aristegui, J.**, University of Las Palmas, Gran Canaria, Spain, jaristegui@dbio.upgc.es

**Reint {haler, T.**, University of Vienna, Vienna, Austria, thomas.reinhaler@univie.ac.at

**MICROBIAL CARBON CYCLING IN THE MESO- AND BATHYPELAGIC NORTH ATLANTIC**

We have measured the carbon demand of the heterotrophic microbial community in the North Atlantic from 65°N to 5°S and the standing stock of particulate (POC) and dissolved organic carbon (DOC) as well as the dark inorganic carbon (DIC) fixation by the deep-water autotrophic community. Tight correlations were found between microbial respiration and the POC concentrations throughout the individual deep-water masses. Moreover, video analyses of macroscopic deep-water particles revealed that the abundance of these macroscopic particles is inversely related to the oxygen concentrations in the adjacent waters indicating that heterotrophic microbial activity in the deep waters might be related to macroscopic particles. Whether these aggregates originate from phytoplankton production in surface waters or whether they can be formed autochthonously by microbial dark DIC fixation has been evaluated by comparing the POC concentrations and DIC fixation rates. Based on the measured DIC fixation rates in the deep North Atlantic, we conclude that the majority of these large buoyant particles originate from the surface waters and become buoyant as they sink into denser deepwaters.

**Hershsberger, P. K.**, U.S. Geological Survey, Marrowstone Marine Field Station, Nordland, USA, phershsberger@usgs.gov

**Winton, J. R.**, U.S. Geological Survey, Western Fisheries Research Center, Seattle, USA, jwinton@usgs.gov

**AN EMPIRICAL APPROACH TO UNDERSTANDING THE ECOLOGY OF A VIRAL DISEASE AFFECTING PACIFIC HERRING**

Advancements in our understanding of ecological disease processes occurring in wild marine fish populations have recently been realized through the development of laboratory colonies of specific pathogen-free (SPF) marine fishes. These valuable experimental animals provide the ability to apply a reductionist approach to complex questions in disease ecology by employing a laboratory model system involving the natural hosts and etiological agents for specific diseases of concern. Here, we demonstrate the utility of this approach for assessing the relative contribution of biological and physical factors that predispose Pacific herring populations to epizootics and mass mortalities caused by viral hemorrhagic septicemia, including the lack of herd immunity, the presence of chronic viral carriers in the population, copious viral shedding by infected individuals, cool water temperatures, water circulation patterns, and host behavioral characteristics. Empirical surveillance tools, based on these predisposing factors are being developed to forecast the potential for future epizootics and offer adaptive management strategies that will be intended to prevent or mitigate the negative impacts of the disease.

**Hertler, H.**, Inter American University of Puerto Rico / CECLA, San Germán, Puerto Rico, hertler@inter.edu

**Ramirez-Toro, G.**, Inter American University of Puerto Rico / CECLA, San Germán, Puerto Rico, ceclia@prtc.com

**OYSTERS AS INDICATORS IN SUB-TROPICAL CLIMATES**

In the Caribbean, as elsewhere in the world, near-shore and coastal marine systems are increasingly threatened by onshore changes in land use. Specific causes and effects and the use of a community species as a biological indicator of ecosystem health are rarely documented. Suspension-feeding bivalves are regarded as excellent biological indicators of aquatic community health, but there is limited information about tropical and sub-tropical species in this function. Changes in these populations or impacts on their health can serve as early warning of changes in the ecology of a system. Evaluating spatial differences in physiological measures of bivalve health...
may be useful in strengthening ecological assessment in an area. In this study water quality parameters and population size, structure and physiological condition of two sub-tropical oysters, Isognomon alatus and Crassostrea rhizophorae. Data suggest that oysters fare better in less disturbed, clearer water as compared to eutrophied areas where food availability may be greater. In addition, by including oysters as representatives of the microparticle to suspension-feeder trophic pathway, we significantly strengthen our overall ecosystem assessment. We hope to craft recommendations for using one or both of these organisms as key bioindicators for assessing the status of subtropical aquatic communities.

Hetland, R. D., Texas A&M University, College Station, USA, hetland@tamu.edu

NORTHERN GULF OF MEXICO HYPOXIA AS SEEN THROUGH THE LENS OF CONTINENTAL SHELF DYNAMICAL PROCESSES

A series of statistical and numerical models are used to investigate dynamical processes that affect seasonal hypoxia in the northern Gulf of Mexico. The bottom boundary layer is important in determining the spatial and temporal scales of hypoxia in the western part of the region historically affected by seasonal hypoxia. The eastern region, south and east of Terrebonne Bay, is more directly influenced by fresh water and nutrient fluxes from the Mississippi river. Much of the interannual variability in hypoxic area occurs in the western region, where hypoxia is only present in some years; in contrast, the hypoxia is observed nearly every year in the eastern region. Hypoxic area is a coarse measure of shelf ecosystem health, as it combines many dynamically distinct regions and is influenced by a myriad of processes. Alternate metrics are sought, which both gauge ecosystem health and are more directly influenced by nutrient load. Metrics that are most sensitive to nutrient load are sought because nutrient load is the only primary forcing variable that may be influenced by management activities.

Hettinger, A., Bodega Marine Laboratory, University of California Davis, Bodega Bay, USA, abettinger@ucdavis.edu

Sanford, E., Bodega Marine Laboratory, University of California Davis, Bodega Bay, USA, esanford@ucdavis.edu

Gaylord, B., Bodega Marine Laboratory, University of California Davis, Bodega Bay, USA, bgaylord@ucdavis.edu

Hill, T. M., Bodega Marine Laboratory, University of California Davis, Bodega Bay, USA, tmill@ucdavis.edu

Russell, A. D., University of California Davis, Davis, USA, adrussell@ucdavis.edu

PERSISTENT CARRY-OVER EFFECTS OF PLANKTONIC EXPOSURE TO OCEAN ACIDIFICATION IN THE OLYMPIA OYSTER

Anthropogenic increases in greenhouse gases since pre-industrial times have led to reductions in ocean pH and carbonate saturation. We investigated the consequences of ocean acidification on larvae and juveniles of the ecologically important Olympia oyster. Planktonic larvae exposed continuously to elevated CO2 were 1.4% smaller than those reared under control conditions. Following settlement, individuals raised as larvae under control or elevated CO2 were exposed as benthic juveniles to both control and elevated CO2 conditions. After one week, juveniles that had been exposed as larvae to elevated CO2 had grown 38% less than larvae raised under control conditions, regardless of the CO2 conditions they experienced as juveniles. In the laboratory, these negative carry-over effects extended at least 1.5 months after juveniles were transferred to a common environment. In separate experiments, juveniles exposed to different CO2 conditions as larvae were outplanted to field sites to test whether juvenile habitat modifies these carry-over effects. Overall, our results suggest that negative effects of ocean acidification on oyster larvae can persist well into the juvenile phase with potential demographic consequences for oyster populations.

Hewson, J., Cornell University, Ithaca, USA, hewson@cornell.edu

Barbosa, J. G., Cornell University, Ithaca, USA, hewson@cornell.edu

Brown, J. M., Cornell University, Ithaca, USA, jm636@cornell.edu

Couch, C. S., Cornell University, Ithaca, USA, css89@cornell.edu

Dunlap, D., University of South Florida, St Petersburg, USA, ddunlap1@marine.usf.edu

Hairston, J. N., Cornell University, Ithaca, USA, ngh1@cornell.edu

Harvell, C. D., Cornell University, Ithaca, USA, cdh5@cornell.edu

Kearns, C. M., Cornell University, Ithaca, USA, cmke@cornell.edu

LaBarre, B. A., Cornell University, Ithaca, USA, ba92@cornell.edu

Ng, T. F., University of South Florida, St Petersburg, USA, terrefan@gmail.com

METAVIROMIC-ENABLED ECOLOGICAL INVESTIGATIONS OF INVERTEBRATE DISEASE

The advent of high-throughput sequencing applied to viruses has permitted investigations of viral diversity within, and comparison between habitats, but viromics also provides a powerful diagnostic tool to identify potential pathogens of metazoa. While marine viruses are known to play crucial roles in aquatic ecosystems, comparatively little is known about their interaction with dominant grazers or benthic invertebrates. We have investigated putative pathogens of microcrustacean grazers in freshwater and marine habitats, and viral communities associated with healthy and diseased gorgonian sea fans. Through comparative library analyses and application of metaviromic-enabled quantitative molecular methods we have investigated the transport, prevalence and active transcription of viruses of these groups of invertebrates. Our results demonstrate that previously unrecognized groups of viruses may be involved in aquatic invertebrate disease. For example, viral genome fragments retrieved from aspergillosis disease-affected tissues of gorgonian sea fans share similarity with temperate bacteriophage, but most protein-encoding genes bear no similarity to known viruses or higher organisms. Moreover, our studies demonstrate the utility of metaviromics, particularly when coupled with post-genomic analyses, for investigating the roles of viruses in disease ecology.

Hidalgo, M., University of Oslo/Centre for Ecological and Evolutionary Synthesis (CEES), Oslo, Norway, manuel.hidalgo@bio.uio.no

Rouyer, T., University of Oslo/Centre for Ecological and Evolutionary Synthesis (CEES), Oslo, Norway, t.a.rouyer@bio.uio.no

Olsen, E. M., Institute of Marine Research/Fjødevig Marine Research Station, His, Norway, esben.moland.olsen@imr.no

Cerviño, S., Spanish Institute of Oceanography/Vigo Oceanographic Centre, Vigo, Spain, santiago.cervino@vio.es

Saborido-Rey, F., Institute of Marine Research, Vigo, Spain, fran@iim.csic.es

Murua, H., AZTI Foundation, Pasaia, Spain, hmurua@azti.es

Páteiro, C., Spanish Institute of Oceanography/Vigo Oceanographic Centre, Vigo, Spain, carmen.pineiro@vio.es

Stenseth, N. C., University of Oslo/Centre for Ecological and Evolutionary Synthesis (CEES), Oslo, Norway, n.c.stenseth@bio.uio.no

LIVING CLOSE DOING DIFFERENTLY: THE ROLE OF THE BIOCOMPLEXITY IN FISHING-INDUCED TRUNCATED DEMOGRAPHIES

The size-selective harvesting of large/small fish encompasses detrimental effects both on life history traits and on the population dynamics. However, life-history traits variation and population dynamics are not independent processes and their interaction is still a central challenge for fisheries ecologists. In this study, we combine life-history traits with population evidences on how two close stock subunits of the European hake in the Atlantic belonging to the same population (not genetically different) followed different “biological tracks” when recovering from the low densities imposed by fishing. Though the two stocks suffered an age truncation (removal of older age classes) in early/mid-nineties, north stock shifted to reproduce at smaller
Recent models and concepts suggest that resource ratios are the key to understand the relationship between biodiversity and primary production. We tested this concept in two microcosm experiments with pelagic model metacommunities. The metacommunities received different P-supply, the patches differed in N:P ratios. In the first experiment, a phytoplankton assemblage was inoculated with or without ciliate consumers. At the level of the entire metacommunity, we found strong increases in biomass and decreases in species richness and evenness with increasing P-supply. Without consumers, increasing resource use efficiency (RUE, realized biomass per unit P) was found with increasing richness and evenness. At the patch level, evenness increased realized productivity only at imbalanced N:P (2 or 128) but not at balanced N:P. In the second experiment, we again found increases in biomass and decreases in evenness with increasing P and a positive correlation between regional evenness and RUE. When we compared the phytoplankton assemblage to the component monospecies, the mixtures were not always outperforming the single species, but we found significant overyielding at highest P-supply. In conclusion, P-supply drives absolute productivity and affects diversity, whereas resource stoichiometry constrains the relationship between biodiversity and RUE.

Hilton, J. A., University of California - Santa Cruz, Santa Cruz, USA, jhilton@ucsc.edu
Villareal, T. A., University of Texas Marine Science Institute, Port Aransas, USA, tvillareal@mail.utexas.edu
Tripp, H. J., University of California - Santa Cruz, Santa Cruz, USA, htripp@ucsc.edu
Foster, R. A., Max Planck Institute for Marine Microbiology, Bremen, Germany, rfoster@mpi-bremen.de
Carter, B. J., University of California - Santa Cruz, Santa Cruz, USA, bcarter@ucsc.edu
Zehr, J. P., University of California - Santa Cruz, Santa Cruz, USA, zehrj@ucsc.edu

THE GENOME OF A DIATOM-ASSOCIATED HETEROCYSTOUS CYANO-BACTERIUM
Heterocystous cyanobacteria form associations with a wide variety of eukaryotic hosts, including marine diatoms. The relationships of Nostoc spp. and Anabaena spp. with multicellular plants are well-studied, but little is known about diatom-diazotroph associations (DDAs). A common DDA is between the marine diatom Hemiaulus hauckii and the cyanobacteria Richelia intracellularis and is commonly found in oligotrophic open ocean environments. We obtained a draft genome of R. intracellularis from cells separated from the host diatom H. hauckii by flow cytometry sorting. The genome of R. intracellularis has considerably low percent coding (57%) and GC content (34%) relative to the three sequenced genomes of free-living or facultative symbiotic heterocystous cyanobacteria (averages of 80% and 41%, respectively), suggesting an obligate symbiotic lifecycle. Additionally, R. intracellularis lacks several genes encoding for key nitrogen acquisition and metabolism proteins. Hypotheses regarding the interactions between host and symbiont, and the implications for cycling of nitrogen and carbon in the open ocean are considered.

Hinder, S. L., Swansea University, Swansea, United Kingdom, 502112@swansea.ac.uk
Gravenor, M. B., Swansea University, Swansea, United Kingdom, M.B.Gravenor@swansea.ac.uk
Hays, G. C., Swansea University, Swansea, United Kingdom, G.Hays@swansea.ac.uk
Edwards, M., SAHFOS, Plymouth, United Kingdom, maed@sahfos.ac.uk
Walne, A. W., SAHFOS, Plymouth, United Kingdom, anwa@sahfos.ac.uk

THREAT TO HUMAN HEALTH: IS THE INCIDENCE OF HARMFUL ALGAL BLOOM SPECIES INCREASING?
There is widespread concern that Harmful Algal Blooms (HABs) may be increasing in marine systems accompanied by major negative socioeconomic impacts (e.g. threats to human health and marine harvesting). However long time-series of HAB incidence are generally lacking. We analysed a 48 year (1960-2007) time-series of HAB occurrence in the NE Atlantic region using data from the Continuous Plankton Recorder survey comprised of 88,348 individual samples. One key HAB species, Noctiluca scintillans, has become much more widespread, spreading to occupy almost the whole of the southern region of the North Sea in the last decade. These results reiterate concern about increasing HAB occurrence. Accompanying the range changes were phenological shifts in the seasonal peak of abundance. For other HAB species, such as Dinophysis spp., Protoperidinium spp. and Pseudo-nitzschia seriata, different changes in distribution, abundance and phenology were found. These results imply that changing conditions are causing species-specific responses.

Hinmon, K. L., University of Texas at El Paso, El Paso, USA, khinson@miners.utep.edu
Walsh, E. J., University of Texas at El Paso, El Paso, USA, ewalsh@utep.edu

GENETIC VARIATION IN THE ROTIFIER BRACHIONUS PLICATILIS: NATURAL VERSUS IMPACTED POPULATIONS
Genetic variation allows organisms to adapt to changes in their environment. Studies have shown that pollutants decrease the amount of variation in some aquatic species. The purpose of our research is to test whether genetic diversity of the rotifer Brachionus plicatilis is impacted by water quality. We predict that genetic
diversity will be less in polluted habitats. An urban population (Ascarate Lake, El Paso Co., TX) will be compared with an un-impacted remote population. Basic water chemistry parameters and heavy metal were quantified. Genetic variation was determined by amplified (COI, 16S RNA genes; ITS region) and sequenced from cloned individuals. Most water chemistry parameters fell within the EPA freshwater chronic criteria for both sites except for conductivity, salinity, and TDS. However, several metals exceeded the criteria (i.e., Aluminum, Cadmium, Chromium, Copper, Selenium) in Ascarate Lake. Preliminary analyses of 16S RNA genes show no genetic variation among 16 individuals from the urban population. Work to be completed includes metal analysis of the remote location (Los Hundos, Mexico) and determination of genetic variation within and between populations using genetic distances and haplotype frequencies.

Hirst, M. B., University of California, Davis, Davis, USA, mbhirst@ucdavis.edu
Reeder, W. H., California State University, Chico, Chico, USA, wreeder@mail.csuchico.edu
Wolle, G. V., California State University, Chico, Chico, USA, GWolle@csuchico.edu
Dawson, S. C., University of California, Davis, Davis, USA, sxadawson@ucdavis.edu

THE GENOME OF THE FIRST ACIDOPHILIC AND THERMOPHILIC HETEROLOBOSEAN, TETRAMITUS THERMACIDOPHILUS STRAIN BSL

Acidophilic microbial eukaryotes such as amoebae inhabit moderate to high temperature geothermal environments. We isolated the acidophilic amoeboid flagellate T. thermacidophilus strain BSL from Lassen Volcanic National Park. T. thermacidophilus grows optimally within a pH of 2–6 and at a temperature of 40–50°C. We sequenced the genome of this acidophilic amoeba to better understand the adaptations of protists to extreme environments. T. thermacidophilus was separated from co-cultured bacterial and fungal using flow cytometry and cell sorting. Genomic DNA and cDNA were sequenced using high throughput sequencing methods. Contigs were assembled using MiRA and genes were identified and annotated using Interpro and compared to the related mesophilic heterolobosean V. gruberi. Genomic analysis is currently under way to explore evolutionarily conserved genes associated with adaptations to this acidic environment, as well as genes associated with metabolism, amoeboid motility, intracellular signaling, and laterally transferred genes. Understanding the genomic inventory of the first “extreme” amoeboid eukaryote will inform our understanding of how protists adapt and evolve in extreme environments.

Hitchcock, J. N., University of Technology Sydney, Sydney, Australia, james.hitchcock@student.uts.edu.au
Mitrovic, S. M., University of Technology Sydney, Sydney, Australia, Simon.Mitrovic@uts.edu.au

RESPONSES OF ESTUARINE BACTERIOPLANKTON AND PHYTOPLANKTON TO DISSOLVED ORGANIC CARBON AND INORGANIC NUTRIENT ADDITIONS

Changes in flow patterns due to over extraction of water, in conjunction with climate change, have significantly reduced freshwater inflows to estuaries on the south east coast of Australia. Reduction of inflows has been shown to lead to a reduction in the input of allochthonous carbon to estuaries. This increases the need to understand the role of allochthonous carbon in estuarine functioning and food webs. This study examines the responses of planktonic bacteria and phytoplankton to additions of dissolved organic carbon (DOC) and inorganic nutrients (nitrogen and phosphorus). In-situ microcosm (1.25L) experiments were deployed in-situ at several sites in the estuary. Bacterial biomass and oxygen consumption increased in treatments receiving additions of DOC, and DOC in conjunction with nutrients. Chlorophyll a significantly reduced in treatments receiving DOC alone. The results support the contention that DOC delivered to this estuary via increased inflows can stimulate the heterotrophic bacterial community. Implementing effective flow management on the regulated coastal catchments of Eastern Australia to increase allochthonous DOC inputs will likely be important to bacterioplankton communities and determine the time period of heterotrophic dominance.

Ho, P. C., National Taiwan University/Institute of Oceanography, Taipei, Taiwan ROC, bookwormpageho@gmail.com
Hsieh, C. H., National Taiwan University/Institute of Oceanography, Taipei, Taiwan ROC
Miike, T., National Taiwan University/Institute of Oceanography, Taipei, Taiwan ROC

CHANGE THE MENU-IMPACTS OF OMNIVORY ON THE STRUCTURE OF SIZE SPECTRUM IN A PLANKTON SYSTEM

Size spectra link the relationship between population density and organism body size. Empirical research revealed connections of size spectrum with community structures and environmental conditions: a shallower spectrum and larger predator-prey size ratio corresponds to higher biomass transfer efficiency, and nutrient-rich systems. In this research, I use a nutrient-phytoplankton-zooplankton model to study the effects of feeding breadth and nutrient supply on the structure of size spectrum. Model results indicate generally that increasing feeding breadth increases the population of top predator through enhanced direct energy transfer from lower trophic levels and that increasing nutrient supply elevates top predator population density and results in a shallower spectral slope. These model outputs are qualitatively consistent with empirical observations, although the range of slopes in model outputs is smaller than that in empirical data. However, if the feeding breadth or new nutrient flux exceeds a certain threshold, the populations start to fluctuate and amplitude of fluctuation increases with feeding breadth and new nutrient flow. Large amplitude of fluctuation corresponds to wide range of slope values, and it could be an explanation of slope variation in some aquatic systems.

Ho, T., Academia Sinica, Taipei, Taiwan ROC, tyhoo@gate.sinica.edu.tw
Yang, S., Academia Sinica, Taipei, Taiwan ROC
Lin, T., Academia Sinica, Taipei, Taiwan ROC
Lee, D., Academia Sinica, Taipei, Taiwan ROC

CADMIUM ISOTOPE FRACTIONATION IN SOME MARINE PHYTOPLANKTON

The isotope composition of bioactive trace metals in seawater or environmental records, such as Fe-Mn crusts or biogenic hard parts, hold useful information to understand contemporary and past oceanic biogeochemical processes. The biogeochemical cycling of the trace metals is first driven by phytoplankton uptake in oceanic surface water. It is believed that phytoplankton preferentially take up lighter isotopes under metal replete condition. Here we show that the isotope fractionation of Cd in marine phytoplankton is regulated by the structure of membrane transport system and the fractionation is highly dependent on the concentrations of bioavailable Zn and Fe in seawater. Under Zn replete condition, Phaeodactylum tricornutum (diatom) does not fractionate Cd; in contrast, coccolithophores take up lighter Cd. Surprisingly, diatom take up lighter Cd under Zn or Fe deplete condition.
Hodgson, J. R., St. Norbert College, De Pere, USA, jim.hodgson@snc.edu
Brosseau, C. J., St. Norbert College, De Pere, USA, chase.brosseau@snc.edu
Cline, T., University of Wisconsin, Madison, USA
Zinn, L., University of Wisconsin, Madison, zinn@wisc.edu

CHANGING GROWTH RATES AS A RESULT OF A TOP-DOWN MANIPULATION

Ecosystem responses to manipulation are often not predictable and spark disagreement among fishery managers. In a small, seepage lake of Northern Wisconsin, thermal stratification in four dimictic lakes with varying sediment geochemistries systems show to reductions in external loadings. Porewater, hypolimnetic, and while external loading is a major driver of eutrophication in lakes, internal cycling thermal stratification in four dimictic lakes with varying sediment geochemistries systems show to reductions in external loadings. Porewater, hypolimnetic, and while external loading is a major driver of eutrophication in lakes, internal cycling.

Hofmann, F. E., Old Dominion University/Center for Coastal Physical Oceanography, Norfolk, USA, hofmann@ccpo.edu
Bush, D., Rutgers University/Haskin Shellfish Research Laboratory, Port Norris, USA, bushek@hsrl.rutgers.edu
Ford, S. E., Rutgers University/Haskin Shellfish Research Laboratory, Port Norris, USA, susan@hsrl.rutgers.edu
Guo, X., Rutgers University/Haskin Shellfish Research Laboratory, Port Norris, USA, xguo@hsrl.rutgers.edu
Powell, E. N., Rutgers University/Haskin Shellfish Research Laboratory, Port Norris, USA, eric@hsrl.rutgers.edu
Haidvogel, D. B., Rutgers University/Institute of Marine and Coastal Sciences, New Brunswick, USA, dale@marine.rutgers.edu
Wilkin, J., Rutgers University/Institute of Marine and Coastal Sciences, New Brunswick, USA
Klinck, J. M., Old Dominion University/Center for Coastal Physical Oceanography, Norfolk, USA, klinck@ccpo.edu

UNDERSTANDING HOW DISEASE AND ENVIRONMENT COMBINE TO STRUCTURE RESISTANCE IN ESTUARINE POPULATIONS

Delaware Bay oyster populations are influenced by two lethal parasites that cause Dermo and MSX diseases. A program developed for Delaware Bay as part of the NSF EID initiative focuses on understanding how oyster population genetics and population dynamics interact with the environment and these parasites to structure the host populations, and how these interactions might be modified by climate change. Laboratory and field studies include identifying genes related to MSX and Dermo disease resistance, potential regions for refugia and mechanisms that allow them to exist, phenotypic and genotypic differences in oysters from putative refugia and high-disease areas, and spatial and temporal variability in the effective size of spawning populations. Resulting data provide inputs to oyster genetics, population dynamics, and larval growth models that interface with a three-dimensional Delaware Bay circulation model. Lagrangian particle tracks are used to infer transport pathways of oyster larvae and MSX and Dermo disease pathogens. The understanding gained from this study provides insights into long-term changes in Delaware Bay oyster populations that occur as the oysters respond to climate, environmental, and biological variability.

Holden, D., Rutgers University, New Brunswick, USA, dholden@eden.rutgers.edu
Golding, D., Rutgers University, New Brunswick, USA
Llauger, L., University of Puerto Rico, San Juan, USA
Lopez, O., University of Puerto Rico, San Juan, USA
Goldinger, D., Rutgers University, New Brunswick, USA
Sogor, A., University of Miami, Miami, USA

VALIDATION OF AN ULTRA HIGH FREQUENCY RADAR FOR CURRENT MAPPING AND VESSEL TRACKING IN THE URBANIZED HUDSON RIVER ESTUARY

A RiverSonde Ultra High Frequency (UHF) Radar manufactured by CODAR Ocean Sensors was installed over looking the Hudson River in the summer of 2010 by students in the DHS Summer Research Institute at Stevens Institute of Technology. This was the first dual use test of a RiverSonde for simultaneous current measurements and small vessel detection. The radar was used to measure the along and cross channel surface flow of the Hudson River using the same Doppler principle used by High Frequency (HF) Radars typically deployed along the coast. The RiverSonde surface current measurements were compared to tidal measurements as well as the NYHPS model currents. At the end of the installation the pattern for the receive antenna was measured using a transponder atop a small boat. Initial findings indicate that it is important to measure the antenna pattern after installation to have the most accurate current measurements. In addition to measuring currents, the RiverSonde was used to detect the position and speed of small vessels running both along and across the Hudson, using GPS, AIS, satellites and shore based cameras for validation.
THRESHOLDS OF WARMING FOR ARCTIC PLANKTON COMMUNITIES

Climate warming is especially severe in the Arctic, which is experiencing an average temperature increase of 0.4 °C per decade, two times the global average rate. Furthermore, the Arctic has lost more than half its summer ice extent since 1980 and predictions suggest that the Arctic will be ice free in the summer as early as 2050, which could increase rate of warming. Predictions based on metabolic theory assume that temperature increases will enhance metabolic rates and thus both the rate of primary production and respiration will increase. However, these predictions do not account for the specific metabolic balance of the communities. We tested experimentally the response of Arctic plankton communities to seawater temperature spanning from 1 °C to 10 °C. Two types of communities were tested, Arctic communities from water collected in the Barrents Sea and fjord communities from water collected in the Svalbard fjord system. The results suggest a temperature threshold of 5 °C beyond which the metabolism of plankton communities shifts from autotrophic to heterotrophic. Arctic communities showed a much clearer threshold response to temperature manipulations than fjord communities.

Holtappels, M., Max Planck Institute for Marine Microbiology, Bremen, Germany, mholtapp@mpi-bremen.de

Lichtschlag, A., Max Planck Institute for Marine Microbiology, Bremen, Germany, alichtsc@mpi-bremen.de

Ihsan, Y. N., Max Planck Institute for Marine Microbiology, Bremen, Germany, ynhisan@mpi-bremen.de

Struck, U., Museum of Natural History, Berlin, Germany, ulrich.struck@mfn-berlin.de

Boetius, A., Max Planck Institute for Marine Microbiology, Bremen, Germany, aaboetius@mpi-bremen.de

Çagatay, N., Istanbul Teknik Universitesi, Istanbul, Turkey, cagatay@itu.edu.tr

Lavik, G., Max Planck Institute for Marine Microbiology, Bremen, Germany, glavik@mpi-bremen.de

Kuypers, M. M., Max Planck Institute for Marine Microbiology, Bremen, Germany, mkuypers@mpi-bremen.de

INFLOW OF OXIC MEDITERRANEAN WATERS STIMULATES SULFIDE OXIDATION COUPLED TO AUTOTROPHIC DENITRIFICATION IN THE ANOXIC LAYERS OF THE BLACK SEA

In aquatic systems with frequent or permanent anoxia, such as the Baltic Sea, the Black Sea or enclosed fjords, strong mixing of anoxic and oxic waters occurs predominantly where the oxygenic intersects with the sediment or during inflow events that inject oxic water into anoxic layers. The impact of mixing events on the biogeochemical cycling and on the microbial community is not well studied yet. Here, we present data from the south western Black Sea, where saline, oxygenated Mediterranean water leaves the Bosporus Strait and is mixed into the anoxic waters of the Black Sea. Oxygen intrusions and temperature/salinity anomalies were detected down to depths of 240 m and 370 m, respectively. High resolution nutrient profiles cutting these Bosporus plumes exhibit significant alteration of fixed nitrogen and sulfide inventories. Incubations with added 15N-nitrate indicate high capacities for nitrification and dissimilatory nitrate reduction to nitrogen gas. These processes are essential for the recycling of nitrogen in the Black Sea and other coastal systems with frequent anoxia.

Hood, R. R., University of Maryland Center for Environmental Science, Horn Point Laboratory, Cambridge, USA, rhood@umes.edu

Brown, C. W., Cooperative Institute for Climate Studies, University of Maryland, College Park, USA, christopher.brown@noaa.gov

Wiggett, J. D., Department of Marine Sciences, The University of Southern Mississippi, Stennis Space Center, USA, jerry.wiggett@usm.edu

Long, W., University of Maryland Center for Environmental Science, Horn Point Laboratory, Cambridge, USA, we.long@umes.edu

Xu, J., NOAA/NOS/CSDL, Silver Spring, USA, ji.xu@noaa.gov

Wood, R., NOAA/NCOS Cooperative Oxford Laboratory, Oxford, USA, bob.wood@noaa.gov

Jacobs, J., NOAA/NCOS Cooperative Oxford Laboratory, Oxford, USA, john.jacobs@noaa.gov

Prasad, M. B., ESSIC University of Maryland, College Park, USA, mbkp@umd.edu

Lanerolle, L. W., NOAA/NOS/CSDL, Silver Spring, USA, lyon.lanerolle@noaa.gov

CFEPS: THE CHESAPEAKE BAY ECOCLOGICAL PREDICTION SYSTEM

The Chesapeake Bay is an important economic and recreational resource that has been subjected to increasing stress due to anthropogenic impacts. These impacts include eutrophication and they have contributed to increased frequency of toxic bloom events that can negatively impact human health. In this presentation we give an introductory overview of the Chesapeake Bay Ecological Prediction System (CFEPS), which provides prototype ecological nowcasts and short-term forecasts of physical and biogeochemical properties as well as blooms of jellyfish, harmful algae and pathogenic microbes in the Bay.

Hoskins, D. L., Savannah State University, Savannah, USA, dhoskins@savannahstate.edu

Boudou, J., Metropolitan Planning Commission, Savannah, USA, jboudou@metplanc.org

THE CHATHAM COUNTY RESOURCE PROTECTION COMMISSION: A MODEL OF INNOVATION IN LAND CONSERVATION

In coastal areas, a cross section of pressures, natural and human, affect the landscape and function of land and water resources. In southeast Georgia (USA), a lost battle to save a small marsh hammock in 2004 led a group of concerned citizens to create a strategy for resource protection that has yielded a strong working model for partnerships between private individuals and regional planning authorities. The Chatham County Resource Protection Commission (CCRPC) was created in 2008 to identify green spaces having significant natural and historical values and/or which are important to sources of potable water. Housed and staffed by the local planning authority, the CCRPC consists of nine appointed commissioners who use a locally-driven protection strategy with technical advisors. It is one of two government-appointed land conservation programs in Georgia to work at the county level. This presentation will describe how science-based criteria and stakeholder involvement have allowed this commission to protect over 3,925 square kilometers of natural coastal areas in two years and win the 2010 Natural Leaders Award in Land Conservation from the State of Georgia.

Hossler, K., The Ohio State University, Columbus, USA, hossler.3@osu.edu

Bouchard, V., The Ohio State University, Columbus, USA, bouchard.8@osu.edu

Fennnessy, M. S., Kenyon College, Gambier, USA, fennnessym@kenyon.edu

Frey, S., University of New Hampshire, Durham, USA, serita.frey@unh.edu

Bauer, J. E., The Ohio State University, Columbus, USA, bauer.362@osu.edu

RESTORATION POTENTIAL AND ECOLOGY OF ARBUSCULAR MYCORRHIZAL IN FRESHWATER DEPRESSIONAL WETLANDS

Natural freshwater depressional wetlands are nutrient-rich, productive ecosystems. Created wetlands, in contrast, typically display reduced plant productivity and microbial activity, primarily because they are often constructed in nutrient-poor (i.e., upland) soils. A potential key to successful wetland creation may be the formation of arbuscular mycorrhizal (AM), which are symbiotic associations between plant roots and endophytic fungi. In prairie systems, for example, mycorrhizal associations are critical to the survival of many native plants and restoration projects often inoculate with the fungi to increase likelihood of success. We quantified AM abundance for ten created and five natural freshwater marshes in central Ohio, USA. AM were present in both created and natural wetlands, but tended to be most prevalent in recently created and low-quality systems. A cause-and-effect model suggests that AM presence has a small but significant positive effect on plant biomass, particularly for dense, low-nutrient wetland soils. Controlling factors include plant phenology and hydrology. The results from this observational study support the potential for AM to improve wetland restoration and creation projects, warranting further observational and experimental study.

Hotaling, L. A., University of South Florida, St. Petersburg, USA, lhotaling@marine.usf.edu

Stolkin, R. A., University of Birmingham, Edgbaston, United Kingdom, rsto@tcd.ie

Kirkey, W., Clarkson University, Potsdam, USA, wkirkey@clarkson.edu

Bonner, J. S., Clarkson University, Potsdam, USA, jbonner@clarkson.edu

Lowes, S., Columbia University/Teachers College, New York, USA, susanl@columbia.edu

Lin, P., Columbia University/Teachers College, New York, p2151@columbia.edu

Ojo, T., Clarkson University, Potsdam, USA, tojo@clarkson.edu
SENSE IT: STUDENT ENABLED NETWORK OF SENSORS FOR THE ENVIRONMENT USING INNOVATIVE TECHNOLOGY

SENSE IT is a project funded by the National Science Foundation (NSF) which strives to enrich science, technology, engineering and mathematics (STEM) education by providing teacher professional development and classroom projects in which high school students build from first principles, program, test and deploy sensors for water quality monitoring. Sensor development is a broad and interdisciplinary area, providing motivating scenarios in which to teach a multitude of STEM subjects, from mathematics and physics to biology and environmental science, while engaging students with hands-on problems that reinforce conventional classroom learning by re-presenting theory as practical tools for building real-life working devices. The SENSE IT program is currently developing and implementing a set of high school educational modules which teach environmental science and basic engineering through the lens of fundamental STEM principles, at the same time introducing students to a new set of technologies that are increasingly important in the world of environmental research. Specifically, the project provides students with the opportunity to learn the engineering design process through the design, construction, programming and testing of a student-implemented water monitoring network in the Hudson and St. Lawrence Rivers in New York. This presentation will provide an overview of the educational modules, sensors and evaluation results.

Houliez Emilie, E., Université Lille 1 - LOG, Wimereux, France, emilie.houliez@ed.univ-lille1.fr
Lizine Fabrice, F., Université Lille 1 - LOG, Wimereux, France, fabrice.lizine@univ-lille1.fr
Schmitt Francois, F., CNRS - LOG, Wimereux, France, francois.schmitt@univ-lille1.fr
Lefebvre Sebastien, S., Université Lille 1 - LOG, Wimereux, France, sebastien.lefebvre@univ-lille1.fr
Artigas Luis Felipe, L. F., ULCO - LOG, Wimereux, France, felipe.artigas@univ-littoral.fr

VARIABILITY IN THE PHOTOSYNTHETIC ACTIVITY OF PHYTOPLANKTON IN THE EASTERN ENGLISH CHANNEL: USE OF MODULATED FLUORESCENCE

The variability in the photosynthetic activity of phytoplankton was studied in the coastal waters of the Eastern English Channel (France) at different time scales (hourly to inter-annual) and related to environmental conditions. Physico-chemical parameters, phytoplankton community structure and photosynthetic parameters were investigated in situ between October 2008 and August 2010. The photosynthetic activity was obtained by measuring rapid light curves (RLC) using Pulse Amplitude Modulated (PAM) fluorometry. Maximum photosynthetic capacity (maximum electron transport rate, ETR) and photosynthetic efficiency (initial slope of the RLC, alpha) were highly variable and positively correlated at all time scales. At short time scale (hour to day), photosynthetic parameters’ variations reflected photoacclimation and endogenous variations. At longer time scale (seasonal to inter-annual), the highest values of maximum photosynthetic capacity and photosynthetic efficiency were observed in winter and summer whereas the maximum biomass was observed during spring blooms. These results highlighted the influence of community structure on photosynthetic activity. According to the time scale considered, the photosynthetic parameters’ variations were linked to different environmental factors showing thus the complexity of the photosynthetic activity of phytoplankton in well mixed ecosystems such as the English Channel.

Hoving, H. J., MBARI, Moss Landing, USA, hjhoving@mbari.org
Robison, B. H., MBARI, Moss Landing, USA, rob@mbari.org

INCREMENTAL DEPOSITION IN STATOLITHS: A TOOL TO RESEARCH LONGEVITY AND GROWTH IN DEEP-SEA SQUID

The longevity of marine organisms (e.g. corals, fish and bivalves) tends to positively correlate with depth. The aim of our research is to determine whether this trend holds for squid; semelopagous, nektomic mollusks that are abundant in marine ecosystems. Age in squid may be derived from the number of increments that are laid down in their statoliths. In coastal species, statolith increments are laid down after the fluorescent mark was compared with the number of elapsed days. For two species these experiments confirmed that one statolith increment was deposited per day, enabling the first calculation of growth rates for these species. For two other species the findings were more ambiguous; and problems with interpretation of their increments are discussed.

Hsieh, C., National Taiwan University, Taipei, Taiwan ROC, chsieh@ntu.edu.tw
Yamauchi, A., Kyoto University, Otsu, Japan, a-yama@ecology.kyoto-u.ac.jp
Nakazawa, T., National Taiwan University, Taipei, Taiwan ROC, tknkw@ntu.edu.tw
Wang, W., National Taiwan University, Taipei, Taiwan ROC, weifen@ntu.edu.tw

FISHING EFFECTS ON AGE AND SPATIAL STRUCTURES UNDERMINE POPULATION STABILITY OF FISHES

We study fishing effects on age (size) and spatial structures of exploited fishes. Accumulating evidence has shown that large and experienced spawning individuals are able to produce higher quality and quantity of eggs, known as maternal effects, and that individuals of different age classes tend to spawn in different locations and times. These behaviors are associated with a healthy age structure and contribute to bet-hedging capacity that is important in smoothing out short-term environmental variability. Here, we document a widespread phenomenon of age (size)-truncation of exploited populations driven by size-selective fishery removals. Such size-selective fishing may have evolutionary consequence and may be difficult to reverse. In addition, fishing often reduces population spatial heterogeneity that also contributes importantly to bet-hedging. We review studies showing that the effects of age truncation and reduction of spatial heterogeneity have reduced resilience and elevated the fluctuation amplitude of exploited populations facing a changing environment. All the evidence suggests that, by altering age or spatial structures, may make exploited fishes more prone to catastrophic shifts.

Hudson, E. M., University of South Florida, St. Petersburg, USA, euhoson3@gmail.usf.edu
Torres, J. J., University of South Florida, St Petersburg, USA, joetorres@marine.usf.edu

METABOLIC ADAPTATIONS TO EXTREME COLD IN THE ANARCTIC KRILL EUPHAEUSIA SUPERBA

Whole animal respiration measurements along with metabolic enzyme activity levels and proximate composition data were used to elucidate the metabolic poise of Euphausia superba in waters of the Western Antarctic Peninsula shelf in the early fall (Mar-Apr) of 2010. Three enzymes representing two important intermediary metabolic pathways were chosen to corroborate the measurements of whole animal metabolism: citrate synthase (CS), malate dehydrogenase (MDH) (aerobic pathway) and lactate dehydrogenase (LDH) (anaerobic pathway). Muscle proximate composition data (percent water, percent protein, percent lipid, and protein as a percentage of wet mass) were used as general indicators of condition. Whole animal metabolism observed in the early fall period sampled during the present study was comparable to fall-winter rates obtained during the later fall (April-May) time-frame sampled during SO GLOBEC, suggesting that the transition to winter metabolism in E. superba occurs in early March. Whole animal respiration was mirrored in the activities of the CS, MDH, and LDH.

Huebert, K. B., NOAA Southeast Fisheries Science Center, Miami, USA, klaus.huebert@noaa.gov
Serafy, J. E., NOAA Southeast Fisheries Science Center, Miami, USA, joe.serafy@noaa.gov
Walter, J. F., NOAA Southeast Fisheries Science Center, Miami, USA, john.f.walter@noaa.gov
Bohnscak, J. A., NOAA Southeast Fisheries Science Center, Miami, USA, jim.bohnscak@noaa.gov

LINKING SMALL FISH TO BIG FISH: POPULATION DYNAMICS OF GRAY SNAPPER IN BISCAYNE NATIONAL PARK

Gray snapper are among the most commercially and recreationally important coral reef fishes of South Florida. In the gray snapper life cycle, larvae are pelagic, juveniles typically utilize mangrove habitat as nurseries, and adults generally associate with coral reefs. We used two eleven-year time-series (1999-2009) of visual survey data collected in mangrove and reef habitat within Biscayne National Park to generate size-based and habitat-specific population models of gray snapper. Modeled densities were used to explore population dynamics, including growth, migration, mortality, and stock-recruit relationships. Significant correlations between densities
of small juveniles in one year and larger juveniles in the following year were used to estimate juvenile growth. Correlations between densities of fish in the mangroves in one year and on the reef in the following year revealed migrations. Declines in densities of fishes inhabiting the reef and belonging to the same year-class were used to estimate mortality. Finally, correlations between densities of mature adults and small juveniles suggested that the gray snapper stock in Biscayne National Park is at least partially self-recruiting.

Huebner, J. D., University of Winnipeg, Winnipeg, Canada, jhuebner@uwinnipeg.ca

Loadman, N. L., University of Winnipeg, Winnipeg, Canada, n.loadman@uwinnipeg.ca

Wiegand, M. D., University of Winnipeg, Winnipeg, Canada, mwiegand@uwinnipeg.ca

A DETAILED LIGHT AND ELECTRON MICROSCOPIC EXAMINATION OF THE CELL AND TISSUE MORPHOLOGY OF DAPHNIA MAGNA

Daphnia are widely used in environmental and toxicological studies. Surprisingly, there are few studies of their cellular and sub-cellular cytoarchitecture. Previous scanning electron microscopy studies have looked primarily at changes in morphology in response to predation pressure, and the small number of transmission electron microscopy studies have examined specific organs such as the heart. To date, there have been no comprehensive studies using both light and electron microscopy of the cells and tissues of Daphnia. We present a further investigation of the tissue and cytoarchitecture of normal Daphnia magna. These data on cell and tissue structure will be useful for observing microanatomical changes and organelle changes occurring in response to environmental changes related to climate change or exposure to contaminants. For this study, Daphnia magna were fixed in a modified Karnovsky’s fixative, post-fixed in 1% OsO₄, and airdried. Thin sections were cut, stained with uranyl acetate and lead citrate and observed in a transmission electron microscope.

Huebner, E., University of Manitoba, Winnipeg, Canada, ehuebner@cc.umanitoba.ca

Otero, X. L., Universidade de Santiago de Compostela, Santiago de Compostela, Spain, xo.oter@usc.es

IRON AND TRACE METALS IN MICROBIAL MATS AND UNDERLYING SEDIMENTS: RESULTS FROM THE GUERRERO NEGRO SALTFLAT, BAJA CALIFORNIA SUR, MEXICO

Total trace metals (Cd, Co, Cu, Fe, Mn, Ni, Pb, Zn) and pyrite-associated metals were measured in a microbial mat and underlying anoxic-sulfide sediment collected from the salt pan of Guerrero Negro (GN). Baja California Sur, Mexico. Enrichment factors (EF₉) of Co, Pb, and Cd were high in the matrix (EF₉₈ = 2.2 ± 0.4, 2.8 ± 1.6 and 34.5 ± 9.8, respectively) and even higher in the underlying sediment (EF₉₈ = 4.7 ± 1.5, 14.5 ± 6.2 and 89 ± 27, respectively). Moreover, low degrees of trace metal pyritization (DTMP; 0% for Ni, Pb to 25 ± 12% for Cu) were measured in sediments and microbial mats of GN. Organic-carbon to pyrite-sulfur (C/S) molar ratios measured in the mat (294-2667) and sediment (81-658) were, on average, approximately 77 times higher than those generally found in normal marine sediments (7.5 ± 2.1). These results point toward the possibility that evaporation basins or copper leaching from subsurface weathering while DOC respiration is low, whereas inputs of respiratory products of terrestrial carbon is dominated by groundwater during winter.

Huey, T. M., The Ohio State University, Columbus, USA, huey.253@osu.edu

Grottoli, A. G., The Ohio State University, Columbus, USA, grottoli.1@osu.edu

Matsui, Y., The Ohio State University, Columbus, USA, matsui.8@osu.edu

LAND-USE IMPACT ON THE CHARACTER AND AGE OF CARBON IN SMALL TEMPERATE STREAMS

The impact of local land-use practices on the transfer of carbon from land to small streams is understudied despite the fact that it has the most pronounced impact on stream carbon at these scales. We measured the concentration, δ¹³C, and δ¹⁵N of DOC, DIC, and POC in small streams draining a forested, unimproved pasture, large and small mixed land-use, and no-till and tilled corn watershed in Coshocton, Ohio in the fall, spring, and summer and during a winter and spring runoff event.

Sambrook, C., Stockholm University, Stockholm, Sweden, christoph.humborg@itms.su.se

Mörth, C. M., Stockholm University, Stockholm, Sweden, magnus.morth@geo.su.se

Giesler, R., Umeå University, Umeå, Sweden, Reiner.Giesler@emg.umu.se

C pruning is a potentially significant source of bioavailable P to primary producers in aquatic systems. The presence of the alkaline phosphatase (APase) enzyme indicates inorganic P deficiency and the potential for utilization of the DOP pool. Seasonal and spatial variability of alkaline phosphatase activity (APA) was quantified in Hefia Fishpond, a coastal brackish-water pond adjacent to Kaneohe Bay, Hawaii. Whole community APA (> 0.7 μmol mg⁻¹ h⁻¹) normalized to chlorophyll a, revealed changes in APA in concert with APA specific inventories and ratios. Specifically, we observed elevated dissolved organic nitrogen to phosphate ratios (DIN:DIP) following a major storm event, accompanied by elevated APA and alterations in phytoplankton community. Taken together, these data suggest that storm pulses of fluvial material into the coastal ocean can significantly perturb the resident phytoplankton community. Ultimately, investigating the potential bioavailability of DOP increases our understanding of controls on primary production and phytoplankton community structure.

Hunt, C. W., University of New Hampshire, Durham, USA, chunt@unh.edu

Vandemark, D., University of New Hampshire, Durham, USA, doug.vandemark@unh.edu

Chapron, B., Institut Français de recherche et d’Exploitation de la Mer, Plouzane, France, bchapon@ifremer.fr

Reul, N., Institut Français de recherche et d’Exploitation de la Mer, Plouzane, France, nreul@ifremer.fr

Wisser, D., University of New Hampshire, Durham, USA, dominik.wisser@unh.edu

Salisbury, J. E., University of New Hampshire, Durham, USA, joe.salisbury@unh.edu

SPATIOTEMPORAL PATTERNS IN SEA SURFACE DENSITY IN THE TROPICAL ATLANTIC

The Aquarius (NASA/CONAE) and SMOS (ESA) missions are poised to deliver the first global scale SSS measurements. These data, in conjunction with satellite SST, will enable broad scale estimates of sea surface density. Recent analyses of NASA AMSR-E microwave data have produced monthly salinity maps of tropical waters, which we combine with MODIS SST to estimate surface density. We use a five-year
time series of AMSR-E and other satellite data to examine the timing and amplitude of sea surface density in the Tropical Atlantic and its spatio-temporal relationships to surface heating and cooling, net precipitation, and river discharge. In the context of these analyses, we identify provinces where surface density is correlated to each of these variables in time and space. We also report on ways in which the timing and spatial distribution of MODIS ocean color productivity data are related to variability in sea surface density.

Hunt von Herbing, L., University of North Texas, Denton, USA, vonherbing@unt.edu
Pan, T., UNT, Denton, USA, franciscan68@hotmail.com
Mendez, F., UNT, Denton, Mexico, FernandoMendezSanchez@my.unt.edu
Garduno, M., Universidad Autonoma del Estado de Mexico, Toluca, Mexico, mgardunop@uaemex.mx
Gallegos, O., Universidad Autonoma del Estado de Mexico, Toluca, Mexico, obg@uaemex.mx
Ruiz, L., Universidad Autonoma del Estado de Mexico, Toluca, Mexico, ruiz.gomez.mar@uaemex.mx
Rodríguez, G., Universidad Autonoma del Estado de Mexico, Toluca, Mexico, azul_17_J@hotmail.com

HIGH ALTITUDE WATERSHED CONSERVATION PHYSIOLOGY IN MEXICO: USING PHYSIOLOGICAL TOOLS TO MEASURE ENVIRONMENTAL STRESSES

Situated at 10,000ft in the Mexican mountains is the Corral de Piedra microbasin and watershed. This watershed supports 50 commercial fish farms, provides 20% of Mexico City’s drinking water, and supplies water to the surrounding conservation area inhabited by endemic fishes, amphibians and reptiles. Mexico, a country of megadiversity containing over 10-20% of the world’s biodiversity, has 34 reserve biospheres and the Corral de Piedra region is a “Santuario de Agua” or “water sanctuary.” But, increased water demand in addition to climate change, are exerting severe stresses on the region because as the climate warms species are displaced higher, eventually perishing as a result of thermal stress. An international US and Mexican team of researchers employed in-field diagnostic physiological tools to measure stress levels in aquatic alpine fauna. Results show that water quality and supply is critical to watershed health, and that levels of stress are measurable and related to habitat change. Ultimately, these tools may be used to measure stress effects of climate change on endangered populations in other aquatic communities across the globe.

Hutchinson-Delgado, Y. M., University of Puerto Rico, Mayaguez, Puerto Rico, yahaira.marie@gmail.com
Hernandez-Delgado, E., University of Puerto Rico, Rio Piedras, Puerto Rico, coral_giac@hotmail.com

Rapid Degradation of Federal Designated Critical Habitats of the Threatened Elkhorn Coral in Vega Baja and Manati, P.R.

Coral reef communities at a potential Natural Reserve at Vega Baja, Puerto Rico have suffered from recent increases in anthropogenic activities, including: 1) beach renourishment, 2) chronic raw sewage spills from local storm sewers, and 3) spillovers from a recent sewage pipe repair project along the shoreline. The objective of this study was to compare the mortality of Acropora palmata populations along the coast of Vega Baja from 1997 to 2009 with control sites in Manati. A total of 103 digital video transects at Vega Baja and 62 at Manati were recorded, from which percent benthic cover was estimated with digital processing software. Long-term evidence suggests recent significant mortality of A. palmata stands in Vega Baja, while Manati sites showed no evidence of pollution induced diseases. Overall, a total of 62% loss of Elkhorn coral occurred between 1997 and 2009 at Vega Baja, resulting in a dominant shift towards a non-reef building benthic community. Local conditions have deteriorated in part due to human activities over a short-term scale, and have caused unequivocal stress and mortality on Elkhorn coral stands.

Hyde, K. J., NOAA/NMFS, Narragansett, RI, USA, kimberly.hyde@noaa.gov
Fogarty, M. J., NOAA/NMFS, Woods Hole, MA, USA, michael.fogarty@noaa.gov
Hare, J. A., NOAA/NMFS, Narragansett, RI, USA, jon.hare@noaa.gov
O’Reilly, J. E., NOAA/NMFS, Narragansett, RI, USA, jay.oreilly@noaa.gov

APPLICATION OF REMOTE SENSING PHYTOPLANKTON COMPOSITION MODELS IN ESTIMATES OF FISHERIES PRODUCTION POTENTIAL

Fishery production potential is a function of primary production, the fraction of production available to higher trophic levels, the transfer efficiency between successive trophic levels, and the number of trophic levels through which energy is transferred. Two pathways are recognized for transfer of primary production in marine ecosystems – the classical grazing food chain, principally diatom production and direct grazing by mesozooplankton; and nanoplanckton production, which includes the microbial foodweb and involves additional trophic transfer steps. The highly productive northeast U.S. continental shelf ecosystem has several commercially significant fisheries and recent analyses suggest that phytoplankton biomass has increased up to 33% during the last decade compared to the 1970-80s. Furthermore, other studies have observed a shift from larger diatom to smaller nanoplanckton and picoplankton species. Current fishery production models use estimates of primary production from MARMAP shipboard surveys (1977-1988), yet it is unlikely that these measurements are representative of the current phytoplankton community. Thus this study will evaluate satellite remote sensing models of phytoplankton species composition/size fraction to estimate diatom production in order to improve current estimates of fisheries potential production.

Jähnig, J. S., Trinity College Dublin, Dublin, Ireland, pinobai@tcd.ie
Rocha, C., Trinity College Dublin, Dublin, Ireland, roca@tcd.ie

Cromophoric Dissolved Organic Matter Dynamics Linked to Benthic Reactivity in an Intertidal Sand Flat

The role of sandy benthic ecosystems in mitigating N loading through Submarine Groundwater Discharge (SGD) to coastal marine ecosystems is uncertain. Benthic biogeochemical mediation in the seepage face over inorganic and organic N loads to Ria Formosa coastal lagoon (Portugal) was explored. Preliminary analysis of field porewater distribution indicated that at the seepage face benthic reactivity can significantly modulate inorganic N fluxes to the lagoon. Nevertheless, measured SGD-derived N fluxes to the lagoon were dominated by the organic N pool, comprising 80-95% of the total N seeped out to the lagoon. Flow-through experiments in combination with EEM spectroscopy and PARAFAC modeling showed benthic biogeochemical enhancement of protein-like cromophoric dissolved organic matter (CDOM) loads. High benthic metabolic rates (ΣCO2 production rate in the order of 300 nmol cm-2 h-1 and potential nitrate reduction rates of 91 nmol cm-2 h-1) were linked to up to 4 times increase in labile protein-like CDOM fluxes within a 1cm-depth horizon studied. We suggest that the study of CDOM might offer crucial information in clarifying N fluxes and nitrate reduction pathways present in sediments affected by SGD.

Ichim-Moreno, N., King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, noru.moreno@kaust.edu.sa
Bajic, V., King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, vladimir.bajic@kaust.edu.sa
Ravasi, T., King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, timothy.ravasi@kaust.edu.sa
Micklem, G., University of Cambridge, Cambridge, United Kingdom, gos@gen.cam.ac.uk
Voolstra, C. R., King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, christian工具@kaust.edu.sa

The Genome Sequence of the Dinoflagellate Symbiodinium SP, a Symbiont from Scleractinian Corals

Dinoflagellates are ubiquitous marine and freshwater protists. As free-living photosynthetic plankton, they account for ~50% of the primary productivity of oceans and lakes. As photosynthetic symbionts, they provide essential nutrients to corals that are the architects of one of the most productive ecosystems: coral reefs. Dinoflagellates are adapted to a wide variety of environments as reflected by a tremendous diversity in form and nutrition. Additionally, they play important roles as parasites and predators. More specifically, they form the evolutionary sister group to the apicomplexans that are best known for being human and animal pathogens (e.g. Plasmodium as the agent of malaria). We report here the projected sequencing of a dinoflagellate genome via next generation sequencing methodology. This genome will not only inform us about the supposedly enormous gene repertoire of dinoflagellates, it will also help us understand the capacities, weaknesses, and evolution of parasitism and mutualism. Furthermore, it will aid in explaining some remarkable features of dinoflagellate biology such as their unique genome structure and gene regulation.
These results establish this microarray as a promising candidate technology for high-throughput studies of whole communities of organisms. The expression of that potential, for whole communities of organisms. These approaches produce a large volume of non-specific data that is useful for surveys and for evaluation of the most active metabolic processes. Targeted yet high-throughput studies of the dynamics of important organisms and processes can be more directly studied using microarrays. We built a NimbleGen array of environmental sequences for cyanobacterial genes of interest and tested its efficacy in targeted studies. Hybridization of RNA derived from cyanobacterial cultures and environmental samples from the South Pacific Ocean revealed both high sensitivity and specificity of the microarray. Expression of Prochlorococcus and Synechococcus genes could be detected and discriminated between species in environmental samples. In this study, we applied molecular methods (PCR-DGGE) to evaluate the seasonal and spatial variations in benthic bacterial community structure and its value as a biological index of oxygen depletion. Clear clustering of band patterns was observed at 90-m depth in June, but not in November. The main basin at around 90-m depth has been often exposed to low but persistent O2 concentrations. As an independent assessment parameter, we used simultaneous O2 recordings from within the diffusive boundary layer (DBL), that were compared with theoretical values as derived from the respective shear velocity estimates. Shear velocity values of the TKE method derived significantly higher theoretical O2 concentration while the EC and the ID approach provided results that were not significantly different from the measured O2 concentrations. Overall, the differences from measured O2 concentration in the DBL were 0.2% for the EC method, 9.8% for the TKE method, and 0.7% for the ID method. The results suggest that the EC method is the best approach for estimating shear velocities though not significantly different from the ID method, while the TKE method was unreliable at the ~70 m deep, relatively calm study site.

Inoue, T., Port and Airport Research Institute, Yokosuka, Japan, inoue-t@ipc.pari.go.jp
Glud, R. N., Southern Danish University, Denmark, rmg@biol.dtu.dk
ESTIMATING SHEAR VELOCITY USING IN SITU O2 MICRO PROFILE MEASUREMENTS: COMPARISON BETWEEN THREE DIFFERENT METHODS
Three approaches for deriving shear stress from near-bottom ADV measurements; Eddy Correlation (EC), Turbulent Kinetic Energy (TKE), and Inertial Dissipation (ID) were compared. As an independent assessment parameter, we used simultaneous O2 recordings from within the diffusive boundary layer (DBL), that were compared with theoretical values as derived from the respective shear velocity estimates. Shear velocity values of the TKE method derived significantly higher theoretical O2 concentration while the EC and the ID method provided results that were not significantly different from the measured O2 concentrations. Overall, the differences from measured O2 concentration in the DBL were 0.2% for the EC method, 9.8% for the TKE method, and 0.7% for the ID method. The results suggest that the EC method is the best approach for estimating shear velocities though not significantly different from the ID method, while the TKE method was unreliable at the ~70 m deep, relatively calm study site.

Ishikawa, K., Lake Biwa Environmental Research Institute, Otsu, Japan, ishikawa-k@ibri.jp
Nakajima, T., Lake Biwa Environmental Research Institute, Otsu, Japan, lyonese@aires.enviot.ne.jp
Ishikawa, T., Shiga University, Otsu, Japan, ishikawa@shiga-u.ac.jp
CLIMATE IMPACTS AT THE SEDIMENT-WATER INTERFACE: OXYGEN DEPLETION AND BENTHIC BACTERIAL COMMUNITY STRUCTURE IN LAKE BIWA, JAPAN
Lake Biwa is a warm monomictic lake that is experiencing ongoing climate change. Water temperatures increased by 0.1°C yr−1 during 1984-2007, which caused a delay in winter vertical mixing, accelerated lake stratification in spring, and extended stratified periods. Climate change has had persistent algal blooms associated with excess non-point source phosphorus (P) from the landscape. Streambank erosion accounts for 5-100% of the sediment load from streams into collecting water bodies. The P contribution of this erosion has not been well quantified, yet could be a significant source of non-point P. The objectives of this study were to 1) to quantify levels of soil test P and total P (TP) in eroding sediments; 2) compare P in streambank sediments relative to soil texture, depth, drainage, land use/land cover, slope and surficial geology; and 3) to identify critical source areas through geospatial analysis, locating regions with high P and high erosion. Sample soils were taken from 75 erosion features to a depth of 90 cm on 4 streams in Chittenden County, Vermont. Preliminary results showed that streambank sediments on Allen Brook contained an equivalent amount of TP as the total non-point P delivered from Allen Brook to Lake Champlain for the 1999-2005 period. Thus, streambank erosion has the potential to be a major source of P.

Ishee, E. R., University of Vermont, Burlington, USA, eishee@uvm.edu
Ross, D. S., University of Vermont, Burlington, USA, dross@uvm.edu
CONTRIBUTION OF STREAMBANK EROSION AS A NON-POINT SOURCE OF PHOSPHORUS TO LAKE CHAMPLAIN FROM 4 STREAMS IN CHITTENHEN COUNTY, VT
Lake Champlain has had persistent algal blooms associated with excess non-point source phosphorus (P) from the landscape. Streambank erosion accounts for 5-100% of the sediment load from streams into collecting water bodies. The P contribution of this erosion has not been well quantified, yet could be a significant source of non-point P. The objectives of this study were to 1) to quantify levels of soil test P and total P (TP) in eroding sediments; 2) compare P in streambank sediments relative to soil texture, depth, drainage, land use/land cover, slope and surficial geology; and 3) to identify critical source areas through geospatial analysis, locating regions with high P and high erosion. Sample soils were taken from 75 erosion features to a depth of 90 cm on 4 streams in Chittenden County, Vermont. Preliminary results showed that streambank sediments on Allen Brook contained an equivalent amount of TP as the total non-point P delivered from Allen Brook to Lake Champlain for the 1999-2005 period. Thus, streambank erosion has the potential to be a major source of P.

Ishikawa, K., Lake Biwa Environmental Research Institute, Otsu, Japan, ishikawa-k@ibri.jp
Nakajima, T., Lake Biwa Environmental Research Institute, Otsu, Japan, lyonese@aires.enviot.ne.jp
Ishikawa, T., Shiga University, Otsu, Japan, ishikawa@shiga-u.ac.jp
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Lake Biwa is a warm monomictic lake that is experiencing ongoing climate change. Air temperatures increased by 0.1°C yr−1 during 1984-2007, which caused a delay in winter vertical mixing, accelerated lake stratification in spring, and extended stratified periods. The main basin at around 90-m depth has been often exposed to low but fluctuating oxygen conditions of less than 2 mg L−1. In this study, we applied molecular methods (PCR-DGGE) to evaluate the seasonal and spatial variations in benthic bacterial community structure and its value as a biological index of oxygen depletion. Clear clustering of band patterns was observed at 90-m depth in June, but not in November when dbrB gene-targeting primers were used. Following a typhoon in October 2009, partial recovery of DO at the lake bottom in October and total recovery in February were observed. Our results imply that changes in bacterial community structure are affected not only by DO concentrations, but also by the recovery processes.

Ivey, J. E., Florida Fish and Wildlife Research Institute, St Petersburg, FL, USA, Jim.ivey@MyFWC.com
Jochens, A. E., TAMU, GCOOS-RA, College Station, TX, USA, ajoehens@tamu.edu
Heil, C. A., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, ME, USA, Cynthia.Heil@gmail.com
Musakos, S., Florida Fish and Wildlife Research Institute, St Petersburg, FL, USA, Sue.Murasako@MyFWC.com
Yunker, A., Florida Fish and Wildlife Research Institute, St Petersburg, FL, USA, Ashley.Yunker@MyFWC.com

Ibrahim, N., University of Virginia / CarICOOS, St. Thomas, U.S. Virgin Islands, nidadri@uvir.edu
Wright, V., University of Virginia / CarICOOS, St. Thomas, U.S. Virgin Islands, vwright@uvir.edu
Corredor, J., University of Puerto Rico at Mayaguez / CarICOOS, Mayaguez, Puerto Rico, jorge.corredor@upr.edu
COASTAL AND MARINE SPATIAL PLANNING FOR THE US CARIBBEAN REGION: FIRST STEPS
Developing a plan for the management of coastal and marine environments for the US Caribbean Region, as it is for other regions, is extremely complicated and consists of a set of non-trivial tasks. Nonetheless, through careful consideration of the multitude of dimensions involved in the planning process, the realization for a successful and practical plan for managing resources is possible. The first non-trivial task is to identify a clear and concise purpose agreed to by all the stakeholders with a successful and practical plan for managing resources is possible. The first non-trivial task is to identify a clear and concise purpose agreed to by all the stakeholders with a successful and practical plan for managing resources is possible. The first non-trivial task is to identify a clear and concise purpose agreed to by all the stakeholders with a successful and practical plan for managing resources is possible.
A COMPREHENSIVE COASTAL OCEAN/ESTUARINE MONITORING NETWORK IN SOUTHWEST FLORIDA

Rapid coastal development in Florida presents a dichotomy: people are attracted by the natural beauty of the coastal environment while the natural beauty is stressed by increased population. To empower coastal communities to make informed development decisions, science-based information is required. One effective tool to provide concurrent biological, chemical and physical data is a sustained observational system. The Florida Fish and Wildlife Research Institute, a partner in the Gulf of Mexico Coastal Ocean Observing System, deployed a network of water quality platforms measuring these parameters at estuarine/coastal exchange points on the West Florida Shelf. Data from a 6 month Sarasota Bay deployment demonstrated significant correlations between rainfall, wind direction, and increases in urea concentrations. These increases were followed by shifts in species composition from diatoms to picoplankton domination. Data from these platforms provide timely information useful to managers to set coastal nutrient criteria and by communities to identify potentially problematic development decisions, e.g., leading to increased harmful algal blooms. Future plans include use of data to link estuarine and coastal ocean ecosystem models, providing additional tools for community planners.

Jackson, K. J., Florida Fish and Wildlife Research Institute, St. Petersburg, FL, USA, Julie.Jackson@myfwc.com Granholm, A., Florida Fish and Wildlife Research Institute, St. Petersburg, FL, USA, April.Granholm@myfwc.com

THE CHESEAPEAKE BAY VIBRIO SPP. FORECAST SYSTEM

The estuarine bacteria Vibrio cholerae, V. vulnificus, and V. parahaemolyticus are capable of causing severe and occasionally life-threatening infections in humans. While 50-60 cases are reported annually in the Chesapeake region, few efforts have focused on understanding the distribution of these opportunistic pathogens on a scale relevant to regional management. To address this concern, a partnership was established to enhance monitoring capabilities, model the distribution of these species, and develop ecological forecasts. Through collaboration with Maryland and Virginia water quality monitoring programs, Vibrio spp. are enumerated using quantitative PCR and linked directly to the associated water quality data. ChesROMS, a regional adaptation of the Rutgers Ocean Modeling System, is used to force empirical models derived from these large data sets. Nowcasts, 3-day, 14-day, and seasonal forecasts are provided through restricted access to state and county health officials for use in education and decision making. Models are also being used to evaluate other scenarios, such as regional climate change. Finally, monitoring efforts are continuous allowing for validation of empirical models, evaluation of forecast model skill, and tuning over time.

Jamnesh, H. W., MBARI, Moss Landing, USA, jaha@mbari.org Coletti, L. I., MBARI, Moss Landing, USA, coletti@mbari.org Sakamoto, C. M., MBARI, Moss Landing, USA, saca@mbari.org Fitzwater, S. E., MBARI, Moss Landing, USA, sfitz@mbari.org Jannasch, H. W., MBARI, Moss Landing, USA, jaha@mbari.org

NITRATE MEASUREMENTS ON APEX PROFILING FLOATS

Profiling floats have provided a global picture of physical processes in all oceans. Here we describe two versions of profiling APEX floats that incorporate the ISUS optical nitrate sensors, as well as oxygen and bio-optical sensors, that would enable a similar view of ocean nutrient chemistry. The In Situ Ultraviolet Spectrometer (ISUS) can detect nitrate down to ~0.5 µM nitrate and requires no reagents. Version-1 of the APEX-ISUS float has an optical probe installed in the bottom endcap of the float, with all supporting electronics mounted in voids within the standard float. Version-2 incorporates the probe in the top endcap, with all electronics mounted together. This allows simpler assembly and calibration and the probe can be placed in the pumped sample stream for biofouling protection. Eight floats are currently collecting data near Hawaii, Station Papa, Bermuda, and around the Antarctic. We describe the design, construction and examples of data the APEX-ISUS floats have collected so far.

Wood, R. NOAA/NCCOS Oxford Lab, Oxford, USA, Bob.Wood@noaa.gov

119 (*) represents Invited presentations
Janssen, F., Max Planck Institute for Marine Microbiology, Bremen, Germany, fjanssen@mpi-bremen.de
Donis, D., Max Planck Institute for Marine Microbiology, Bremen, Germany, ddonis@mpi-bremen.de
Fischer, J. P., Max Planck Institute for Marine Microbiology, Bremen, Germany, jfscher@mpi-bremen.de
Holvatapp, M., Max Planck Institute for Marine Microbiology, Bremen, Germany, mholtapp@mpi-bremen.de
Lichtschlag, A., Max Planck Institute for Marine Microbiology, Bremen, Germany, alichtsc@mpi-bremen.de
Staney, E., GKSS Institute for Coastal Research, Geesthacht, Germany, Emil.Staney@gkss.de
Wenzhöfer, F., HGF MPJ Group Research Group on Deep Sea Ecology and Technology, Alfred Wegener Institute, Bremerhaven, Germany, fwenzhoe@mpi-bremen.de
Boetius, A., HGF MPJ Group Research Group on Deep Sea Ecology and Technology, Alfred Wegener Institute, Bremerhaven, Germany, aboetius@mpi-bremen.de

HYPOX team,

UNDERSTANDING OXYGEN DYNAMICS AT THE HYPOX PROJECT TARGET SITE AT THE CRIMEAN SHELF: COMBINING COMPLEMENTARY MONITORING APPROACHES

Responding to observations and projections of decreasing oxygen concentrations in aquatic systems, the EU project HYPOX set out to improve oxygen observation capacities. In contrast to classical CTD-based monitoring approaches of oxygen concentration, HYPOX observatories focus on high-resolution temporal and spatial dynamics in oxygen availability and consumption and on an understanding of the processes that drive hypoxia formation. Following this concept, moored and drifting observatories, a Benthic Bottom Layer Profiler, a Multifiber Optode, benthic chambers, microsensor profilers, and an eddy correlation system were deployed during cruise leg 15/1 of RV MARIA S. MERIAN to investigate hypoxia dynamics at the Crimea Shelf (Black Sea). The monitoring of physical and biological processes was complemented by visual observations. The measurements revealed extreme fluctuations with water column oxygen concentrations dropping by up to 125 µmol L⁻¹ per hour at some sites. Combining high resolution oxygen measurements with flux determinations and hydrographical observations it could be shown that hypoxia formation in Crimean Shelf bottomwaters is mainly determined by oscillations of the chemocline depth and only to a minor extent by benthic or pelagic oxygen consumption.

Jarvie, H. P., Centre for Ecology & Hydrology, Wallingford, United Kingdom, hjp@ceh.ac.uk
Neal, C., Centre for Ecology & Hydrology, Wallingford, United Kingdom, cn@ceh.ac.uk
Withers, P. J., School of Environment, Natural Resources and Geography, Bangor University, Bangor, United Kingdom, p.withers@bangor.ac.uk
Baker, D. B., National Center for Water Quality Research, Heidelberg University, Tüllin, OH, USA, dbaker@heidelberg.edu
Richards, R. P., National Center for Water Quality Research, Heidelberg University, Tüllin, OH, USA, prichard@heidelberg.edu
Sharpley, A. N., Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR, USA, sharpley@uark.edu

EXPLORING PHOSPHORUS RETENTION AND RELEASE IN RIVERS AND WATERSHEDS USING EXTENDED ENDMEMBER MIXING ANALYSIS

Extended Enmember Mixing Analysis (E-EMMA) offers a simple and versatile tool to explore macronutrient retention and release along the river-watershed continuum and relies solely on routinely-measured concentration and flow data. Here, E-EMMA is applied to two river systems: the Thames (U.K.) and Sandusky (U.S.), which drain similar watershed areas but have contrasting dominant phosphorus (P) sources and hydrology. On an annual timescale, up to 48% of the P flux was retained for the Sandusky and up to 14% for the Thames. However, under ecologically critical low-flow periods, in-stream processes resulted in net retention of up to 93% of the P flux in the Sandusky and 42% of the P flux in the Thames. The results indicate that in-stream processes under low flows are capable of regulating the downstream delivery of P in a way that may help to reduce ecological impacts to downstream river reaches, by reducing ambient river-water P concentrations at times of greatest eutrophication risk. The results also suggest that, by moving towards cleaner rivers, and improved ecosystem health, the efficiency of P retention may actually increase.

Jayne, E. A., College of William and Mary, Williamsburg, USA, ejayne@vims.edu
Dichnt, R. M., College of William and Mary, Williamsburg, USA, rfdichnt@vims.edu
Falconer, R., Chatham University, Pittsburgh, USA, falconer@chatham.edu
Coehran, M. A., Virginia Institute of Marine Science, Gloucester Point, USA, mcoehran@vims.edu

AIR-SEA FLUX OF VOLATILE ORGANIC CARBON

A method is being developed to measure volatile organic carbon (VOC) flux across the air-sea interface. Airborne VOC is measured by pumping marine air through solid sorbent tubes (e.g. Tenax). Surface water VOC is measured by equilibrating seawater with pure air, and measuring the VOC concentration of that air, also using sorbent tubes. To obtain an estimate of mass transfer coefficient, volatile compounds with high Henry’s Law constants (H>0.1 L atm mol⁻¹), which are water-film limited in diffusion, are experimentally separated from air-film limited, water-soluble compounds with low H (<0.1 L atm mol⁻¹) using a series of pure water traps in both air and water sampling. Concentration gradients of high-H and low-H fractions are being used to estimate air-sea VOC flux in Chesapeake Bay and the Atlantic Ocean. Preliminary measurements indicate a net VOC efflux in Chesapeake Bay and the Atlantic Ocean during the summer, although observations are ongoing.

Jearld, Jr., A., NOAA Fisheries Service/Northeast Fisheries Science Center, Woods Hole, MA, USA, Ambrose.Jearld@noaa.gov
Liles, G., NOAA Fisheries Service/NFESC, Woods Hole, MA, USA, George.Liles@noaa.gov
Gutierrez, B., U.S. Geological Survey, Woods Hole Science Center, Woods Hole, MA, USA, bgutierrez@usgs.gov
Howard, J., NOAA Fisheries Service/NFESC, Woods Hole, MA, USA, Jahowar2@mail.noaa.gov

THE WOODS HOLE PARTNERSHIP EDUCATION PROGRAM: INCREASING DIVERSITY IN THE OCEAN AND ENVIRONMENTAL SCIENCES IN ONE INFLUENTIAL SCIENCE COMMUNITY

To increase diversity in one influential science community, a consortium of public and private institutions created the Woods Hole Partnership Education Program, or PEP, in 2008. Participating institutions are the Marine Biological Laboratory, NOAA Fisheries Service, Sea Education Association, U.S. Geological Survey, Woods Hole Oceanographic Institution, the Woods Hole Research Center, and University of Maryland Eastern Shore. Aimed at college juniors and seniors with some course work in marine and/or environmental sciences, PEP is a four-week course and a six-to-eight-week individual research project under the guidance of a research mentor. Thirty-two students have participated to date. Investigators from the science institutions served as course faculty and research mentors. We listened to experts regarding critical mass, mentoring, adequate support, network recruitment, and then built a program based on those features. Two years in we have a program that works and that has its own model for choosing applicants and for matching with mentors. Our challenges now are fine-tuning our match process, enhancing mentoring skills, preparing our students for a variety of lab cultures, and setting expectations high while remaining supportive.

Jenkins, B. D., University of Rhode Island, Kingston, USA, bjenkins@uri.edu
Brown, S. M., University of Rhode Island, Kingston, USA, shelleyb192@gmail.com
Fulweiler, R. W., Boston University, Boston, USA, rfw@acs.bc.edu
Nixon, S. W., University of Rhode Island, Narragansett, USA, swn@gso.uri.edu

COMBINED MOLECULAR AND BIOGEOCHEMICAL METHODS TO DECIPHER THE CONTROLS ON NITROGEN CYCLING CONSORTIA IN ESTUARINE SEDIMENTS

Estuaries are coastal environments highly impacted by human activity including the delivery of macronutrients, e.g. nitrogen, into these systems. At the same time, consequences of global climate change, such as increased temperature, can alter the in situ dynamics of estuarine community members on different trophic levels. Microorganisms in estuaries are responsible for major nitrogen transformations. In recent years, the sediment communities in Narragansett Bay have shown reduced rates of nitrogen removal via denitrification and episodic nitrogen fixation. We have been conducting field sampling and experiments manipulating sediment mesocosms to test whether changes in organic matter deposition to the benthos control the activity of denitrifiers and diazotrophs. Since sediment nitrogen cycling communities are extremely diverse, we are using molecular methods to target potentially active members. We have obtained sequence libraries of expressed genes for denitrification (nirS) and for N fixation (nifH) and are targeting the presence and activity of
specific groups by combining quantitative PCR and quantitative RT-PCR methods. Expression of both nir and ndh has been detected in mesocosms with ranging flux measurements, indicating that these processes may co-occur.

Jennings, L. L., California State University, Monterey Bay, Seaside, USA, l.jennings@csusb.edu
Klein, N. J., University of Southern California, Los Angeles, USA, nicholol@usc.edu
Beck, A. L., Virginia Institute of Marine Science, Gloucester Point, USA, abeck@vims.edu
Hutchins, D. A., University of Southern California, Los Angeles, USA, dahutch@usc.edu
Sadhuo Wilhemy, S. A., University of Southern California, Los Angeles, USA, sanudo@usc.edu

IMPACT OF TRACE METALS AND B-VITAMINS ON PHYTOPLANKTON DYNAMICS DURING THE NORTH ATLANTIC SPRING BLOOM
Surface water samples were collected in the North Atlantic Ocean along a transect from the Azores to Iceland and were analyzed for B-vitamins, dissolved and particulate phase trace metals in order to examine how those chemical parameters influenced phytoplankton dynamics during the North Atlantic Spring Bloom. Distinct concentration gradients were observed along the transect for dissolved Fe and Co; generally increasing northward (from 0.5-1M and 20-35pM), with a sharp peak observed in Northern Sea ice meltwaters (2nM Fe and 80pM Co). Dissolved Ni, Zn, and Pb did not follow this trend, and generally were constant (at ~3nM, 0.5nM, and 40pM). In phytoplankton, intracellular metal concentrations varied, but generally were 30% of the total cellular inventory (from ~40% for Co and Mn, to 30% for V and Ni, to 25% for Fe and Mo). A Principal Component Analysis (PCA) was applied to correlate the chemical variables with phytoplankton species composition. The PCA produced three broad clusters; the 1st represents an association between coccolithophore pigments, dissolved Co and Fe, and intracellular Mn quotas. The 2nd cluster groups cyanobacterial pigments with dissolved vitamin B12 and intracellular Fe quotas. The 3rd cluster shows association among pigments characteristic of diatoms, transparent exopolymers particles, and phytoplankton V-quotas. The PCA also suggests that cluster 3 variables were inversely correlated to concentrations of dissolved vitamin B1, Ni and Zn.

Jerdle, C. L., University of Notre Dame, Notre Dame, USA, cjerde@nd.edu
Mahon, A. R., University of Notre Dame, Notre Dame, USA, amahon@nd.edu
Chadderton, W. L., The Nature Conservancy, Notre Dame, USA, lchadderton@TNC.org
Lodge, D. M., University of Notre Dame, Notre Dame, USA, dlodge@nd.edu

EARLY DETECTION OF INVASIVE SPECIES USING ENVIRONMENTAL DNA: AN ONGOING CASE STUDY OF ASIAN CARP INVASION OF THE GREAT LAKES
Detecting species at low abundance can be very difficult, which leads to an error in inference – concluding a species is absent when actually present. Consequently, the first recorded occurrence of an invasive species is often well after a population has established, which reduces the efficacy of management actions. We have used an environmental DNA (eDNA) approach for early detection of Asian carps to demonstrate the management importance of improved detection methods for invasive species. The process of conducting eDNA surveillance includes collecting a water sample, extracting DNA from the filtrate, and screening the DNA using species specific molecular markers. Notably, we used this method in the Chicago Area Waterway System (CAWS) and found the first indications that Asian carp were present in an electric barrier meant to prevent their spread into the Great Lakes. Motivated by the eDNA results, commercial fishermen were deployed in reaches above the electric barriers, and verified the eDNA detections by catching a live bighead carp, approximately two kilometers upstream from where the uppermost positive bighead detection was recorded. The Asian carp invasion of the Great Lakes now turns to delimitating the extent to which individuals may have spread to nearby rivers and streams, and if Asian carp have infiltrated the barre trade. Updates of ongoing eDNA applications to delimitating the Asian carp distribution in the Great Lakes region will be provided.

JIEZEOUEL, D., University Paris 7 & IGP, Paris, France, jezequel@igp.fr
THOMAZO, F., University Paris 7, Paris, France, fthomazo@hotmail.fr

A NEW DGT FORBORONENVIRONMENTAL STUDIES IN AQUATIC SYSTEMS
Boron is a micronutrient for plants and animals, but elevated concentrations can lead to toxic effects. Bioavailable forms, boric acid and borate, are present in aquatic environments at either high level (seawater, some ground waters) or low level (pristine rivers, rainwater). In parallel analysis of boron at trace level is not easy except with ICP-MS but some blank and memory effects may render the analysis difficult. Furthermore there is a lack of in situ boron probe for aquatic systems monitoring. This study describes a new DGT (Diffusive Gradient in Thin-film) device for the concentration determination of dissolved boron in surface freshwaters. This device is based on a boron specific resin (Amberlite IRA 745) spread into an agarose hydrogel that represents the accumulation layer. A polyacrylamide hydrogel and a protective porous membrane act as the diffusive layer. We validated this boron specific DGT in laboratory experiments as well as in situ deployments. The possibility to use this new tool for monitoring is established, this device giving the conventional time weighted average concentration (TWAC) of boron (Seine river experiments).

Jiang, L., Yale University, New Haven, USA, Lijing.jiang@yale.edu
Raymond, P. A., Yale University, New Haven, USA, PeterRaymond@yale.edu
Butman, D., Yale University, New Haven, USA, David.Butman@yale.edu

CARBONATE MINERAL SATURATION STATES IN RIVERS OF THE CONTINENTAL UNITED STATES OVER THE LAST 100 YEARS
Aragonite and calcite saturation states in rivers of the conterminous United States were estimated from a historical data set of calcium, alkalinity and pH. Most of the data were sampled between 1940 and 2010, with the earliest dated back to the 1900s. Carbonate mineral saturation states were calculated using a Matlab version of the CO2SYS. The calculated aragonite saturation states ranged from 0 to 250. They showed good spatial correlation with precipitation with higher saturation states occurring in regions with the least precipitation. We suggest precipitation plays an important role in the spatial distribution of carbonate mineral saturation states. Higher precipitation decreases carbonate mineral saturation states by lowering the concentration of both carbonate and calcium ions. Other than precipitation, the type of rocks (lithology) and the soil pH also play important roles in shaping the spatial distribution of carbonate mineral saturation states.

Jiang, M., University of Massachusetts Boston, Boston, USA, mingzhijiang@umb.edu
Charette, M., WHOI, Woods Hole, USA
Measures, C., University of Hawaii, Boston, USA
Zhou, M., University of Massachusetts Boston, Boston, USA

MODELING FE TRANSPORT AND LIMITATION TO PHYTOPLANKTON BLOOMS IN ANTARCTIC PENINSULA, DRAKE PASSAGE, AND SCOTIA SEA
Recent observations have identified a natural iron fertilization area over the shelf of Elephant Island, Antarctica, where southern Antarctic Circumpolar Current (ACC) impinges upon the shelf and interacts with the shelf current leading to a strong off-shelf transport of Fe-rich shelf waters. Satellite and in-situ measurements suggest that this iron input sets the stage for massive phytoplankton bloom downstream in the southern Scotia Sea, one of the most productive regions in the Southern Ocean. We have developed a high-resolution (~2km) regional model based on the Regional Ocean Modeling System (ROMS) and coupled it with a simple NPPD-Fe-Radium model to simulate the Fe transport and primary productivity in the region. Model results suggest a coherent circulation throughout the year that produces extensive off-shelf transports of shelf waters around Elephant Island, consistent with field results. Model results suggest that while Fe is not a limiting factor to the phytoplankton growth in Antarctic Peninsula, the off-shelf Fe transport indeed is important to the primary productivity and carbon export in the southern Scotia Sea.

Jiao, N., Xiamen University, Xiamen, China, jiao@xmu.edu.cn
Azam, F., Scripps Institution of Oceanography, La Jolla, USA

MICROBIAL CARBON PUMP – A MECHANISM FOR LONG-TERM CARBON STORAGE IN THE GLOBAL OCEAN
The biogeochemical behavior of the enormous marine dissolved organic matter (DOM) reservoir is an important issue in understanding the role of the ocean in climate change. The majority of DOM in the ocean is recalcitrant, with an average age of 5000 years, constituting a sequestration of carbon in the ocean. However, the mechanisms controlling the generation and removal of the recalcitrant DOM are largely unknown. The proposed microbial carbon pump (MCP; Jiao et al. NATURE REVIEWS Microbiology 2010:8:593-599) offers a formalized and mechanistic focus on the significance of microbial processes in carbon storage in the recalcitrant DOM reservoir, and a framework for testing hypotheses on the sources and sinks of DOM. A mechanism understanding of the functioning and efficiency of the MCP is an urgent need since ocean warming may change carbon flux partitioning and pathways thus potentially enhancing the role of the MCP in carbon storage. A working group...
John, D. E., University of South Florida, St. Petersburg, USA, djohn@marine.usf.edu
Paul, J. H., University of South Florida, St. Petersburg, USA, jpaul@marine.usf.edu
Ulrich, R. M., University of South Florida, St. Petersburg, USA, rmulrich@mail.usf.edu
Fries, D. P., University of South Florida, St. Petersburg, USA, dfries@marine.usf.edu

A RAPID, PORTABLE METHOD TO CONFIRM SEAFOOD TISSUE AS GROUPER BASED ON ISOTHERMAL NUCLEIC ACID AMPLIFICATION

Grouper are an important seafood product, but are sometimes substituted with less desirable or valuable fish. The complexity of DNA barcode amplification and sequencing currently precludes use outside a molecular biology laboratory. A method to allow rapid and easy confirmation of grouper tissue would enable broader testing for forensics and quality. The technology would also be beneficial to biological research for sampling of fishable stocks or rapid identification of egg/larvae. We testing for forensics and quality. The technology would also be beneficial to biological research for sampling of fishable stocks or rapid identification of egg/larvae. We

Fries, D. P., University of South Florida, St. Petersburg, USA, dfries@marine.usf.edu

PATHWAYS TO STEM

The Institute for Broadening Participation (IBP) has extensive experience assisting institutions and organizations with recruitment and retention efforts through its work with the NSF’s IGERT, AGEP, and REU programs. IBP personnel developed and implemented the MS PHD’s in Earth System Science, which has historically been funded by NASA Headquarters and NSF Geosciences. Most recently IBP has begun participating in NASA OSSI, NSF COSEE, ADVANCE and RISE activities. During the course of our work, we have designed and tested successful strategies for working with all types and sizes of institutions. These include mixing large conference presentations with small meetings of faculty/staff, targeted virtual outreach, and extensive web resources. We have compiled quantitative and qualitative evidence that our web-based infrastructure is successful in connecting large geographically dispersed sets of constituencies. We also use effective communication and cross-promotion strategies that encourage the use of our web resources and digital collaboration tools. This presentation will discuss successful tools and strategies for facilitating increased engagement and mentoring of students throughout STEM fields, in general, and the Earth system sciences in particular.

Johnson, B. S., MBARI, Moss Landing, USA, sjohnson@mbari.org
Young, C. R., Harvard, Boston, USA, cyounglqool.harvard.edu
Harvey, J. B., MBARI, Moss Landing, USA, jharvey@mbari.org

AN EASTERN PACIFIC HYBRID ZONE INVOLVING DEEP-SEA HYDROTHERMAL VENT MOLLUSKS

The discovery of a hybrid zone between sister-species of limpets (Mollusca: Vetigastropoda: Lepetodrilidae) and mussels (Mollusca: Mytiloida: Bathymodiolinae) from hydrothermal vents along the East Pacific Rise presents the second known example of hybridization involving mid-ocean taxa. Molecular analyses show a species-level split across the Easter Microplate (EM) region (22°–27°S latitude); a known, bathymetrically inflated geological feature associated with dispersal boundaries for several vent taxa. The two species mix and hybridize at an intermediate site (23°S) along the northwestern margin of the Easter Microplate. Analyses of the hybrid populations revealed significant cytonuclear disequilibrium with deficiencies of recombinant genotypes in both taxa, suggesting that the EM region might represent a tension zone for both taxa. Processes that might limit genetic exchange across the Easter Microplate region of the southern East Pacific Rise are discussed.

Johnson, K. S., MBARI, Moss Landing, USA, johnson@mbari.org
Riser, S. C., University of Washington, Seattle, USA, riser@ocean.washington.edu
Swift, D., University of Washington, Seattle, USA, swift@ocean.washington.edu
Coletti, L. J., MBARI, Moss Landing, USA, coletti@mbari.org
Jannasch, H. W., MBARI, Moss Landing, USA, jha@mbari.org
Plant, J. N., MBARI, Moss Landing, USA, jplant@mbari.org
Sakamoto, C. M., MBARI, Moss Landing, USA, saca@mbari.org
Church, M. J., University of Hawaii, Honolulu, USA, mchurch@hawaii.edu
Lomas, M. W., BIOS, St. Georges, Bermuda, michael.lomas@bios.edu

HOT AND BATS: AN IN SITU COMPARISON USING PROFILES FLOATS WITH CHEMICAL SENSORS

Apex profiling floats, equipped with oxygen, nitrate, temperature, pressure and conductivity sensors have been deployed at the Hawaii Ocean Time-series and at the Bermuda Atlantic Time-series Study. The floats profile from 1000 m to the surface every 5 days and data is available on the Internet in near-real time. The results highlight some rather striking and surprising differences. BATS is generally considered to be an area of high mesoscale eddy activity. However, the nitrate concentrations at HOT shows much more variability on the time scale typical of mesoscale processes. The data from HOT demonstrate that the bulk of the nitrate needed to support net community production (NCP) is acquired below the euphotic zone (Johnson, Riser and Karl, Nature, 465, 1062-1065, 2010). At BATS, much of the nitrate required...
to support NCP is transported into the ephypptic zone by late winter mixing and upward transport at the base of the ephypptic zone during spring. However, during summer and fall nitrate acquisition occurs from below the ephypptic zone, as at HOT.

Johnson, M. D., Woods Hole Oceanographic Institution, Woods Hole, USA, mjohnson@whoi.edu
Vardi, A., Department of Plant Sciences, Weizmann Institute of Science, Rehovot, Israel, assaf.vardi@weizmann.ac.il

Using functional genomics approaches to study the role of chemical signaling in microzooplankton-prey interactions

Protoplankton grazers are the dominant consumers of phytoplankton production in the world's oceans. While selective grazing and prey nutritional status are known to play important roles in grazing rate variability, we are only beginning to understand chemical cues that shape predator-prey interactions. Here we investigated the role of the potent intracellular signal nitric oxide (NO) as a variable in predator selection using transgenic clones of the diatom Phaeodactylum tricornutum (Pt) and the heterotrophic dinoflagellate, Oxyrrhis marina (Om). Genetic transformants of Pt produced elevated levels of a NO-associated protein, fused to green fluorescent protein (NOA-GFP), resulting in lower threshold responses to a variety of environmental stressors. Grazing by Om on PNOA-GFP clones was depressed compared to ingestion of wild type (WT) or control GFP producing Pt, suggesting that selection by Om may be mediated through sensing of prey signaling and/or related infochemicals. Furthermore, the presence of Om cells or conditioned filtrates resulted in greater prey aggregation in PNOA-GFP clones compared to WT, suggesting that NO signaling may play a role in changes of prey phenotype to escape grazing pressure.

Johnson, M. D., CSU Northridge, Northridge, USA, mjohnson@csun.edu
Carpenter, R. C., CSU Northridge, Northridge, USA, robert.carpenter@csun.edu

The combined effects of elevated pCO2 and temperature on growth and calcification rates of the crustose coralline alga Hydrolithon onkodes.

This study elucidates the combined impacts of elevated temperature and pCO2 on an important calcifying organism in coral reef ecosystems, crustose coralline algae (CCA). Hydrolithon onkodes was collected from Kaneohe Bay, HI and exposed to a fully factorial combination of temperature (26°C, 28°C) and pCO2 (420, 550, 890 µatm) treatments. Calcification rates of H. onkodes were measured after 21 days using two techniques: 1) calcification from changes in buoyant weight, and 2) short-term calcification rates measured using the alkalinity anomaly technique. There was no significant interactive effect of elevated temperature and pCO2 on either longer-term or short-term measurements of calcification. pCO2 had a significant effect on long-term calcification, and calcification was significantly lower in the 900 µatm treatment. Temperature had a significant effect on short-term rates of calcification, with rates significantly reduced at 28°C, regardless of pCO2. These results provide evidence indicating that there was no significant synergistic effect of temperature and pCO2 on CCA calcification. However, both temperature and pCO2 are independently important, and elevations in either have negative implications for calcification of H. onkodes.

Johnson, S., Hampton University/NOAA, Hampton, USA, symone.johnson@rocketmail.com
Garrett, A., NOAA, Silver Spring, USA, ann.garrett@noaa.gov

Preserving endangered species: Pesticide management

Agency reports, called biological opinions, were reviewed to gather a list of procedures that intend to protect threatened or endangered species from being exposed unnecessarily to harmful pesticides during treatment. Four sites were chosen to examine proper pesticide treatment that would not harm various endangered species inhabiting the site. Fishes inhabiting the sites included numerous species of steelhead, salmon, and chum. There was a mixture of variables for each site of study. Therefore, at each site, a specific treatment was applied to the area. Literature was reviewed to evaluate the efficacy of the methods. Overall, the consistently relevant variables were wind speed and direction, precipitation, and nozzle setting. This project was chosen because it is vital to preserve species, particularly those that are endangered or threatened. This project also assisted NOAA in its role as a technical advisor to federal agencies that use pesticides to control invasive species and other undesirable pests where they overlap with federally protected species.

Jokela, A., Queen's University, Kingston, Canada, anneli.jokela@queensu.ca
Arnott, S. E., Queen's University, Kingston, Canada, arnotts@queensu.ca
Beisner, B., Université du Québec à Montréal, Montreal, Canada, beisner.beatrixx@uqam.ca

Influence of the Exotic Predatory cladoceran Bythotrephes longimanus on the vertical distribution of zooplankton prey in Inland lakes of the Canadian Shield

Adaptive responses by native prey species can influence the invasion success of exotic predators. The exotic predatory cladoceran Bythotrephes longimanus is a visual predator which occupies a shallow position in the water column. Adaptive movement by zooplankton prey could have important consequences for the long-term success of Bythotrephes by reducing resource availability. In 2007, a stratified survey of 14 invaded lakes was conducted to determine the diel distribution of zooplankton prey. We found that the mean proportion of daphnids and calanoid copepods was significantly lower in the epilimnion during the day than at night and the epilimnionic proportion of these individuals decreased with increasing Bythotrephes density. To further investigate this pattern, we conducted lab experiments in 2010 to determine the phototactic response and vertical distribution of Daphnia from invaded and uninvaded lakes when exposed to Bythotrephes kairomone. Contrary to patterns described for the Great Lakes, we found no evidence of a behavioural response in the presence of kairomone. The vertical distribution of Daphnia appears instead to be lake specific with overall differences in the mean position occurring between invaded and uninvaded lakes.

Jonca, J., CNRS/LEGS, TOULOUSE, France, justyna.jonca@legos.obs-mip.fr
Giraud, W., CNRS/LEGS, TOULOUSE, France, william.giraud@legos.obs-mip.fr
Thouron, D., CNRS/LEGS, TOULOUSE, France, danielle.thouron@legos.obs-mip.fr
Comtat, M., UPS/LGC, TOULOUSE, France, comtat@chimie.ups-tlse.fr
Garcon, V., CNRS/LEGS, TOULOUSE, France, veronique.garcon@legos.obs-mip.fr

Phosphate monitoring in the oxygen minimum zones: A novel electrochemical reagentless method

Oxygen Minimum Zones, mainly localized in the EBUS, are known to play a crucial role on climate evolution via greenhouse gases budgets and on marine ecosystems (respiratory barrier, modifications of the nitrogen cycle). Deoxygenation will have widespread consequences due to the role O2 plays in the biogeochemical cycling of carbon, nitrogen, phosphorus and other important elements such as Fe, S. Developing new sensors for improving our understanding of the coupled biogeochemical cycles (P-O-C-N) in these regions constitute an immense challenge. Electrochemistry provides promising reagentless methods by going further in miniaturization, decreasing the response time and energy requirements and thus increasing our observing capacities in the oceans. We present an electrochemical method for phosphate determination in seawater. With reagents addition, we optimize the best conditions to produce the phosphomolybdic complex. We then use oxidation of molybdenum to produce molybdates and protons in absence of any reagent. Phosphate concentrations can be detected by chronoamperometry with a 0.1 µM detection limit. We propose a solution to address the silicate interference issue and present an application of this method in the OMZ offshore Peru.

Jones, C. M., Center Quantitative Fisheries Ecology, Norfolk, USA, cjonese@odu.edu
Can otolith chemistry measure philopatry and connectivity?: fact and fiction

Otolith chemistry is proving to be an excellent tool to evaluate habitat residence of fish from the larval stage onward and has recently supplanted the use of other tags in very young fish. As with any method undergoing burgeoning use, important considerations for the application of otolith chemistry are being overlooked. In this talk, I will discuss important considerations in using this technique including: difficulty evaluating philopatry; consideration in hindcasting movement; violation of statistical principles and their effect on correct evaluation of movement. For example, Otolith chemistry can reveal if a fish has returned to its natal habitat, but not the percentage of return. Likewise, without knowledge of initial production, one cannot correctly identify source and sink habitats. Further, care must be taken when statistically analyzing your data because assumptions are often violated for many traditional analyses such as using a series of laser-ablation spots from a single otolith without addressing the lack of independence and autocorrelation.
temperatures. We investigated how temperature (20, 22, and 24 °C) influenced the presence of “noisy” and incomplete data. The BHM framework can incorporate prior knowledge about uncertain quantities, using probability distributions, for model parameters and/or the initial conditions for state variables. Bayesian inference yields a joint posterior probability distribution for the model state and parameters given the data. We use the BHM framework in a series of twin-experiments, to investigate what we can really learn about the state and model parameters for biogeochemical systems, under different observation scenarios.

Jordan, K. R., Southern Illinois University, Carbondale, USA, krrjordan@siu.edu
Brooks, M. L., Southern Illinois University, Carbondale, USA, mbrooks@siu.edu

THE EFFECTS OF SUBLETHAL TEMPERATURE AND FOOD LIMITATION ON TIGRIOPUS CALIFORNICUS

Marine copepods constitute 60 to 80% of zooplankton biomass and inhabit upper waters of pelagic systems; increasing their vulnerability to variations in atmospheric temperatures. We investigated how temperature (20, 22, and 24°C) and altered food availability (limited, moderate, unlimited) affect behavior and reproduction in Tigriopus californicus. Higher temperatures (24°C) suppressed their overall activity but unexpectedly augmented reproductive output. By the conclusion of the 28-d experiment, adult abundances were 2-fold greater than populations held at 20°C. Although eutrophers upregulated their food consumption with increasing temperature, our results suggest that despite food limitation, global warming will prompt copepods to invest energy in reproductive output. Currently, we are investigating temperature effects on chromophoric dissolved organic matter (CDOM) secretions and reproductive output. Copepods can consume 32% of particulate carbon from 0 to 4000 m in the Pacific sub-arctic. If CDOM secretions keep pace with consumption, then quantifying the magnitude of CDOM production from copepods is critical to evaluating the attenuation of biologically damaging UV radiation.

Jørgensen, L., Aarhus University, National Environmental Research Institute, Roskilde, Denmark, jlr@nru.dk
Stedmon, C. A., Aarhus University, National Environmental Research Institute, Roskilde, Denmark, csted@nru.dk
Kragh, T., University of Copenhagen, Hillerød, Denmark, tkragh@bio.ku.dk
Markager, S., Aarhus University, National Environmental Research Institute, Roskilde, Denmark, mmk@nru.dk
Middelboe, M., University of Copenhagen, Helsingør, Denmark, mmiddleboe@bio.ku.dk
Sondergaard, M., University of Copenhagen, Hillerød, Denmark, msondergaard@bio.ku.dk

TRACING THE FORMATION OF BIOREFRACTORY HUMIC ORGANIC MATTER IN THE GLOBAL OCEAN

Despite the fact that the majority of organic carbon in the ocean exists as refractory DOM, the characteristics and production of this material remain poorly quantified. A fraction of dissolved organic matter (DOM) fluoresces, and this property has been used to investigate the formation of biorefractory humic-like DOM fractions. A unique global dataset of DOM fluorescence revealed seven different fractions of DOM: two humic-like, four amino acid-like and one chemically uncharacterized. The two humic-like DOM fractions have different net production rates, distribution, and spectral characteristics. Our results show that their distributions are a balance between supply from continental run off, net microbial production in the dark ocean (> 200 m) and photochemical removal in surface waters (0-200 m). These trends, combined with the persistence of these fluorescence signals across deep ocean ventilation timescales, indicate that it represents a ubiquitous, common end product of terrestrial and aquatic organisms.

Joye, S. B., University of Georgia, Athens, GA, USA, sjoye@uga.edu
Crespo-Medina, M., University of Georgia, Athens, GA, USA, mcm@uga.edu
Hunter, K. S., University of Georgia, Athens, GA, USA, kshunter@uga.edu
Voermeyer, A., University of Georgia, Athens, GA, USA, avvoermeyer@gmail.com
Beer, L., University of Georgia, Athens, GA, USA, lbeer@uga.edu
Bowles, M. W., University of Georgia, Athens, GA, USA, marshall@uga.edu
Asper, V., University of Southern Mississippi, Stennis Space Center, MS, USA, veronica.asper@usm.edu
Diercks, A., University of Southern Mississippi, Stennis Space Center, MS, USA, arn.diercks@usm.edu
Teske, A. F., University of North Carolina, Chapel Hill, NC, USA, ateske@email.unc.edu
Benitez-Nelson, C., University of Southern California, Columbia, SC, USA, cbnelson@geol.sc.edu

BRADY, J., Skidaway Institute of Oceanography, Savannah, USA, jay.brades@skio.usg.edu
Montoya, J., Georgia Institute of Technology, Atlanta, USA, joseph.montoya@biology.gatech.edu
Passow, U., University of California, Santa Barbara, USA, uta.passow@lifesci.ucsb.edu
Moore, W. S., University of South Carolina, Columbia, USA, woogroel.sc.edu
Subramaniam, A., La Jolla Institute for Allergy and Immunology, University of California, San Diego, USA, ajit@llio.ucsd.edu
Wade, T., Geological and Environmental Research Group, College Station, USA, terry@gerg.tamu.edu
Arnott, C., University of North Carolina, Chapel Hill, USA, carnott@email.unc.edu
Zieroth, K., University of North Carolina, Chapel Hill, USA, zieroth@email.unc.edu
Burgess, E., Savannah River Ecology Lab, Aiken, USA, burgess@srel.edu
Highsmith, R., National Institute for Undersea Science and Technology, Oxford, USA, ray@olemiss.edu

THE MICROBIAL SLIME HIGHWAY: OIL TRANSPORT TO THE BENTHOS AND CONSEQUENCES ON MICROBIAL DYNAMICS IN DEEP GULF OF MEXICO ENVIRONMENTS

Approximately 4,000,000 barrels of oil were injected into the Gulf of Mexico system during the BP oil well blowout. We evaluated the impact of oil on microbial
distributions and activities along the seafloor during two cruises, one in early May 2010 and one in August-September 2010. During the May cruise, little evidence of weathered oil deposition was observed and rates of sediment microbial activity (sulfate reduction and anaerobic oxidation of methane) were low, indicating little input of exogenous organic carbon. During the September cruise, surficial layers (<1 cm to >10 cm thick) containing weathered oil entrained within an organic matrix were observed across a large area. Radioisotopic, sediment trap, and photographic evidence suggest a recent, significant sedimentation event at substantial distances from the wellhead. Sedimentation of weathered oil-containing material to the seafloor altered microbial metabolism and abundance and appeared to have lethal affects on bentonic infaunal communities. The full impacts of weathered oil deposition on sensitive chemosynthetic habitats remains to be fully documented but the consequences could be substantial.

Joyner, J. L., University of Georgia, Athens, USA, jljoyner@uga.edu

Lipp, E. K., University of Georgia, Athens, USA, elipp@uga.edu

Okereke, J., University of Georgia, Athens, USA, tokereke22@gmail.com

Joyner, J. L., University of Georgia, Athens, USA, jljoyner@uga.edu

Serratia marcescens is common in the environment but sewage contamination has introduced it into the coastal marine ecosystem. This bacterium is pathogenic to many organisms, including humans and more recently coral. While its mode of pathogenesis is not yet known for corals, its virulence in a C. elegans model has been attributed to the expression of at least three key genes. The distribution and frequency of these genes among environmental S. marcescens strains has not previously been evaluated. We surveyed strains of S. marcescens for known virulence genes from marine and environmental sources in the Florida Keys, associated with outbreaks of white pox disease in elkhorn coral (A. palmata). Conventional PCR was used to screen isolates for homologues of the Shiga-typing LPS biosynthesis genes (lpsF), virulence (vir) transport (gspA) and siderophore (shlB) genes. Analyses to date indicate that these genes are not universally present among environmental strains. Ongoing work will discern differences in virulence gene prevalence between known pathogenic and non-pathogenic strains of S. marcescens against A. palmata and will provide needed basic information about possible mechanisms of interaction among this pathogen-coral host system.

Jungling, S., University of Potsdam, Institute of Biochemistry and Biology, Potsdam, Germany, sjungling@uni-potsdam.de

Lukas, M., University of Potsdam, Institute of Biochemistry and Biology, Potsdam, Germany, lukas@uni-potsdam.de

Wacker, A., University of Potsdam, Institute of Biochemistry and Biology, Potsdam, Germany, wacker@uni-potsdam.de

CHOLESTEROL AND OXYGEN SHORTAGE: EFFECTS ON DAPHNIA MAGNA
Cholesterol limitation caused by blooms of sterol-free cyanobacteria and oxygen depletion in deep water layers of stratified lakes may act as stressors on zooplankton species. Primarily the keystone genus Daphnia, well known for their extensive diel vertical migrations to greater depths in the presence of visually hunting predators, may be limited by both environmental factors. However, nothing is known about interactive effects of limiting concentrations of oxygen and the essential diet ingredient cholesterol. Therefore we raised Daphnia magna on a cyanobacterium supplemented with various amounts of cholesterol under different oxygen concentrations and analyzed their growth responses and ingestion rates. Both, a lack of cholesterol and low oxygen concentrations diminished the somatic growth rate of D. magna. Below a certain threshold level of cholesterol the daphnids ingested more food suspension even under limiting oxygen conditions. This indicates that cholesterol limitation has a stronger effect on ingestion of D. magna whereas oxygen depletion preferentially impacts somatic growth.

Junker, K., Leibniz Institute for Baltic Sea Research Warnemünde, Rostock, Germany, karin.junker@io-warnemuende.de

Dippner, J. W., Leibniz Institute for Baltic Sea Research Warnemünde, Rostock, Germany, joachim.dippner@io-warnemuende.de

A NEW BALTIC SEA ENVIRONMENTAL INDEX
Since 2000/2001 the correlation between North Atlantic Oscillation (NAO) index and biological variables in the Baltic Sea fails which might be attributed to a global climate regime shift. To understand the variability of environmental variables in the Baltic Sea, a new index is developed and presented here. The Baltic Sea Environmental (BSE) index is defined as the 1st principal component score of four time series: the Arctic Oscillation (AO), local meridional wind, salinity (120-200m, Gotland Sea) and integrated runoff into the Baltic Sea. Thus, it reflects the local characteristics of the Baltic Sea better than NAO or AO and, in contrast to other local indices like the Baltic Sea index or the Chen index, also accounts for the sensitivity of the biology to changes in salinity. First results from downsampling experiments show good performance of the BSE regarding physical variables like SST or Landsort (Sweden) gauge data. Regarding the prediction of selected zooplankton species is the BSE index superior to the mentioned indices.

Juranić, I. W., University of Washington, Seattle, USA, laurie.jurankic@noaa.gov

Fedey, R. A., NOAA-PMEL, Seattle, USA, richard.a.fedey@noaa.gov

Adin, S. R., NOAA-PMEL, Seattle, USA, simone.adin@noaa.gov

ROBUST PREDICTION OF NORTH PACIFIC CARBON SYSTEM DYNAMICS USING EMPIRICAL RELATIONSHIPS WITH HYDROGRAPHIC DATA
The subarctic North Pacific is a region particularly sensitive to ocean acidification, warranting ongoing observing and monitoring efforts. Here, cold surface waters drive an enhanced solubility pump which aids surface ocean uptake of anthropogenic CO2 while intermediate-depth waters bear the signature of the biological pump (CO2-rich, O2-poor) accumulated over basin-transit timescales penetrate up wards to depths of 200-300m. Thus, the surface pelagic community is subject to acidification from above and below, arising from both natural and anthropogenic causes. Because detailed time-series of water-column carbon measurements are not available for this region, we developed empirical relationships between commonly available hydrographic parameters (i.e., temperature, O2) and pH, aragonite, and calcite saturation state (Ωarag and Ωcalc) to evaluate seasonal and interannual variability. Using high-quality data from two recent cruises along 152°W, we achieved robust fits: R2 values of 0.98, RMS errors of 0.016 (pH), 0.049 (Ωarag), and 0.078 (Ωcalc) for data between 50-500m. These relationships can be applied to autonomous platforms to provide insight into seasonal controls on pH, Ωarag, and Ωcalc, and potential ecosystem vulnerabilities to global change.

Jürgens, K., Leibniz Institute for Baltic Sea Research, Rostock, Germany, klaus.juergens@io-warnemuende.de

Berg, C., Leibniz Institute for Baltic Sea Research, Rostock, Germany, carlo.berg@io-warnemuende.de

Bruckner, C., Leibniz Institute for Baltic Sea Research, Rostock, Germany, christian.bruckner@io-warnemuende.de

Feile, J., Leibniz Institute for Baltic Sea Research, Rostock, Germany, janie.feile@io-warnemuende.de

Glaubitz, S., Leibniz Institute for Baltic Sea Research, Rostock, Germany, sabine.glaubitz@io-warnemuende.de

Grote, J., University of Hawaii, Kaneohe, USA, igrote@hawaii.edu

Jost, G., Leibniz Institute for Baltic Sea Research, Rostock, Germany, guenter.jost@io-warnemuende.de

Labrenz, M., Leibniz Institute for Baltic Sea Research, Rostock, Germany, matthias.labrenz@io-warnemuende.de

Schott, T., Leibniz Institute for Baltic Sea Research, Rostock, Germany, thomas.schott@io-warnemuende.de

CHEMOAUTOTROPHIC ARCHAEOAL AND BACTERIAL KEY PLAYERS LINKING THE NITROGEN AND SULFUR CYCLE IN A PELAGIC REDOXCLINE OF THE BALTIC SEA
Oxic-anoxic transition of some marginal seas and coastal environments are sites of important biogeochemical transformations. A high proportion of chemoheterotrophic prokaryotes characterizes the microbial communities. We used different approaches to reveal more information on their identity, abundance and biogeochemical significance. Experimental, physiological and genomic evidence indicated that one cluster within the Epsilonproteobacteria, constituting the most important chemolithoautotroph around the oxic-anoxic interface, is responsible for chemooautotrophic denitrification, coupling denitrification to the oxidation of reduced sulfur compounds. In the suboxic zone, crenarchaea closely related to the Candidatus Nitrospumilus maritimus are abundant and probably responsible for ammonia oxidation, as evidenced by amoA expression profiles. Therefore the biogeochemical transformations of the two key players within the nitrogen cycle might be coupled. However, although both organisms seem to have distinct niches and functions, they are distributed in a wide depth zone across the redox gradient. This raises the question for their metabolic adaptations, including the existence of mixotrophy, in water layers where known electron donors or acceptors are absent. Metagenomics, metatranscriptomics, and incubations experiments in combination with SIP-RNA were used to gain more information in this respect.
A Caribbean fishery index is used to identify contrasting environmental conditions in atmosphere and ocean reanalysis fields associated with high and low catch rates over the period 1971–2004. A number of composite features are noted: cooler surface temperatures and warmer, drier weather across the southern half of the Caribbean favors higher catch rates. There is a rise of elevated sea level on 16ºN that reflects anticyclonic recirculation. South of the ridge the Caribbean Current is strengthened, while north of the ridge anomalous eastward currents are found along the axis of the Antilles Islands of Caymans, Jamaica, Hispanola, Puerto Rico and Guadeloupe. The atmospheric Hadley circulation is weaker during years of high catch and tropical cyclones are rare. This work uncovers basin-scale forcing of aggregate fish catch, and reflects a north-south gradient in land-atmosphere hydrology, and composite oceanographic differences based on reanalysis data. In addition, seasonal and interannual cycles of ocean productivity are investigated using satellite ocean color. Certain features of long-term climate change in the Caribbean Sea are also reviewed.

Hypoxia in the coastal waters of the NW Atlantic is caused by the combined effects of natural fluctuations in ocean circulation and climate, and human activities that cause eutrophication. Recent studies have shown that anammox is tightly coupled to aerobic ammonium oxidation and nitrate reduction in oxygen minimum zones (OMZs). The co-occurrence of aerobic and anaerobic N-cycling processes indicates that anaerobic microorganisms like anammox bacteria can tolerate oxygen. Here we performed O2 manipulation experiments (0–25 µM O2) with 13N-labelled substrates to investigate the influence of hypoxia on fish populations has been fairly limited. In particular, there has been little attention to derive exposure histories of simulated fish populations or to explain large-scale fish movement patterns in response to changing oxygen concentrations. To address this problem, we have coupled a high-resolution, three-dimensional, unstructured-grid, Finite Volume Coastal Ocean Model (FVCOM) with Water Quality Analysis Simulation Program (WASP5) and an Individual Based Fish Model (IBM). The coupled models were implemented to simulate the seasonally hypoxic region of the Louisiana-Texas shelf. We used the models to investigate how different behavioral movement approaches (e.g., kinesis versus fitness, degree of avoidance) and temporally- and spatially-dynamic hypoxia conditions can affect fish distributions and the exposure histories of individual fish.
the O2-sensitivity of anaerobic and aerobic N-transformations in the Namibian and Peruvian OMZs. Anammox activity decreased with increasing O2 concentration but was still measurable at levels up to ~15 µM of O2. This relatively high O2 tolerance implies that a significantly larger ocean volume might be affected by N-loss than previously assumed. Aerobic ammonia oxidizers remained equally active over the entire range of adjusted O2 concentrations hinting at a high affinity for O2. Nitrate reduction to nitrite remained active at ~25 µM of O2. These results provide insight into the possible response of the oceanic N-cycle to the predicted future changes in dissolved O2 due to global warming.

Kamenos, N. A., University of Glasgow, Glasgow, United Kingdom, nick.kamenos@glasgow.ac.uk

ENHANCED SUMMER WARMING IN THE EAST ATLANTIC OVER THE LAST 650 YEARS AND THE RESPONSE OF MARINE ZOOPLANKTON

Modeling and measurements have shown that Atlantic marine temperatures are rising. However, low resolution of those records 1) masks regional details critical for determining the rate and extent of climate oscillations and 2) prevents robust determination of climatic impacts on marine ecosystems. To address both issues, a fort nightly resolution marine climate record from 1353-2006 was constructed for North East Atlantic shallow inshore waters using a novel proxy and compared to changes in marine zooplankton abundance. Since 1353, summer marine temperatures increased more than winter temperatures. Rising temperatures were characterized by a 5-65 year temperature oscillations which began in 1700 indicating that such oscillations in climate may only be a recent but widespread phenomenon. Critically, enhanced summer warming led to a fall in abundance of the copepod Calanus finmarchicus, a major food item for cod. The abundance of C. finmarchicus is projected to be lower in 2040 than at present. Enhanced summer warming appears to affect productivity near the base of the marine food web with potentially significant knock-on effects for marine fisheries during the next few decades.

Kamykowski, D., North Carolina State University, Raleigh, NC, USA, dan_kamykowski@ncsu.edu

ATLANTIC MERIDIONAL OVERTURNING CIRCULATION AND SYNCHRONY IN PACIFIC AND ATLANTIC OCEAN SARDINE-ANCHOVY POPULATIONS.

Sardine-anchovy populations off Japan, California, Peru and South Africa/Namibia can fluctuate synchronously on decadal scales. Climate signals propagating through atmosphere and ocean have been invoked as synchronizing agents through teleconnection mechanisms. Thermohaline circulation appears involved through interdecadal dislocation of the North Atlantic convergence area or changes in deep current strength. Variations in both the deep and shallow arms of thermohaline circulation propagate through the Atlantic Ocean as Rossby and Kelvin waves. Regional wave-related control appears associated with nutrient enrichment such that stronger eastern boundary current flow correlates with increased upwelling (California, Peru, Benguela), while increased western boundary current meandering increases inter-current mixing (Kurashio/Oyashio).

In the present analysis, sardine-anchovy fishery locales correspond to latitudinally banded nutrient patterns associated with Atlantic Meridional Overturning Circulation (AMOC) variability throughout the twentieth century world ocean monitored using a bipolar sea surface temperature (SST) index and phosphate concentrations inferred from SST. Sardine-anchovy fishery variability lagged AMOC variability by 2-3 years after IS95. This analysis complements previous fisheries-oriented global ocean SST and sea level pressure analyses by considering an ocean-focused, physical-chemical-biological sequence from a bottom-up control perspective.

Kane, D. D., Defiance College, Defiance, USA, dkane@defiance.edu

Defiance College, Defiance, USA, dkane@defiance.edu

College, Defiance, USA, dkane@defiance.edu

Lake Erie (LE) has recently returned to a eutrophic state. Loadings of soluble nutrients (i.e., soluble reactive phosphorus) from the predominantly agricultural Maumee and Sandusky Rivers (MSR) have increased during the last decade. Concomitantly, cyanobacterial Harmful Algal Blooms (cyano-HABs) have increased in extent and duration in western LE. Herein we discuss 1) correlations between nutrient loading (MSR) and cyano-HAB (LE), 2) temporal and spatial dynamics of nutrients and cyano-HABs (MSR), 3) indicators of nutrient limitation (LE and MSR), and 4) processes that affect cyanohab growth and transport from MSR into LE. Especially relevant to these interactions is that cyano-HABs have been found at biomasses approaching xxx g m-3 throughout the MR, from first-order streams to offshore LE. Consequently, a new paradigm for understanding LE from both ecological and management aspects must consider these multiple, coupled aquatic ecosystems. We will discuss these linkages from the context of the Algal Loading Hypothesis, which posits that tributary-derived algae exported to LE greatly affect offshore cyano-HABs.

Kane, D. D., Defiance College, Defiance, USA, dkane@defiance.edu

Maxcy, J., Defiance College, Defiance, USA, jmaxcy@defiance.edu

Mavroidis, S. M., Defiance College, Defiance, USA, smavroidis@defiance.edu

Czech, M., Lourdes College, Sylvania, USA, mczech@lourdes.edu

McKay, R. M., Bowling Green State University, Bowling Green, USA, rmckay@bgsu.edu

Griggs, N. D., Defiance College, Defiance, USA, nrgriggs@defiance.edu

COLLEGIATE SERVICE LEARNING USING LAURENTIAN GREAT LAKES TRIBUTARY WATER QUALITY MONITORING: MAKING THE MAUMEE RIVER GLISTEN

As part of the Great Lakes Great Lakes Innovative Stewardship through Education Network (GLISTEN), students at Defiance College have participated in a variety of interrelated activities dealing with the largest tributary to Lake Erie and the Laurentian Great Lakes, the Maumee River. This initiative has included: integrating water quality components into three varied courses (ecology, field zoology, biochemistry II), monthly water quality monitoring, and outreach with middle school and high school students. This initiative has been very student-lead, with an undergraduate student serving as a GLISTEN liaison to a local watershed group (Upper Maumee Watershed Partnership) and leading a number of these activities. Finally, we compare nutrient data derived from undergraduate student field sampling and lab analysis with that derived from a water quality laboratory to determine the utility of using such data in research projects.

Kapetsky, J. M., Consultants in Fisheries and Aquaculture Sciences and Technologies, Inc., Leland NC, USA, clastinc@bellsouth.net

Aguilar-Manjarrez, J., Food and Agriculture Organization of the United Nations, Rome, Italy, jose.aguilarmanjarrez@fao.org

Jenness Enterprises, GIS Analysis and Application Design, Flagstaff AZ, USA, jennessent@icloud.com

Ferreira, J. G., Institute of Marine Research. Dept. Ciências e Engenharia do Ambiente. Faculdade de Ciências e Tecnologia, Monte de Caparica, Portugal, joao@hoomi.com

GLOBALLY COMPREHENSIVE ESTIMATES OF OFFSHORE MARICULTURE POTENTIAL FOR CORIA, ATLANTIC SALMON AND BLUE MUSSEL COMPARATIVE AMONG ALL MARITIME NATIONS

Spatially based analyses are essential for an understanding of where and at what pace mariculture can develop. The spatial analytical capacity and data exist to tailor spatial analyses for each species and culture system at global and national levels. A pragmatic spatial analytical framework was created that is flexible, that integrates a variety of criteria fundamental to development, and that is based on the limits of current mariculture practice with regard to species and systems. The analytical framework includes technical, economic, growth and other use criteria. The framework provides globally comparative estimates of mariculture potential for three species that are widely cultured, that have established global markets and that are broadly indicative of mariculture potential for other species with similar requirements: cobia, Atlantic salmon and blue mussel. The estimates of potential are comprehensive of the Exclusive Economic Zones (EEZs) of all maritime nations. Potential is measured in terms of the surface area in each EEZ meeting the thresholds imposed on the criteria. The estimates of potential are verified with national production statistics and with the locations of actual farming sites.
**THE ROLE OF HYPOXIA AND DREISSENA MUSSELS ON INTERNAL PHOSPHORUS LOADING IN A GREAT LAKES COASTAL SYSTEM**

We assessed the potential importance of internal phosphorus loading, focusing on influences of sediment type, oxygen levels and dreisnenna mussels on sediment phosphorus fluxes. Sediment cores were collected from three regions of Saginaw Bay, a eutrophic embayment of Lake Huron. The cores were utilized in two separate incubation experiments evaluating: 1) sediment P flux under aerobic and anoxic conditions, and 2) nutrient remineralization from mussel biodeposits. Cores were assessed for bacterial content, carbon, nutrients, and mineral-content characterization. Anaerobic treatments exhibited significantly higher P release into overlying waters when compared to aerobic treatments. This release was greatest in sediments collected from depositional areas. These results may indicate that contributions of P from sediments in Saginaw Bay are controlled by episodic anoxic events. Elevated P levels were not detected in association with dreisnenna biodeposits; however, bacterial concentrations in these cores were 10 orders of magnitude higher than control treatments. These results may indicate that bacteria associated with dreisnenna mussels may play a large role in phosphorus consumption. These results may raise further questions of remineralization rates of biodeposits when assessing loading effects.

**DISSOLVED ORGANIC MATTER IN THE OCEAN: AN EXTREME COMPLEX AND DIVERSE MIXTURE OF ORGANIC MOLECULES**

The main portion of dissolved organic matter (DOM) in the ocean is refractory or recalcitrant, and thus, DOM sequesters carbon for thousands of years. Only a small part is labile and semi-labile that is transformed into recalcitrant DOM on various time scales. Without knowledge on molecular structures it is impossible to discern why DOM is so resistant against decomposition. Using Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR-MS) the molecular elemental composition of thousands of DOM molecules can be determined. Structural information of single isolated masses is obtained by collision induced dissociation FT-ICR-MS. Mainly stepwise losses of CO2 and H2O were observed for all precursor masses. Therefore, it can be concluded that similar structures (carboxyl and hydroxyl groups) are ubiquitously present in DOM. Most molecules are highly oxygenated which implies that they are not per se stable and should be utilizable by microorganisms. The common view is that biotic and abiotic processes exist that make organic material recalcitrant and thus unattainable for microbial degradation. A close co-operation between chemistry and microbiology is indispensable to understand the cycling of DOM.

**SPATIAL PATTERNS OF ABUNDANCE, PRODUCTION, AND GROWTH OF MARINE HETEROTROPHIC BACTERIA IN THE EASTERN CANADIAN ARCTIC**

Although heterotrophic bacteria are ubiquitous in the World Ocean, often dominate planktonic biomass, and are central in the cycling of energy and materials in marine ecosystems, relatively little is known about the regulation of bacterial processes in high latitude oceans. As part of the Canadian Arctic SOLAS – IPY Initiative, bacterial abundance, production, and growth rates were assessed in the Lancaster Sound – Baffin Bay region of the Eastern Canadian Arctic. Across the study area, bacterial abundance and rates of production and growth ranged from 1.8 – 16.6 x 10^3 cells l^-1, 0.21 – 1.58 μg C l^-1 d^-1, and 0.01 – 0.31 d^-1, respectively. Bacterial characteristics differed in the Arctic Surface Water (ASW) and Baffin Bay Surface Water (BBSW) masses, which were defined by biological and physical properties. In BBSW, where bacterial abundances were highest, both production and growth rates were lowest.
These patterns suggest that there is a segregation of the dominant controlling factors (resource availability vs. mortality) in distinct Arctic water masses, a feature that has not been incorporated into predictive models of high latitude biogeochemical cycles and climate change.

Keener, P., NOAA Office of Ocean Exploration and Research, Charleston, USA, paula.keener-chavis@noaa.gov

NOAA AND INDONESIAN EXPLORERS: ENHANCING PUBLIC UNDERSTANDING OF OCEAN EXPLORATION TOGETHER ACROSS INTERATIONAL BORDERS

Last year, an international team of scientists and educators from the United States and Indonesia collaborated to explore the unknown deep ecosystems of Indonesian waters. Using the NOAA Ship Okeanos Explorer along with the Indonesian Research and Fisheries Vessel Baruna Jaya IV, the Indonesia–USA Deep-Sea Exploration of the Sangihe Talalad Region Expedition was the first major step in a multi-year partnership between the two governments to explore the little-known ocean surrounding Indonesia. The expedition, also the maiden voyage of the NOAA Ship Okeanos Explorer, was the first joint international mission with two ships sending live video telepresence to ocean explorers in Exploration Command Centers ashore via telepresence in both countries. Both governments were deeply committed to education and outreach to raise awareness of the importance of exploring Indonesia’s deep-sea. NOAA’s Office of Ocean Exploration and Research produced robust educational materials to bring the science of the expedition into classrooms and aquariums, some of which were translated into Bahasa Indonesian. There was productive collaboration with SeaWorld-Indonesia in Jakarta and the Explorerarium in San Francisco to ensure success of these efforts.

Keith, D. J., 1. Atlantic Ecology Division, National Health and Environmental Effects Research Laboratory, USEPA, Narragansett RI, USA, keith.darryl@epa.gov

Lunetta, R., 2. Environmental Services Division, National Exposure Research Laboratory, USEPA, Research Triangle Park, NC, USA, lunetta.ross@epa.gov

Hines, A., 1. Atlantic Ecology Division, National Health and Environmental Effects Research Laboratory, USEPA, Narragansett RI, USA, kuhn.anne@epa.gov

TEMPORAL AND SPATIAL VARIATION IN FISH NURSERY AREAS OF THE ALBEMARLE-PAFMLICO SOUND, NC ESTUARINE SYSTEM DERIVED FROM MERIS

Salt marshes and estuaries along the North Carolina coast serve as nurseries for 90 percent of the economically important fisheries species landed in these waters. The North Carolina Division of Marine Fisheries has divided estuarine and coastal waters into three categories: Primary, Secondary, and Special Secondary Nursery Areas based on salinity. These categories are designed to protect juvenile fish, crustaceans and shellfish from commercial fishing during selected times of the year. In the Albemarle-Pamlico Estuarine System (APES) salinity ranges from 0.5 – 30 ppt. We have created a general salinity model from in situ and laboratory measurements of salinity and CDOM absorption from 190 sampling events (1999 – 2008) in Narragansett Bay, Rhode Island and the Neuse River, North Carolina. The model was validated using a subset of the original dataset. The seasonal salinity distribution across the APES was mapped using CDOM products derived from Medium Resolution Imaging Spectrometer (MERIS) high resolution mode (300 m GSD) imagery (2006 – 2009). By mapping the temporal and geographic distribution of salinity in this system, we hope to provide information which better informs the nursery designation process.

Kehlbe, C. R., NOAA/AOML & UM/RSMAS, Miami, USA, chris.kehlbe@noaa.gov

Bowder, J. A., NOAA/SEFSC, Miami, USA, joan.bowder@noaa.gov

SETTING JUVENILE SPOTTED SEATROUT PERFORMANCE MEASURES TO ASSESS THE SUCCESS OF EVERGLADES RESTORATION ON FLORIDA BAY

Spotted Seatrout, Cynoscion nebulosus, are an important recreational sportfish in Florida Bay and spend their entire life history within the Bay. They are an established indicator of estuarine health (Bortone 2000) and their distribution has been documented to vary in response to salinity patterns within Florida Bay (Thayer et al. 1999). Specifically, the current salinity regime often has persistent high-magnitude hypersalinity events in the central portion of Florida Bay. When this hypersaline water is present, juvenile spotted seatrout are largely absent from this region. One of the interim goals of Everglades restoration is to mitigate these hypersalinity events in Florida Bay. If hypersalinity is reduced, habitat suitability for juvenile spotted seatrout will likely increase. To assess the impact of restoration on sportfish communities in Florida Bay quantitative performance measures will be developed. However, there is no knowledge of the pre-drainage spotted seatrout community in Florida Bay; thus, performance measures must be developed from data collected in a degraded system. Results will be presented that use data collected on juvenile spotted seatrout from a degraded system to set restoration performance measures.

Kelly, M. D., Queen’s University, Kingston, Canada, 8mdk@queensu.ca

Campbell, L. M., Queen’s University, Kingston, Canada, linda.campbell@queensu.ca

Cumming, B. F., Queen’s University, Kingston, Canada

Drevnick, P. E., INRS Centre Eau Terre Environnement, Quebec, Canada

Muir, D., Environment Canada, Burlington, Canada

ACIDIFICATION, TOXIC MERCURY, AND FISH; DESCRIBING CHANGES OF BIOACCUMULATION

Ontario provincial records indicate that fish total mercury (THg) has significantly declined since the 1970’s, yet THg in precipitation has remained relatively stable during this period. With three likely hypotheses; i) changes in food web structure, ii) changes in fish growth rates or iii) declines in acid sulphur (S) deposition, known links to bioavailability directed an assessment of acid precipitation as an influence on fish THg. We examined temporal trends for THg and S in sediment cores with fish tissues from two lakes that differ in S-reduction rates (SRR), Kabeh Lake and Mountain Lake, in south-central Ontario. We hypothesize that lakes with anoxic hypolimnion increase SRR, thus increasing Hg bioavailability. Conversely, lakes with oxic hypolimnion may reflect trends of mercury deposition. Between-lake variability of fish THg is compared to describe changes related to S accumulation in sediments. Paleolimnological records for Kabeh Lake show distinctive trends of increasing S from 1952 to 1990 followed by declines to present, whereas Mountain Lake S remains unchanged over 150 years. Preliminary results of fish THg in Kabeh Lake appear to support our hypothesis. Archived fish samples have provided fish THg to be paired with sediment records through an unprecedented 84 years to further evaluate this relationship.

Kemp, W. M., University of Maryland, Cambridge, USA, kemp@umes.edu

Testa, J. M., University of Maryland, Cambridge, USA, testa@umes.edu

OXYGEN EFFECTS ON NUTRIENT BIOGEOCHEMISTRY: FEEDBACK EFFECTS ON EUTROPHICATION

Although influences of low oxygen concentrations on biogeochemical processing of nitrogen and phosphorus have been shown experimentally, the hypothesized feedback effects on eutrophication-induced coastal hypoxia have been difficult to demonstrate. Here we apply long term field observations, statistical analyses, and numerical models to estimate ecosystem-scale effects of these processes on trends of eutrophication and its reversal for the case study of Chesapeake Bay. We analyze a 25-year record of O2 density, NH4, and PO4 pools at seasonal and inter-annual scales for a large stratified estuarine system experiencing variable summertime oxygen depletion in bottom waters. Year-to-year changes in pools of O2 and reduced forms of DIN and DIP are related to variations in climatic conditions and in TN and TP loading from adjacent watershed. Turnover rates for these pools are computed using model-generated transport and transformation rates to compare physical and biogeochemical contributions to mass-balances at seasonal and regional scales. These data analyses are linked with scenario simulations using a sediment diagenesis model to explore integrated feedback effects under a range of nutrient inputs and climatic conditions.

Kenna, T. C., Lamont-Doherty Earth Observatory, Palisades, USA, tkenna@ldeo.columbia.edu

Masqué, P., University of Barcelona, Bellaterra, Spain, Pere.Masque@ub.cat

Camara-Mor, P., University of Barcelona, Bellaterra, Spain, Patricia.Camara@ub.cat

Puigcorbé, V., University of Barcelona, Bellaterra, Spain, viena.puigcorbe@uab.cat

Masqué, P., University of Barcelona, Bellaterra, Spain, Pere.Masque@uab.cat

Kenna, T. C., Lamont-Doherty Earth Observatory, Palisades, USA, tkenna@LDEO.columbia.edu

Rijkenberg, M., Royal Netherlands Institute for Sea Research - NIOZ, Texel, Netherlands, mfrank@ifm-geomar.de

Gerringa, L., Royal Netherlands Institute for Sea Research - NIOZ, Texel, Netherlands, Loes.Gerringa@nioz.nl

De Baar, H., Royal Netherlands Institute for Sea Research - NIOZ, Texel, Netherlands, Heim.de.Baar@nioz.nl

ANTHROPOGENIC RADIONUCLIDES IN THE ATLANTIC OCEAN 4 DECADES AFTER GEosecs; RESULTS FROM GEOTRACES CRUISES A11 AND A02

Our project is focused on determining the total concentrations of the anthropogenic radionuclides (ARNs) 239Pu, 240Pu, 237Np, and 137Cs in full depth profiles from several
We are interested in addressing our experience that science influences management, and the value of long-term datasets for influencing the release of hatchery salmon. Highlight the use of surface currents to track and predict the path of contaminants through all of the avenues required to reach a very diverse group of users. While scientists can easily communicate in scientific terms, it isn’t always clear if their message can be translated by managers into valuable information for decision making. It takes a strong interdisciplinary team to translate complex science through all of the avenues required to reach a very diverse group of users.

In this presentation, we’ll look at the ways in which California’s Ocean Observing Systems are using a stakeholder-driven Advisory Committee to guide the transformation from research to application. We’ll also highlight successful examples of our efforts to address fisheries and water quality management by developing products and integrating data from diverse platforms and programs. For example, we may highlight the use of surface currents to track and predict the path of contaminants and the value of long-term datasets for influencing the release of hatchery salmon.

We are interested in addressing our experience that science influences management, but management needs are what influence policy.

Atlantic GEOTRACES cruises occurring in 2010, with the goal of a broad brush characterization of the ARNs in the Atlantic Ocean some 37 years after GESECS. These isotopes also exhibit a range of Kd values (sediment water distribution coefficients, Pu-Np, Cs), and geochemical behaviors, as well as provide a means to resolve different sources of radioactive contamination. We will address processes such as advection (new water mass tracers), sources and sinks (characteristic isotopic signatures), as well as scavenging and particle dynamics across a range of contrast regions in terms of total particle fluxes and types of particles. Here we present water column distributions from GEOTRACES cruises completed by Germany (RV Meteor M81/1, GEOTRACES Cruise A11) and the Netherlands (RV Pelagia cruise 64PE319/321, GEOTRACES Cruise A02). These data will be compared to available GESECS data. Inventory ratios will be used to identify sources, use them as water mass tracers, and to elucidate important processes such as scavenging.

TERDISCIPLINARY LEARNING ABOUT THE EARTH AND ITS ENVIRONMENT

RIVER SUMMER: A MODEL PROGRAM FOR FACULTY THAT PROMOTES INTERDISCIPLINARY LEARNING ABOUT THE EARTH AND ITS ENVIRONMENT

River Summer has proven to be an extraordinarily valuable development experience for faculty from numerous Hudson Valley colleges and universities who are engaged in many disciplines. Our program provides a unique opportunity for faculty to teach and learn from each other through multi-disciplinary, inquiry-driven, hands-on field-based activities. River Summer brings together people from widely different perspectives and diverse disciplinary backgrounds to live and study the Hudson River and its watershed. This novel educational platform immerses participants in the landscape and provides strategies for participants to incorporate new curricula in their home institutions. Numerous activities have been made available online, encouraging a wider network of field based learning experiences. Over four weeks, faculty from research universities, community colleges, liberal arts institutions, and middle and high schools work and live together, often on board a research vessel or in a remote tent campsite, for several days at a time. The enthusiasm and energy that the project evokes suggests that the model developed for this program could be successfully implemented in other settings to promote interdisciplinary learning about the Earth and its environment.

Kerkering, H. A., CeNCOOS, Moss Landing, USA, heather@mbari.org

TERDISCIPLINARY LEARNING ABOUT THE EARTH AND ITS ENVIRONMENT

Khan, A. L., University of Colorado/Institute of Arctic and Alpine Research, Boulder, USA, alialauren@gmail.com

Many governance structures advocate that the best science be applied to the policy and management decisions that affect the economy, health and resilience of our coastal resources. While scientists can easily communicate in scientific terms, it isn’t always clear if their message can be translated by managers into valuable information for decision making. It takes a strong interdisciplinary team to translate complex science through all of the avenues required to reach a very diverse group of users.

In this presentation, we’ll look at the ways in which California’s Ocean Observing Systems are using a stakeholder-driven Advisory Committee to guide the transformation from research to application. We’ll also highlight successful examples of our efforts to address fisheries and water quality management by developing products and integrating data from diverse platforms and programs. For example, we may highlight the use of surface currents to track and predict the path of contaminants and the value of long-term datasets for influencing the release of hatchery salmon.

We are interested in addressing our experience that science influences management, but management needs are what influence policy.

Kieber, D. J., State University of New York, College of Environmental Science and Forestry, Syracuse, USA, dkieber@esf.edu

Kieber, D. J., State University of New York, College of Environmental Science and Forestry, Syracuse, USA, cepsiese@syr.edu

CALIFORNIA OCEAN OBSERVING SYSTEMS: DESIGNED TO BRING SCIENCE TO MANAGEMENT

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Kieber, D. J., State University of New York, College of Environmental Science and Forestry, Syracuse, USA, dkieber@esf.edu

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Skrabal, S. A., University of North Carolina Wilmington, Wilmington, USA, skrabals@uncw.edu
Avery, G. B., University of North Carolina Wilmington, Wilmington, USA, averygg@uncw.edu
Mead, R. N., University of North Carolina Wilmington, Wilmington, USA, meadra@uncw.edu

PHOTOCHEMICAL PRODUCTION OF DISSOLVED ORGANIC AND INORGANIC NUTRIENTS FROM RESUSPENDED SEDIMENTS
A series of photolysis experiments was conducted in the presence of tidal creek and continental shelf sediments to address the role of resuspension on nutrient fluxes in coastal waters. There was a significant increase in TDN, phosphate and DOC when sediments were resuspended in overlying water and exposed to simulated sunlight. Photochemical fluxes were significantly higher than dark controls at all sites indicating that this was predominately a light-mediated process. DOC fluxes from fine (<10 µm) sediments were one to three times higher than previous studies that used bulk sediment suspensions. The majority of dissolved N was released as DON (87%) with relatively lesser amounts of ammonium (13%) with little or no nitrate. Results from autochonized and allochonized samples suggest the mechanism of photolytic release was predominately abiotic. No significant changes were observed when filtered and unfiltered water were irradiated in the absence of resuspended sediments indicating that ambient particles and dissolved species were not photochemically active in these experiments. Results demonstrate that production from resuspended sediments is an episodically significant source of dissolved nutrients to coastal ecosystems receiving sediment plumes.

Kiene, R. P., University of South Alabama, Mobile, USA, rkiene@disl.org
Li, C., The First Institute of Oceanography, Qingdao, China, caroline210xuan@gmail.com
Yang, G. P., Ocean University of China, Qingdao, gpyang@mail.ouc.edu.cn
Kieber, D. J., SUNY ESF, Syracuse, USA, dkieber@esf.edu
Oswald, L., University of South Alabama, Mobile, USA, loswald@disl.org

BIO-AVAILABILITY AND TURNOVER OF DISSOLVED DIMETHYLSULFO-NIOPROPIONATE (DMSP) IN COASTAL WATERS OF THE GULF OF MEXICO
Dissolved DMSP (DMSPd), an organic sulfur compound derived from phytoplankton, is thought to play important roles in microbial sulfur and carbon cycling in the ocean. DMSP concentrations measured with small-volume drip filtration through Whatman GF/F (DMSP_{GF/F}) are generally low in seawater (1-5 nM), but no direct assessments have been made of whether this pool is entirely bioavailable. For coastal waters of the Gulf of Mexico, 10-30% of the DMSP passing GF/F filters (~0.7 µm pore size) was in particles >0.2 µm and therefore not dissolved. Additionally, dark-incubated seawater GF/F filtrates containing bacteria rapidly consumed endogenous dissolved DMSP (now defined as that passing a 0.2 µm filter), but concentrations did not go below 0.2 to 1.0 nM over several days. We conclude that there is a sizeable refractory DMSP pool included within [DMSP_{GF/F}] and that traditional measures of dissolved DMSP overestimate the bioavailable DMSP pool in coastal waters, which in turn can lead to serious overestimation of DMSP turnover flux. The implications of these findings for sulfur and carbon cycling will be discussed.

Killberg-Thuresson, L. M., The College of William & Mary - Virginia Institute of Marine Science, Gloucester Point, USA, kbellberg@vims.edu
Sipler, R. E., The College of William & Mary - Virginia Institute of Marine Science, Gloucester Point, USA, sipler@vims.edu
Bronk, D. A., The College of William & Mary - Virginia Institute of Marine Science, Gloucester Point, USA, bronk@vims.edu

ANTHROPOGENIC NITROGEN SOURCES STIMULATE GROWTH OF HARMFUL ALGAE IN THE YORK RIVER, VIRGINIA, USA

Anthropogenic nitrogen (N) sources were used to assess their role in exacerbation of a harmful algal bloom (HAB) in the York River, Virginia. Urban storm water run-off from a parking lot (+ Urban), exposed soil from a construction site (+ Soil), and industrial run-off from a local paper mill (+ Industrial) were added to a natural bloom assemblage of nutrient sources during a 7 day bioassay experiment. Nutrient analogs indicate the three anthropogenic source waters had distinct compositions of dissolved inorganic and organic N. The + Urban and + Soil treatments stimulated growth of the harmful dinoflagellate Cochlodinium polycykroides and co-occurring phytoplankton. In these treatments there was a doubling of chlorophyll a and co-occurring nutrient drawdown of both organic and inorganic sources after 1 day. The response in the + Industrial treatment did not significantly differ from the Control until days 5 to 7 when chlorophyll a concentrations doubled due to increased diatom biomass. Overall, anthropogenic N inputs likely have important consequences in the York River, leading to enhanced HAB growth as well as altered phytoplankton community composition within blooms.

Kinlan, B. P., NOAA Biogeochemistry Branch, Silver Spring, MD, USA, Brian.Kinlan@NOAA.gov
Menza, C., NOAA Biogeochemistry Branch, Silver Spring, MD, USA, Charles.Menza@NOAA.gov
Kendall, M. S., NOAA Biogeochemistry Branch, Silver Spring, MD, USA, Matt.Kendall@NOAA.gov
Caldow, C., NOAA Biogeochemistry Branch, Silver Spring, MD, USA, Chris.Caldow@NOAA.gov

INTEGRATING UNCERTAINTY, DYNAMICS, AND VARIABILITY INTO COASTAL AND MARINE SPATIAL PLANNING
The past decade has seen major advances in tools and approaches to utilize complex geospatial data for CMSP. Initial efforts naturally focused on traditional mapping approaches, in which the distribution of populations, communities, ecosystems, habitats, physical features, and human impacts and uses were viewed as static spatial patterns. However, static maps alone are limited in their ability to capture, convey, and account for uncertainty, variability, and dynamic processes—all of which are inherent in ecological, human, and geophysical components of the coastal ocean system. A major challenge for the next generation of marine spatial planning tools is to facilitate planning for systems that are dynamic and variable, with information that is limited and uncertain. We present several case studies that illustrate 1) statistical and analytical approaches that capture the uncertainty and dynamics of marine ecosystems, and 2) practical application of these techniques in real marine spatial planning efforts. Practical approaches are discussed for addressing challenges posed by observation and process error, variable rates of demographic and ecosystems processes, complex patterns of connectivity and resilience to disturbance, and changing ocean climate.

Kinney, J. W., Stony Brook University, Stony Brook, USA, jwkinney@ic.sunysb.edu
Flood, R. D., Stony Brook University, Stony Brook, USA, rlflood@notes.cc.sunysb.edu

INVESTIGATION OF THE PECONIC ESTUARY, LONG ISLAND, NY REVEALS CLUES TO THE EVOLUTION OF AN ESTUARINE ‘OSTER TERRAIN’

Studies of the relict ‘Oyster Terrain’ in the Peconic Estuary on Long Island in New York using multibeam bathymetry, chirp sonar and sample analysis provides a history of estuarine evolution over thousands of years. More than 10,000 relict oyster reefs are exposed as mounds on the seabed within the Peconic Estuary, with more mounds imaged below the sediment surface. The tops of these relict oyster reefs are at water depths of ~6m – 10m and reef thicknesses of up to 6m suggest active reef building over a few thousand years. At 28 psi, the present estuary is too saline for natural populations of the Eastern Oyster, Crassostrea virginica, to survive. Morphological and shell data tell a tale of time when crowded oyster reefs once dominated the area; however, there has been a natural evolution in the Holocene to an environment where oysters are rare. While oyster shells tell us salinity was lower in the past, the shells themselves also provide the opportunity for more detailed environmental reconstruction of this important transition through δ18O dating and geochemical proxies, such as δ86/87 Sr.

Kirchman, D. L., University of Delaware, Lewes, USA, kirschman@udel.edu
Campbell, B. J., University of Delaware, Lewes, USA
Cottrell, M. T., University of Delaware, Lewes, USA
Oliver, M. J., University of Delaware, Lewes, USA

SEASONAL DYNAMICS IN PHOTOGRAPHIC, HETEROTROPHIC AND PHOTOTHEROTROPHIC MICROBES AND DIVERSITY IN DELAWARE COASTAL WATERS

Traditionally, the dominant feature of plankton processes in temperate systems has been considered to be the spring phytoplankton bloom followed by increases in zooplankton in late spring and summer. Models of plankton processes had to be altered to include fluxes of material and energy through heterotrophic bacteria and protistan grazers, as well as the short circuiting of fluxes due to viral lysis. More recent work has revealed a further complication, phototherotrophic microbes. This presentation will review data from Delaware coastal waters where we have been exploring relationships among phototrophic, heterotrophic and phototherotrophic microbes over the past five years. The phototherotrophic microbes include some...
cyanobacteria, aerobic anoxygenic phototrophic bacteria and proteorhodopsin-bearing bacteria. Pyrosequencing of 16S rRNA genes and of the rRNA itself has revealed complex shifts in bacterial community structure and activity (RNA/DNA ratios) that appeared to be only partially coupled to phytoplankton biomass. Changes over seasonal and yearly time scales will be discussed in relationship to changes in phytoplankton biomass and water mass properties assessed by remote-sensing platforms.

Kirkpatrick, B. A., Mote Marine Laboratory, Sarasota, USA, bkirkpat@mote.org
Boyes, A. J., Mote Marine Laboratory, Sarasota, USA, anamari@mote.org
Hall, E., Mote Marine Laboratory, Sarasota, USA, emily8@mote.org
Nierenberg, K., Mote Marine Laboratory, Sarasota, USA, kniereberg@mote.org

AN ART SCHOOL, A MARINE LAB, AND A TOXIC DINOFLAGELLATE: A COLLABORATION FOR IMPROVED PUBLIC OUTREACH

Blooms of the toxic dinoflagellate, Karenia brevis, occur annually off Florida. Over the years, numerous outreach strategies by the science community, such as FAQ cards and website information, have been used to explain this complicated, multifactorial event of nature to the communities impacted. In spite of these efforts, feedback ranging from confusion to frustration has persisted. In 2010, Mote Marine Laboratory partnered with the Ringling School of Art and Design to create outreach materials with an art student’s point of view. Teams of students selected the area of K. brevis effects they wanted to address. They were encouraged to use any medium of interest to them—animations, cartoons, videos, etc. Students were required to consult with local HAB scientists for fact checking. The projects were displayed at Mote Aquarium for the week of November 30 through December 7th. Aquarium visitors provided feedback with a short survey. A panel of HAB scientists also graded the projects for effectiveness and accuracy of the information. Examples of the winning projects will be given as well as ‘lessons learned’ from the endeavor.

Kirkpatrick, G. J., Mote Marine Laboratory, Sarasota, USA, gkirkpat@mote.org

IN-WATER ESTIMATION OF PHYTOPLANKTON COMMUNITY STRUCTURE USING THE OPTICAL PHYTOPLANKTON DISCRIMINATOR

The Optical Phytoplankton Discriminator (OPD, a.k.a. BreveBuster) determines particulate light absorbance spectra and calculates the best fit of multiple absorbance spectra from known taxonomic classes. Through this process the OPD provides an estimate of the phytoplankton community chlorophyll distribution among the classes included in the fit process. In-water operation of the OPD began in May 2003. Since that date 25 of these instruments have been deployed on a variety of autonomous underwater vehicles, buoys, piers, channel markers and boats and ships. It has been utilized in HAB monitoring efforts in the Gulf of Mexico and the Great Lakes, and in phytoplankton community structure studies in the Galapagos Islands and the Mediterranean Sea. Most recently, it has been deployed to Veracruz, Mexico where installation was delayed by hurricane Karl. This presentation will detail the OPD’s capabilities and report results from a two-year evaluation of it’s effectiveness at identifying the HAB species Karenia brevis. Additionally, the ongoing effort to effectively visualize 4-D community structure will be discussed.

Klausmeier, C. A., Michigan State University, Hickory Corners, USA, klausme1@msu.edu
Litchman, E. G., Michigan State University, Hickory Corners, USA, litchman@msu.edu

MODELING PLANKTON SEASONAL SUCCESSION

Each year, the plankton communities of temperate waters receive a major perturbation: winter. The cold temperatures and low light levels due to deep mixing or snow-covered ice reset the communities, clearing the way for a cavalcade of species blooms and replacements called seasonal succession. This topic has occupied plankton ecologists for decades, culminating in a verbal model called the PEG-model, which describes seasonal succession in 24 steps. While the PEG-model summarizes common successional patterns, such as a spring phytoplankton bloom, followed by a clear-water phase due to grazers, followed by summer dominance of inedible phytoplankton. It can also suggest other less intuitive dynamics, such as a spring bloom of inedible phytoplankton or year-to-year variability even under identical abiotic conditions. This approach lets us predict how successional trajectories differ between lakes and will respond to human-induced changes in environmental parameters.

Klein, A. M., University of Texas at Arlington, Arlington, USA, april.klein@mavs.uta.edu
Wilson, W. H., Bigelow Laboratory for Ocean Sciences, Boothbay Harbor, USA, wwilson@bigelow.org
Martinez Martinez, J., Bigelow Laboratory for Ocean Sciences, Boothbay Harbor, USA, jmm1@bigelow.org
Gilg, L. Bigelow Laboratory for Ocean Sciences, Boothbay Harbor, USA

MARINE VIRUSES: A STUDY ON HOST-VIRUS RESPONSE TO ELEVATED LEVELS OF CO2

The coccolithophore Emiliania huxleyi is a globally significant phytoplankton which is commonly infected by the coccolithovirus EhV, often resulting in large scale mortality of E. huxleyi blooms. Rising concentration of atmospheric CO2 causes a decrease in ocean pH levels, termed ocean acidification (OA), and the effects of OA on this host-virus relationship are poorly understood. We tested the hypothesis that elevating the CO2 concentration of seawater samples collected during a coccolithophore-dominated bloom would result in detectable changes in the genetic composition of the host (E. huxleyi) and virus (EhV) populations. Seawater samples were collected during a bloom off the coast of Argentina and incubated with various CO2 levels representing present-day through predicted future scenario concentrations. PCR and denaturation gradient gel electrophoresis (DGGE) were used to identify CO2 induced changes in the genetic structure of the virus-host populations. CO2 had an effect on the genetic composition as some genotypes were present only at low CO2 and others present only at high CO2. These results have implications for the role of OA on the dynamics of a globally important primary producer.

Klingensmith, J., Stony Brook University School of Marine and Atmospheric Sciences, Stony Brook, USA, jki@alfred.edu
Aller, R. C., Stony Brook University School of Marine and Atmospheric Sciences, Stony Brook, USA
Zhu, Q., Stony Brook University School of Marine and Atmospheric Sciences, Stony Brook, USA

DIAGENETIC CYCLING OF SI IN SHALLOW WATER CARBONATE DEPOSITS: ROLE OF SEAGRASS, MANGROVES, AND BIODIVERSITY

Silica cycling in shallow water carbonate sediments is potentially strongly regulated by seagrasses (Thalassia, Syringodium), and benthic macrofauna. Sampling sites within ray feeding pits, seagrass beds, and mangrove prop roots off the southeast tip of South Bimini, Bahamas revealed low dissolved Si and biogenic Si, with ranges (upper ~ 15 cm) of ~ 10 – 200 µM (seagrass bed average ~ 10 µM) and 5 – 35 µmol Si/g respectively. Ammonification rates (high) and silica dissolution rates attenuated sharply with depth, supporting net production fluxes of 4.6 – 8.8 mmol N/m²/d and 0.6 – 0.8 mmol Si/m²/d (10 – 15 cm; T = 28°C). Solute and solid phase concentration distributions are consistent with a subsurface transport sink at ~ 5 to 10 cm, and rapid recycling of Si within the surface litter and root zone (dissolved Si turnover times ~ 1.5 – 2 days in seagrass beds). Planar optode measurements of O₂ distributions revealed dynamic rhizosphere interactions with subsurface deposits consistent with the intense recycling of Si. Si may be an important limiting nutrient governing seagrass and mangrove production in carbonate systems.

Klang, J. L., Fairfield University, Fairfield, USA, jklugg@fairfield.edu

THE LAKE LILLINONAH PARTNERSHIP: A CASE STUDY OF A COLLABORATION BETWEEN A LIMNOLOGIST AND A LOCAL NON-PROFIT ORGANIZATION

Scientists have numerous options when it comes to choosing activities to broaden the impact of their science. The right option for an individual scientist depends on personal style, professional situation and objectives for the interaction. I’ll describe the approach I’ve taken as a faculty member at a primarily undergraduate university that values public outreach. I study algal blooms in Lake Lillinonah, a eutrophic reservoir on the Housatonic River in Connecticut, USA. As part of my research program, I collaborate with a local non-profit organization, Friends of the Lake (FOTL). FOTL citizen scientists collect data from their docks as part a long-term study looking at spatial and temporal variability in algal blooms. The success of that program led to funding for a sensor based water quality monitoring system that we deployed last spring. We’ve partnered with the Global Lakes Ecological Observatory Network (GLEON) which ties citizen scientists in Connecticut with scientists all over the world. Although challenging at times, I have found these projects to be both personally and professionally rewarding. The collaboration is also viewed positively by members of FOTL.
LIPID BIOMARKERS AND MECHANISMS OF CELLULAR STRESS IN THERMAL STRESS.

Hughen, K. A., Woods Hole Oceanographic Institution, Woods Hole, MA, USA, Sohms,h@whoi.edu
Ossolinski, J. E., Woods Hole Oceanographic Institution, Woods Hole, MA, USA, jcervino@whoi.edu
Kneeland, J. M., Woods Hole Oceanographic Institution, Woods Hole, MA, USA, jkneeland@whoi.edu
Capone, D. G., Department of Marine and Environmental Biology, University of Southern California, Los Angeles, USA, capone@usc.edu
Bvanmooy@whoi.edu
Jcervino@whoi.edu
Jkneeland@whoi.edu
Sufficient P is available.

Bonnet, S., Laboratoire d’Océanographie Physique et Biogéochimique - IRD - Faculté des Sciences de Luminy, Marseille, France, Sophie.BONNET@univmed.fr
Dekaezemacker, J., Laboratoire d’Océanographie Physique et Biogéochimique - IRD - Faculté des Sciences de Luminy, Marseille, France, Julien.DEKÆZEMACKER@univmed.fr

SENSITIVITY OF TRICHODESMIUM AND CROCOSPHAERA SPP. GROWTH AND N2 FIXATION RATES TO MACRO NUTRIENT VARIATION IN BATCH CULTURES
Trace metal replete batch cultures of Trichodesmium and Crocosphaera spp. were acclimated and grown under different, environmentally relevant, N and P concentrations and ratios to evaluate changes in growth and N2 fixation rates. Initial nitrate-phosphate concentrations in μM and ratios (N:P ratio) included: 0.0:0.5 (0), 5.0:1.0 (5), 8.0:0.5 (16), and 16.0:1.0 (16). The trend in N2 fixation rates for Trichodesmium spp. treatments was 0.0:0.5 > 5.0:1.0 > 16.0:1.0 > 8.0:0.5, and all were different from each other (p < 0.05). N2 fixation rates in Crocosphaera spp. treatments did not vary as much, but rates in the 0.0:0.5 treatment were higher (p < 0.05) than the 8.0:0.5 treatment. Growth rates for both diazotrophs were higher in cultures with 1 μM P than 0.5 μM P (p < 0.001), suggesting limitation at 0.5 μM P. Both diazotrophs continued to fix N2 in the presence of nitrate, but at 0.5 and 1.0 μM P concentrations, nitrate reduced, but did not stop, N2 fixation. These results imply that N2 fixation may occur at significant rates in N-rich environments when sufficient P is available.

ALLOMERIC AMPLIFICATION AND DIVERGENCE IN SYMBIONT GENOMES OF THE ORANGE-CLAWED CORAL Fungia protensa.

Knapp, A. N., University of Miami, RSMAS, Miami, USA, aknapp@rsmas.miami.edu
Dekaezemacker, J., Laboratoire d’Océanographie Physique et Biogéochimique - IRD - Faculté des Sciences de Luminy, Marseille, France, Julien.DEKÆZEMACKER@univmed.fr
Bonnet, S., Laboratoire d’Océanographie Physique et Biogéochimique - IRD - Faculté des Sciences de Luminy, Marseille, France, Sophie.BONNET@univmed.fr
Sohm, J. A., Department of Marine and Environmental Biology, University of Southern California, Los Angeles, USA, sohm@usc.edu
Capone, D. G., Department of Marine and Environmental Biology, University of Southern California, Los Angeles, USA, capone@usc.edu

RNA SEQUENCING OF MARINE PLANKTON DNA FOR ESTIMATION OF CARBON, NITROGEN, AND PHOSPHORUS BURIAL IN SMALL ARTIFICIAL IMPoundMENTS

Knutsen, H., Aarhus University/NERI, Roskilde, Denmark, hkn@umu.dk
Markager, S., Aarhus University/NERI, Roskilde, Denmark, markager@umu.dk
Søndergaard, M., University of Copenhagen/Freshwater Biological Laboratory, Hillerød, Denmark, msøndergaard@Bio.ku.dk

Bioavailability of Autochthonous Dissolved Organic Nitrogen in Marine Plankton Communities
The purpose of this study was to investigate the bioavailability of dissolved organic nitrogen (DON) produced during a phytoplankton bloom. The experiments were conducted with natural plankton communities as batch growth experiments over approximately 30 days with nitrogen limitation. Five to six times during the exponential and stationary phases of each experimental bloom the bioavailability of DON was measured over 60 days together with DOC and oxygen consumption. The overall aim was to quantify remineralization of the added nitrate. The results showed that maximum 33 % of the added nitrate was remineralized, and with large variation during different growth phases. In contrast natural samples had a steady release of DIN. The CN ratio in DOM was crucial to whether or not a release of DIN was detected. The results showed that a CN ratio below 17 in DON was essential for a subsequent release of DIN. Otherwise nitrogen was retained in the bacterial biomass. We hypothesize that photochemistry and grazing may increase mineralization of DON in shallow ecosystems.

Spatial Connectivity Over a Climatic Gradient in the Cork-Wing Wrasse

Knutsen, H., Institute of Marine Research, Arendal, Norway, halvor.knutsen@imr.no
Jorde, P. E., University of Oslo, Oslo, Norway, p.e.jorde@bio.uio.no

Spatial population structure and connectivity was studied in the Corkwing wrasse (Symphodus melops) by means of microsatellite DNA screenings. Samples along a transect from southern Portugal to Norway revealed marked genetic structure with significantly higher levels of genetic variation in the southern region (Portugal and southwestern UK) as compared to north (Norway and Sweden). On smaller geographical scales, we observe genetic differentiation among sample sites within both the southern and northern regions, suggesting local populations with limited connectivity among them. Findings of significant population structuring in the wrasse at small geographical scale are already providing useful input to fisheries management in Norwegian waters, where wrasses currently are translocated to other parts of the country as biological vectors against salmonid parasites in marine fish farms.

Photoheterotrophic metabolism and carbon utilization in aerobic anoxygenic phototrophs

Knoll, L. B., Miami University, Oxford, USA, knolllb@muohio.edu
Vann, M. J., Miami University, Oxford, USA, vannmj@muohio.edu
Renwick, W. H., Miami University, Oxford, USA, renwickwh@muohio.edu
Kollie, S., Rutgers University, USA

Local burial of carbon, nitrogen, and phosphorus in small artificial impoundments

Knoll, L. B., Miami University, Oxford, USA, knolllb@muohio.edu
Vann, M. J., Miami University, Oxford, USA, vannmj@muohio.edu
Renwick, W. H., Miami University, Oxford, USA, renwickwh@muohio.edu
Kollie, S., Rutgers University, USA

Local burial of carbon, nitrogen, and phosphorus in small artificial impoundments, in particular small impoundments, are thought to have very high OC burial rates and represent a large proportion of global OC buried by inland waters. However, few studies have actually quantified OC burial rates in small impoundments and estimates exhibit large variation. Even less is known about nitrogen and phosphorus burial rates, and the ratios at which carbon and nutrients are buried in these ecosystems. This is surprising given that larger impoundments are a known nitrogen sink. We quantified OC and nutrient burial rates in impoundments found in Ohio, USA. Among impoundments, burial rates were relatively similar for each element (mean: 247-OC, 33-N, and 7-P, g/m2/y). CN ratios were above 10 in some impoundments, suggesting a terrestrial contribution. Using burial rates from the impoundments and previously published work, annual global burial estimates are quantified. Results suggest that these small, artificial systems can play a disproportionately large role in burying carbon and nutrients.

Microsatellite analysis of the WING WRASSE

Knutsen, H., Institute of Marine Research, Arendal, Norway, halvor.knutsen@imr.no
Jorde, P. E., University of Oslo, Oslo, Norway, p.e.jorde@bio.uio.no

Spatial Connectivity Over a Climatic Gradient in the Cork-Wing Wrasse

Knutsen, H., Institute of Marine Research, Arendal, Norway, halvor.knutsen@imr.no
Jorde, P. E., University of Oslo, Oslo, Norway, p.e.jorde@bio.uio.no

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Kobližek, M., Institute of Microbiology CAS, Trebon, Czech Republic, koblizek@alga.cz

Aerobic anoxygenic phototrophs are only recently discovered group of marine aerobic anoxygenic phototrophs. They contain bacteriochlorophyll reaction centers and perform photoheterotrophic metabolism. We investigated the efficiency of their carbon metabolism in carbon-limited chemostat cultures using different substrates and light regimes. When grown in the dark these bacteria converted about 25% of the supplied carbon into their biomass. Under light-dark cycle the bacterial growth efficiency increased up to 50%. The interplay of respiration and photosynthesis was further investigated by oxygen consumption measurements and infra-red kinetic fluorometry. The results showed that exposure to light strongly inhibited the respira-
tion as it was replaced by light-derived energy. The enhanced efficiency of carbon utilization (bacterial growth efficiency) in aerobic anoxygenic phototrophs might be an important factor in tropical regions of the world ocean, which are generally considered as carbon sinks.

Koester, J. A., University of Washington, School of Oceanography, Seattle, USA, koester@uw.edu

Armbrust, E. V., University of Washington, School of Oceanography, Seattle, USA, armbrust@uw.edu

DARWINIAN SELECTION IS MOST EVIDENT IN CLOSELY RELATED DIA-TOM SPECIES

Darwinian selection acts on individual phytoplankters to affect adaption to changing environmental conditions. The metric of positive (Darwinian) selection for individual genes is the ratio of amino acid changing mutations (dN) to silent mutations (dS); a dNdS greater than one indicates positive selection. Genome (and transcriptome) wide pair-wise comparisons of three diatom genera were made, testing the phylogenetic distance at which positive selection can be detected. Positive selection was indicated for 19% of the 11,355 genes pairs of two strains of Thalassiosira pseudonana. Seventy-nine pair-wise comparisons of three diatom genera were made, testing the phylogenetic distance at which positive selection can be detected. Positive selection was indicated for 19% of the 11,355 genes pairs of two strains of Thalassiosira pseudonana. Seventy-five of those genes had a dNdS statistically greater than one. Ditylum brightwellii was represented by a species differentiated by genome size; 10% of the genes had a dNdS greater than one, but none were supported statistically. Fewer genes had a signal of positive selection in the more distantly related Pseudo-nitzschia species. Even though the majority of genes under positive selection have hypothetical or unknown function, these genes are actively influencing the adaptive survivorship of their species. The identification of these genes provides a target to link environmental selective pressures with the genetic mechanism of adaptation.

Koever, W., IFM-GEOMAR, Kiel, Germany, wkoeve@ifm-geomar.de

Kim, H. C., Pohang University of Science and Technology, Pohang, Republic Of Korea Lee, K., Pohang University of Science and Technology, Pohang, Republic Of Korea, ktdj@postech.ac.kr

Ochles, A., IFM-GEOMAR, Kiel, Germany

COMPUTATION OF FCO2 AND THE CONCENTRATION OF CARBONATE IONS AND THE POTENTIAL ROLE OF DOM ACCUMULATION IN OCEAN ACIDIFICATION EXPERIMENTS

The consistency of measurements and computations of components of the CO2-system (alkalinity (A), dissolved carbon dioxide (C), CO2, and pH) has been confirmed repeatedly in open ocean studies, with, e.g. ΔICO2 (ΔICO2 = ICO2meas - ICO2cal, cts) / ICO2meas < 100% below 5%. Recently, Hoppé et al. (2010, Biogesosciences Discussions) provided evidence of significantly larger ΔICO2 in experimental setups. Using high quality measurements from phytoplankton culture and mesocosm experiments, we provide further examples where ΔICO2 is up to 40%. ΔICO2 varied systematically during the course of the experiments. In one set of experiments a clear correlation with the accumulation of dissolved organic carbon (DOC) is evident. Culture and mesocosm experiments are often carried out under high initial nutrient concentrations, supporting elevated biomass and often a substantial build-up of DOC, being significantly larger than observed in the open ocean. To the extent that DOC includes organic acids and bases, it contributes to the alkalinity of seawater contained in the experimental device. We suggest that whenever substantial amounts of DOC are produced during experiments, computer programs used to compute CO2 fugacity may underestimate it significantly.

Koelor, A. S., University of Nebraska at Omaha, Omaha, USA, akoelor@unomaha.edu

Sellin, M. K., Miami University, Oxford, USA, msellin@muohio.edu

SEDIMENTS FROM AGRICULTURALLY INTENSIVE WATERSHEDS DEFEMINIZE FEMALE FISH VIA ANTI-ESTROGENIC ACTIVITY.

Agricultural watersheds can contain mixtures of herbicides, insecticides and veterinary pharmaceuticals. In eastern Nebraska, the primary crops are corn and soybeans, whereas the primary livestock are beef cattle. In two watersheds in this locale, the Elkhorn River and Bow Creek, caged female fathead minnows consistently experience defeminization, as indicated by significant reductions in the expression of estrogen-responsive genes. Furthermore, this defeminization can be reliably duplicated in the laboratory. Interestingly for both watersheds, the defeminization occurs when the fish are exposed to field sediments, but not when they are exposed to the overlying water. The causative compounds responsible for the observed defeminization remain unidentified, and in fact, may differ between the two watersheds. However, recent experiments, using a modified yeast estrogen screen, have found that sediment extracts from the Bow Creek watershed are anti-estrogenic. Results from field and laboratory exposures reveal a novel source of anti-estrogenic activity: sediments from agriculturally intensive watersheds.

Krokol, A. S., University of Nebraska at Omaha, Omaha, USA, akolok@unomaha.edu

Kroek, B., Åbo Akademi University, Turku, Finland, Boris.Koch@awi.de

LINKING MICROBIAL COMMUNITIES AND ENVIRONMENTAL CONTROLS IN THE ATLANTIC OCEAN: RECONSIDERING ECOLOGICAL BIOGEOGRAPHY

In oceanic systems, relatively little is known about linkages between the diversity and composition of complex microbial communities, their biogeochemical functions and environmental controls. Our multidisciplinary study characterized various provinces along an Atlantic meridional transect for both biogeochemical parameters and microbial community structure. Microbial samples were obtained from 75 locations and depths via sequential filtration, which separated eukaryotic (3-µm) and prokaryotic (0.2-3 µm) fractions. Terminal restriction fragment length polymorphism analysis was used to determine the microbial diversity and community composition of these fractions. Bacterial production (BP) was measured at each location via the 3H-Leucine method. BP varied significantly across the meridional transect and was positively correlated with temperature, Chl a and dissolved organic carbon (DOC) concentrations during the old age of DOC in the photic zone (2040-3770 BP).

Further relationships are being explored between bacterial community composition, environmental parameters (temperature, salinity, Chl a), nutrient cycles (nitrogen, silica, phosphorous) and carbon processing (BP, DOC) across the biogeochemical provinces. Ultimately, our work will assess how microbial community composition may be associated with changes in the DOC pool and microbial carbon processing.

Kortelainen, P., Finnish Environment Institute, Helsinki, Finland, pickko.kortelainen@ymapristo.fi

Rantakari, M., Finnish Forest Research Institute, Vantaa, Finland, miitta.rantakari@metla.fi

Pajunen, H., Geological Survey of Finland, Kuopio, Finland, hannu.pajunen@gsf.fi

Huttunen, T., University of Kuopio, Kuopio, Finland

Alm, J., Finnish Forest Research Institute, Joensuu, Finland, jukka.alm@metla.fi

Juutinen, S., University of Helsinki, Helsinki, Finland, sari.juutinen@helsinki.fi

Larmola, T., University of Helsinki, Helsinki, Finland, tuula.larmola@helsinki.fi
Silvola, J., University of Joensuu, Joensuu, Finland
Martikainen, P. J., University of Kuopio, Kuopio, Finland, pertti.martikainen@uku.fi
CARBON EVASION/ACCUMULATION IN RANDOMLY SELECTED BOREAL LAKES
Lakes in the boreal zone are predominantly net heterotrophic, evading terrestrially fixed C into the atmosphere and burying organic carbon in sediments. There are 160,000 lakes larger than one hectare in Finland, covering 10% of the country’s total area. Subpopulations of 177 and 122 lakes, covering the entire country, were randomly selected from the Nordic Lake Survey database for carbon gas and sediment C stock studies, respectively. Land use of the surrounding catchments and water quality (4 seasons, 4 depths) were determined for each lake. These data sets demonstrate that lakes are important conduits for transferring terrestrially fixed C into the atmosphere. Lake water chemistry and carbon pools and fluxes reflected topography, land use, climate and atmospheric deposition. Both CO2 concentrations and Holocene C stocks in the sediments were highest in small, shallow lakes. These randomly selected lakes cover a wide climatic gradient and represent typical land use in the boreal zone, enabling us to compare the impacts of climate and land use on lake water chemistry, ecosystem C balances and landscape C sequestration in the boreal zone.

Korth, F., Leibniz Institute for Baltic Sea Research, Rostock, Germany, frederike.korth@io-warnemuende.de
Liskow, I., Leibniz Institute for Baltic Sea Research, Rostock, Germany, iris.liskow@io-warnemuende.de
Voss, M., Leibniz Institute for Baltic Sea Research, Rostock, Germany, maren.voss@io-warnemuende.de
UPTAKE OF DISSOLVED ORGANIC NITROGEN BY HETEROTROPHIC BACTERIA AND PHYTOPLANKTON ALONG A SALINITY GRADIENT FROM THE NORTH SEA TO THE BALTIC SEA
The Baltic Sea is known for its ecological problems due to eutrophication which can be clearly linked to the input of inorganic nutrients. Studies on the bioavailability of dissolved organic nitrogen (DON) have been rare in the Baltic Sea although DON is thought to contribute significantly to marine eutrophication. DON-labeled algal and crop extract were obtained from Skeletonema costatum and Brussica napus, respectively. These extracts were used to investigate uptake rates of DON by heterotrophic bacteria and phytoplankton in surface waters along a salinity gradient from 2 to 34 PSU in August/September 2009. Both labeled DON sources were exploited by heterotrophic bacteria and phytoplankton with higher rates in the Baltic Sea (0.4±0.3 µM N h⁻¹) than in the North Sea (0.1±0.1 µM N h⁻¹). The DON extract derived from algal was the dominant N form used by phytoplankton, whereas for heterotrophic bacteria the preferred substrate was the crop extract. These findings indicate that DON can be an important contributor to eutrophication in the Baltic Sea when inorganic nitrogen is depleted.

Kosaki, R. K., NOAA Papahanaumoukua Marine National Monument, Honolulu, HI, USA, randall.kosaki@noaa.gov
Kane, C., Division of Aquatic Resources, State of Hawaii Department of Land and Natural Resources, Honolulu, HI, corinne.kane@hawaii.gov
Pyke, R. L., B.P. Bishop Museum, Honolulu, HI, USA, deepreef@bishopmuseum.org
Boland, R., NOAA Pacific Islands Fisheries Science Center, Honolulu, HI, USA, raymond.boland@noaa.gov
McFall, G., NOAA Gray’s Reef National Marine Sanctuary, Savannah, GA, USA, gleason, K., NOAA Papahanaumoukua Marine National Monument, Honolulu, HI, USA, kelly.gleason@noaa.gov
ENDEMIC FISHES DOMINATE MESOPHOTIC CORAL ECOSYSTEMS IN THE NORTHWESTERN HAWAIIAN ISLANDS
Endemic species are significant contributors to the diversity of their respective geographic regions and hence are the foci of many preservation efforts in both marine and terrestrial systems. In coral reef systems, endemic reef fish typically comprise a small portion of the total species richness but are major determinants of global conservation and biodiversity hotspots. We report on the discovery of extraordinary levels of endemism in fish assemblages of mesophotic coral reef ecosystems (MCEs; 30-150 meters) in the Northwestern Hawaiian Islands. Initial presence/absence observations of reef fish at mesophotic depths in the NWHI revealed 45% endemism, twice that recorded in shallow waters of the same region (20.6%), or in any other marine ecosystem globally. Levels of reef fish endemism varied significantly along a latitudinal gradient, increasing from 21% of species present at the southernmost islands to 82% at the northernmost atolls. Numerical abundances of endemic fishes exceeded 90% at the northernmost atolls. These findings indicate that deep coral reefs represent significant repositories of endemism and biodiversity, and present a new focus for marine conservation efforts.

Kosak, C. R., University of Wisconsin-Milwaukee, Milwaukee, USA, crkossak@uw.edu
Sandgren, C. D., University of Wisconsin-Milwaukee, Milwaukee, USA, sandgren@uw.edu
Berges, J. A., University of Wisconsin-Milwaukee, Milwaukee, USA, berges@uw.edu
BETHIC RECRUITMENT AND PHYSIOLOGICAL CELL DEATH IN NATURAL COMMUNITIES OF FRESHWATER PHYTOPLANKTON
Benthic recruitment and physiological cell death have usually been neglected in studies on phytoplankton dynamics in favor of: in situ birth rates, sedimentation and herbivore-mediated mortality. Yet, recruitment and cell death have been shown to be significant factors when they have been the focus of published studies. The current project examines separately the contribution of these factors to seasonal dynamics of freshwater phytoplankton. Recruitment flux estimated from downstream-facing traps deployed just above the sediments at a gradient of water depths was compared to water column standing crop measured as chlorophyll. Data were obtained during the summers of 1996 and 1997 from Peter, Paul, East Long, and West Long Lakes at the University of Notre Dame Environmental Research Center in association with the Trophic CASCADE Project. Subsequent analysis of benthic recruitment contributions to species dynamics is planned using trap and water column preserved samples. The importance of physiological cell death in population dynamics was examined in an urban pond using the fluorescent stains Sytox and Annexin V coupled with epifluorescence microscopy. Additionally, community physiological condition was tracked as CNEP stoichiometry.

Kraberg, A. C., Biological Station Helgoland, Alfred Wegener Institute for Polar and Marine Research, Helgoland, Germany, Alexandra.Kraberg@gawi.de
Loeder, M., Biological Station Helgoland, Alfred Wegener Institute for Polar and Marine Research, Helgoland, Germany, Martin.Loeder@gawi.de
Shchekinova, E., Biological Station Helgoland, Alfred Wegener Institute for Polar and Marine Research, Helgoland, Germany, Elena.Shchekinova@gawi.de
Wilshire, K. H., Biological Station Helgoland, Alfred Wegener Institute for Polar and Marine Research, Helgoland, Germany, Karen.Wilshire@gawi.de
THE IMPORTANCE OF DIATOM RESTING STAGES AS A DETERMINANT OF PHYTOPLANKTON BLOOM DYNAMICS AT THE HELGOLAND ROADS LONG-TERM MONITORING STATION
Routine phytoplankton monitoring has been carried out at the Helgoland Roads long-term station for 45 years. The resulting data set has been used for intensive analyses of spring bloom dynamics, particularly with respect to the seasonal and long-term dynamics of the diatom community. However, the abundance of life-cycle stages (resting spores) has so far been neglected as a separate component of the phytoplankton counts and the relative importance of diatom life-cycle characteristics in determining bloom timing is therefore unknown. We here report results of a mesocosm study and field data (complementing the Helgoland Roads data set) in which for the first time diatom resting stages were enumerated along with their vegetative stages. The main resting stage forming diatom species, particularly of the genera Chaetocorps and Thalassiosira will be described in relation to physical and chemical parameters (temperature, salinity, inorganic nutrients). Their possible importance in determining the beginning and/or end of a bloom as opposed to other biotic factors such as grazing will be outlined and implications of incorporating these life-cycle characteristics into foodweb models will be discussed.

Kremer, C. T., Michigan State University, Kellogg Biological Station, Hickory Corners, USA, kremerc@msu.edu
Klausmeier, C. A., Michigan State University, Kellogg Biological Station, Hickory Corners, USA, klausme1@msu.edu
Kremer, C. T., Michigan State University, Kellogg Biological Station, Hickory Corners, USA, kremerc@msu.edu
Litchman, E., Michigan State University, Kellogg Biological Station, Hickory Corners, USA, litchman@msu.edu
DETECTING THE ROLE OF RESOURCE COMPETITION IN DRIVING NITROGEN-FIXING CYANOBACTERIA BLOOMS: A MECHANISTIC APPROACH
Nitrogen fixing cyanobacteria occur ubiquitously in lakes and sometimes form large, harmful blooms. Because these blooms can dramatically change the ecological dynamics of lakes it is important to understand the mechanisms underlying their origin and maintenance. Hypotheses involving competition for nitrogen and phosphorus predominate. In particular, the capacity for N-fixation and generally poor P competitive ability lead to predictions that cyanobacteria will dominate only at low
N.P. Previous analyses rely primarily on regression-based statistical models to detect patterns consistent with theory, rather than testing theory directly with mechanistic models. We develop methods to predict cyanobacteria relative abundances from resource competition models, while accounting for zero-inflation and incorporating environmental covariates. We apply this approach to data from 543 lakes collected during the US EPA National Eutrophication Survey (1973). Considering zero-inflation allows us to draw conclusions regarding the role of environmental filtering in this system, particularly with respect to latitude, temperature and Secchi depth. Overall, we find significant support for resource competition models. These results simultaneously provide a test of competition theory and insights into the nutrient regulation of harmful cyanobacteria blooms.

Kress, N., Israel Oceanographic & Limnological Res, National Institute of Oceanography, Haifa, Israel, nurit@ocean.org.il
Dromi, D., The Porter School of Environmental Studied, Tel Aviv University, Tel Aviv, Israel, dorokdi@gmail.com
Yacobi, Y. Z., Israel Oceanographic and Limnological Research, Kinneret Limnological Laboratory, Tiberias, Israel, yyzi@ocean.org.il
Stambler, N., Mina & Everard Goodman Faculty of Life Sciences, Bar Ilan University, Ramat Gan, Israel, stambni@mail.biu.ac.il

THE EFFECT OF A REVERSE OSMOSIS SEAWATER DESALINATION PLANT ON THE MARINE ENVIRONMENT: A FIELD STUDY AT THE ISRAELI MEDITERRANEAN COAST

Global production of freshwater by desalination quadrupled in the last 15 years. In Israel, seawater reverse osmosis SWRO produces about 17 % of the country’s water demand and is expected to provide 30% by 2020. While desalination technology is extensively described, little is known of its effects on the marine environment, hindering decision making on a regional scale. The Ashkelon SWRO plant discharges brine and backwash of the pre-treatment filters containing brine hydroxide coagulant at the seashore, next to the cooling waters of a power plant. The mixture of the brine with cooling waters was saltier and warmer than the background, positively buoyant, and dispersed at the surface. Chlorophyll-a concentration and picoplankton cells decreased with increased salinity and temperature. Primary production decreased with increased temperature, and no consistent trend was observed in bacterial production. The pulsed backwash discharge decreased seawater temperature and increased salinity, turbidity, absorption at 440 nm and tinted the seawater red allowing its visual tracking. It further decreased chlorophyll-a, cell numbers and primary production and changed the relative contribution of the picoplankton groups.

Kristofco, L., Allegheny College, Meadville, USA, kristol@allegheny.edu
Maranda, L., Graduate School of Oceanography, University of Rhode Island, Narragansett, USA, imaranda@geo.uri.edu

ULVA SPORE ADHESION ON TREATED OPTICALLY CLEAR SURFACES

Fouling organisms impairs the function of wetted surfaces. A broad-spectrum, reliably successful, and non-toxic, anti-fouling surface treatment is especially needed for optically clear substrates. The goal of this project was to evaluate three proprietary coatings (A, B, and D) for their capacity to deter fouling by Ulva linza. The anti-fouling surface coatings under investigation were not significantly different from those on the control, and spore density on A and D were not significantly different from those on the control, and spore density on B was greater than that on C.

Kritzberg, E. S., Lunds Universitet, Lund, Sweden, emma.kritzberg@limnol.lu.se
Ekström, S., Lunds Universitet, Lund, Sweden, emma.kritzberg@limnol.lu.se

INCREASING CONCENTRATIONS OF IRON IN SWEDISH INLAND AND COASTAL WATERS – RELATION TO CHANGES IN WATER FLOW

Changes in water flow are often held as a factor behind the brownification of surface waters seen in many regions of the Northern hemisphere. The brownification is generally ascribed to increasing concentrations of dissolved organic matter originating from the terrestrial surrounding. However, in many lakes and running waters in Sweden iron concentration increases significantly more than organic matter and is often a better predictor of watercolor. When comparing the increase in watercolor following experimental additions of iron to natural waters, to the in situ relationships between watercolor and iron, one finds that iron alone is a potentially important component behind recorded trends in watercolor. Increasing iron concentrations have implications not only for watercolor (which acts as a forcing factor on structure and function of aquatic communities) but also for the cycling of carbon, nitrogen and phosphorus, as these biochemical cycles are tightly connected to iron. This study addresses the relationship between water flow, iron concentrations and brownification.

Kroeker, K. J., Stanford University, Pacific Grove, USA, kkroeker@stanford.edu
Kordas, R. L., University of British Columbia, Vancouver, Canada, kordas@zoology.ubc.ca
Crim, R. N., University of British Columbia, Vancouver, Canada
Singh, G. G., University of British Columbia, Vancouver, Canada

QUANTIFYING THE VARIATION IN BIOLOGICAL RESPONSES TO OCEAN ACIDIFICATION

Ocean acidification could affect many marine organisms and cause profound ecological shifts. The biological responses to ocean acidification have been measured across a range of taxa, but this information exists as case studies and has not been synthesized into comparisons among functional groups or communities. We used meta-analyses to explore variation in biological responses to ocean acidification, and found significant variation in the sensitivity of marine organisms. Calculating organisms generally exhibited larger negative responses than non-calculating organisms across numerous response variables, with the exception of crustaceans. Calcification varied significantly among organisms using different mineral forms of calcium carbonate. Organisms using the more soluble form of calcium carbonate (high-magnesium calcite) can be more resilient to ocean acidification than less soluble forms (calcite and aragonite). Additionally, there was variation in the sensitivities of life-history stages, but this was dependent on the taxonomic group. The results from the meta-analyses are generally supported by the responses of in-situ benthic marine communities surrounding naturally-occurring volcanic CO2 vents, which show similar variation in sensitivity. Our meta-analyses and field studies suggest the biological effects of ocean acidification are generally large and negative, but the variation in sensitivity among organisms has important implications for ecosystem responses.

Kubanek, J., Tjärno Marine Biological Laboratory, University of Gothenburg and Georgia Institute of Technology, Atlanta, USA, julia.kubanek@biology.gatech.edu
Selander, E., Tjärno Marine Biological Laboratory, University of Gothenburg and Technical University of Denmark, Copenhagen, Denmark
Cervin, G., Tjärno Marine Biological Laboratory, University of Gothenburg, Department of Marine Ecology, Strömstad, Sweden
Pavia, H., Tjärno Marine Biological Laboratory, University of Gothenburg, Department of Marine Ecology, Strömstad, Sweden

DINOFLAGELLATE TOXIN PRODUCTION IS INDUCED BY SPECIES-SPECIFIC COEPOD CUES

Dinoflagellates of the genus Alexandrium are chemically defended against copepod grazing, with saxitoxin-related molecules implicated in decreased copepod feeding rates and reduced copepod fitness following consumption. In previous work, Selander and co-workers showed that waterborne cues from several copepod species induced Alexandrium toxin production, increasing cellular toxin concentrations up to 25-fold. Herein, we present evidence that Alexandrium minutum responds to different waterborne chemical cues from different copepod species. These chemical cues consist of blends of low molecular weight organic compounds that are stable to handling but exuded by copepods at exceedingly low concentrations. We are applying both purification and metabolic profiling approaches towards identification of copepod cues that induce dinoflagellate chemical defenses. The induction of Alexandrium toxins by planktonic grazers could lead to more toxic blooms with possible implications for shellfish toxin accumulation, fish kills, and human health.

Kuehl, S. A., College of William and Mary Virginia Institute of Marine Science, Gloucester Pt., USA, kuehl@vims.edu
Rose, L., College of William and Mary Virginia Institute of Marine Science, Gloucester Pt., USA, llrose@vims.edu
Alexander, C. R., Skidaway Institute of Oceanography, Savannah, USA, clark.alexander@skio.usgs.edu
Orpin, A., National Institute of Water & Atmospheric Research, Wellington, New Zealand, a.orpin@niwa.cri.nz
HOLOCENE AND RECENT EVOLUTION OF THE WAIPAOA MARGIN, NZ – DRAMATIC CHANGES IN SHELF-SLOPE SEDIMENT DISPERSAL PATTERNS FOLLOWING DEFORESTATION

The combination of high sediment yields and the prevalence of tectonically controlled accommodation on collision margins such as that adjacent to the Waipaoa River, NZ, create the potential for these areas to contain high-resolution records of natural and anthropogenic signals. This study describes modern (100-yr) sedimentation patterns off the Waipaoa and quantifies a sediment budget for the continental shelf. This study is compared to long-term Holocene trends. The modern sedimentation patterns seen in this study are similar to those for the Holocene, suggesting that regional tectonics are the major influence on Waipaoa shelf sedimentation. A modern, bulk sediment budget estimates 3.6 ± 0.9 x 106 tons y-1 of sediment remains on the shelf, amounting to only ~25% of the 15 Mt of sediment discharged from the river per year. This indicates massive export of sediment from the study area to the adjacent slope or along the shelf. In contrast, studies of the Mid-Late Holocene sediment budget in the same area indicate that the sediment input and shelf trapping have been roughly in balance. When compared with the modern budget, this suggests an extraordinarily rapid shift from shelf trapping to shelf bypassing, most likely driven by increasing sediment discharge in response to deforestation.

Kuhnz, L. A., Monterey Bay Aquarium Research Institute, Moss Landing, California, USA, linda@mbari.org
Osborn, K. J., Scripps Institution of Oceanography, La Jolla, California, USA, kjosborn@ucsd.edu
Holland, N. D., Scripps Institution of Oceanography, La Jolla, California, USA, nholland@ucsd.edu

DEPTH AND HABITAT DISTRIBUTION OF DEEP-SEA ENTEROPNEUSTS IN THE EASTERN PACIFIC AND HAWAI'I

We reviewed video-annotations of 465 enteropneusts observed using cameras mounted on the Monterey Bay Aquarium Research Institute's Ventana, Tiburon, and Doc Ricketts remotely operated vehicles (ROVs) between March 26, 2000 and August 14, 2010. The geographic range included the Eastern Pacific from Oregon to the Gulf of California, and Hawai'i at an overall depth range of 1,643 to 3,954 m. We identified 11 species from at least six genera. Nine of the species were undescribed. Observed behaviors, habitat associations, and abundance data are presented.

Kujawinski, E. B., WHOI, Woods Hole, USA, ekujawinski@whoi.edu
Longnecker, K., WHOI, Woods Hole, USA, klongnecker@whoi.edu

MOLECULAR-LEVEL CHARACTERIZATION OF DEEP-OCEAN DOM: SIMILARITIES AND DIFFERENCES AMONG GEOGRAPHICAL REGIONS

Dissolved organic matter (DOM) in the deep ocean is one of the largest reservoirs of reduced carbon on Earth, and yet we know little about its molecular-level composition and spatial and temporal dynamics. Taken as a bulk pool, this material is dilute and highly degraded, residing in the deep ocean for thousands of years. However, recent work has suggested that some deepwater DOM is produced (1) by microbial degradation of particulate organic matter (POM) and (2) by free-living bacterial chemosynthesis. To reconcile these results, novel data are required that provide molecular-level links between microbes and dissolved organic matter on various spatial and temporal scales in the deep ocean. As a first step, we have examined deep-water DOM composition with ultra-high resolution mass spectrometry (ESI FT-ICR MS). Here, we compare results from the central Pacific Ocean and the northern and equatorial Atlantic Ocean. We identify components (m/z < 1000) that are retained across these different regions as well as those that are unique to each region. Where possible, we compare shifts in DOM composition with shifts in microbial diversity.

Kutovaya, O. A., Bowling Green State University, Bowling Green, USA, okolga@bgus.edu
Bullerjahn, G. S., Bowling Green State University, Bowling Green, USA, buller@bgus.edu
McKay, R. M., Bowling Green State University, Bowling Green, USA, rmemckay@bgus.edu

EXPRESSION OF PHOSPHORUS ASSIMILATION GENES IN ENDEMIC SYN- ECHOCOCCUS OF THE LAURENTIAN GREAT LAKES

We are examining the genetic potential of picocyanobacteria to recruit different sources of organic phosphorus in both Lake Erie and Lake Superior. The pelagic regions of Lake Superior and eastern Lake Erie are typically P-limited environments, and picocyanobacteria of the genus Synechococcus are the dominant primary producers during the summer. Specifically, we are examining the ability of endemic microbes to assimilate organic phosphates and phosphonates. As a proxy for their utilization of these substrates, we are monitoring the expression of two genes, phnD and phnX. The phnD gene encodes the phosphonate binding protein of the ABC-type phosphonate transporter, whereas the phnX gene encodes a calcium-dependent alkaline phosphatase. We have developed PCR primers to detect the presence of both genes in the endemic picocyanobacteria, and RT-PCR is being used to examine the patterns of expression that serve to assess the degree of P-stress experienced in the phytoplankton. To date, we show that the phnD gene is constitutively expressed, suggesting that freshwater picocyanobacteria are metabolizing exogenous phospho-nate compounds in these severely P-limited environments.

Kvale, K. E., Climate Change Research Centre, University of New South Wales, Sydney, Australia, k.kvale@unsw.edu.au
Matear, R. J., CSIRO Marine and Atmospheric Research, Hobart, Australia
McNeil, B., Climate Change Research Centre, University of New South Wales, Sydney, Australia
Meissner, K., Change Research Centre, University of New South Wales, Sydney, Australia
England, M., Change Research Centre, University of New South Wales, Sydney, Australia

BIOGEOCHEMICAL FEEDBACKS IN A HIGH-CO2 OCEAN

The marine biological response to higher carbon dioxide levels is highly species-dependent. Calcifying organisms are vulnerable to a high CO2 ocean through acidification directly impacting their calcification potential. Non-calcifying organisms however can respond favourably to elevated CO2 levels. Future changes to the oceanic carbonate system are likely to affect ocean carbon storage and ecosystem dynamics. Quantifying the net response of the marine carbon cycle to perturbations in ocean chemistry is hindered by the current structural rigidity of many biogeochemistry-climate models. We include biological dependencies on pCO2 and conduct a parameter sensitivity experiment in a coupled multi-species Biogeochemistry-Atmosphere-Ocean Model, the CSIRO-Mk3L, to establish near-term (next century) vulnerability using IPCC “Representative Concentration Pathways.” We focus the analysis on: 1) the relative success of various parameterizations to capture accepted pre-industrial nutrient distributions, 2) the relative success of these parameterizations in capturing regional and seasonal variability, and 3) quantification of the range of possible change in ocean biogeochemistry (e.g. oxygen levels, calcite and aragonite saturation state, carbon storage) over the coming century.

Kwak, T. J., U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Raleigh, NC, USA, tkwak@ncsu.edu
Cooney, P. B., North Carolina Cooperative Fish and Wildlife Research Unit, Raleigh, NC, USA, pcooney@gmail.com
Buttermore, E. N., North Carolina Cooperative Fish and Wildlife Research Unit, Raleigh, NC, USA, erbutterm@ncsu.edu
Cope, T. W., Department of Environmental and Molecular Toxicology, North Carolina State University, Raleigh, NC, USA, tcop@ncsu.edu
Lazaro, P. R., Department of Environmental and Molecular Toxicology, North Carolina State University, Raleigh, NC, USA, peter_lazaro@ncsu.edu
Shea, D., Departments of Biology and Environmental and Molecular Toxicology, North Carolina State University, Raleigh, NC, USA, dshea@ncsu.edu
Liljestrom, C. G., Puerto Rico Department of Natural and Environmental Resources, San Juan, PR, USA, craig.liljestrom@dma.gobierno.pr

URBANIZATION IMPACTS IN TROPICAL STREAM ECOSYSTEMS: FISH, HABITAT, AND CONTAMINANTS IN PUERTO RICO

Puerto Rico's human population density is among the highest globally, providing a model environment to study the effects of urbanization on tropical aquatic ecosystems. Stream habitat and fish communities integrate streamflow, riparian, and watershed influences and serve as practical indicators of environmental quality. We conducted research in Puerto Rico streams with diverse watershed land use patterns to quantify fish community composition and abundance to model patterns related to physical habitat at multiple spatial scales. We also quantified occurrences of aquatic contaminants (PAHs, pesticides, PCBs, heavy metals) in stream habitat and biota. Our findings revealed clear influences of dams on fish community composition and abundance with no dominant urbanization effect detected, but watershed road density explained occurrence of exotic species. However, we measured elevated concentrations of contaminants in the water, sediment, and fish in urban streams, which may influence stream ecological integrity, aquatic faunal and human health, and designated water uses in urban stream ecosystems. Our findings may provide natural resource managers and water planners the scientific information needed to guide fisheries and ecosystem management and human health risk assessments.
The cross-shelf disintegration of the internal tide and the response of phytoplankton, zooplankton, and macroalgae was measured during the FLOO experiment (Fluxes Linking the Offshore and the Onshore) in Baja California, Mexico, using towed and moored thermistors, current-meters, CTD-ISUS vertical profiles, plankton net casts, and outplants of macroalgae. A strong shoaling of the thermocline, nutricline, and pycnocline, along with a doubling in the concentration of nitrate and chlorophyll fluorescence, occurred in offshore waters. Inshore, a similar abrupt change in temperature, nitrate, vertical meroplankton distribution, and tissue nitrogen of macroalgae occurred within a few hours. This pattern persisted for a full week of strong internal tidal forcing. This study supports the hypothesis that the internal tide can have large consequences in nearshore biology at short time scales (~1hr).

Ladner, S. D., Naval Research Laboratory, Stennis Space Center, USA, Sherwin.Ladner@nrlssc.nasa.gov

deRada, S., Naval Research Laboratory, Stennis Space Center, USA, sergio.derada@nrlssc.nasa.gov

Casey, B., QinetiQ North America Incorporated, Stennis Space Center, USA, Brandon.Casey@nrlssc.nasa.gov

Arnone, R. A., Naval Research Laboratory, Stennis Space Center, USA, arnone@nrlssc.nasa.gov

Jolliff, J., Naval Research Laboratory, Stennis Space Center, USA, jolliff@nrlssc.nasa.gov

ASSESSING THE SPATIAL UNCERTAINTY OF AN EMPERICAL BIO-OPTICAL SYSTEM USING A 3-DIMENSIONAL NUMERICAL MODEL

The 3-Dimensional Optical Generator (3DOG) is an operational system developed at NRL to support Navy MCM operations. 3DOG empirically derives a 3-Dimensional volume of near-shore bio-optical properties by coupling surface satellite measurements, numerical models, and bio-optical glider observations. Coefficients from a series of equations describing physical-optical relationships are optimized using physical parameters (Mixed Layer Depth and Intensity), bio-optical properties (Chlorophyll, Backscattering), and information about the subsurface light field (1% light level, satellite penetration depth) from glider and satellite observations. The optimized set of coefficients and equations are then used to extend the satellite surface bio-optical properties vertically through the water column. We will examine the capability of using a 3-Dimensional numerical bio-optical-physical model in the Northern Gulf of Mexico (deRada, et al.) to assess the skill of the 3DOG system. We assess the effects of increasing and decreasing the number of glider profiles as well as the spatial uncertainties of the derived 3D ecosystem using a standard set of simulated profiles extracted from the numerical model.

Lambert, C., Woods Hole Oceanographic Institution, Woods Hole, MA, USA, clamberg@whoi.edu

Bowman, K., Wright State University, Dayton, OH, USA, bowman.49@wright.edu

Hammerschmidt, C., Wright State University, Dayton, OH, USA, chad.hammerschmidt@wright.edu

MERCURY CONCENTRATION AND SPECIATION FROM THE U.S. GEOTRACES NORTH ATLANTIC OCEAN ZONAL SECTION

We present the results of mercury measurements performed on board of the R/V Knorr from the U.S. GEOTRACES North Atlantic Ocean zonal section. All four of the principal mercury species (elemental, mono- and dimethyl-, and total mercury) were determined in high vertical and horizontal resolution during the cruise. This was made possible by the first large-scale implementation of a new analytical approach for determining methylated mercury species in seawater. In addition, total mercury and monomethylmercury will be determined on subsamples of particulates obtained from in-situ pumps, as well as aerosols and opportunistically collected rainwater.

Lamond, M. E., Trent University, Peterborough, Canada, marishalamond@trentu.ca

Pick, F. R., University of Ottawa, Ottawa, Canada

Buttle, J. M., Trent University, Peterborough, Canada

Pett, E. R., University of Ottawa, Ottawa, Canada

MERIDIAN CONDITIONS AND HIGH FLOW EVENTS

Stormwater ponds are now commonly used as a means to retain and reduce the amount of runoff, sediments, and nutrients flowing into nearby natural water bodies. Nutrient transport through the ponds is influenced by the timing and quantity of water moving into the system. To assess nutrient transport trends through stormwa-

STORMWATER MANAGEMENT PONDS DURING BASEFLOW CONDITIONS AND HIGH FLOW EVENTS

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Pick, F. R., University of Ottawa, Ottawa, Canada

Buttle, J. M., Trent University, Peterborough, Canada

Pett, E. R., University of Ottawa, Ottawa, Canada

ASSESSING THE TRANSPORTATION OF NUTRIENTS THROUGH URBAN STORMWATER MANAGEMENT PONDS DURING BASEFLOW CONDITIONS AND HIGH FLOW EVENTS

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Casey, B., QinetiQ North America Incorporated, Stennis Space Center, USA, Brandon.Casey@nrlssc.nasa.gov

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ter ponds, water samples were collected from inlets and outlets of two ponds located in two Canadian municipalities during baseflow and rain events. Samples were analysed for total, dissolved, and particulate fractions of phosphorus and total suspended solids (TSS). During baseflow conditions, TSS in inlets can be as low as 3.6 mg L⁻¹ and up to 6266 mg L⁻¹ at the start of a rain event. This pattern is similar for TSS in the outlets with 2.2 mg L⁻¹ (baseflow) and 2074 mg L⁻¹ (rain event). During rain events, total phosphorus concentrations were consistently higher in the outlets than in the inlets. This suggests that ponds need ongoing monitoring and maintenance to ensure the build-up of sediments over time does not reduce their effectiveness in removing TSS and nutrients.

Landis, S. H., Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, slandis@ifm-geomar.de

Reusch, T. B. H., Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, treusch@ifm-geomar.de

Roth, O., Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, oroth@ifm-geomar.de

WHO WILL WIN THE HOT WATER RACE? HOST – PARASITE INTERACTIONS AND COEVOLUTION UNDER GLOBAL WARMING.

Recent climate change affects natural and human systems. However, how global change, and the predicted environmental variation alters the interaction of host and parasite taxa has only recently been observed. Recent studies in marine and terrestrial host-parasite systems have shown that the local environment has a strong influence on the interaction between host and parasite. The study of these interactions is not only relevant for the understanding of ecological and evolutionary processes but also of public health importance. In this talk, we will present results from a recent study on the interaction between the crab Cancer magister and the barnacle crustacean Heteromastus filiformis in a global change experiment. The results show that the interaction between host and parasite is strongly influenced by temperature and CO₂ levels, indicating that global change may have a strong impact on the evolution of host-parasite interactions.

Lanerolle, L. W., NOAA/NOS/OCS/CSDL, Silver Spring, USA, Lyon.Lanerolle@noaa.gov

Patchen, R. C., NOAA/NOS/OCS/CSDL, Silver Spring, USA, Rich.Patchen@noaa.gov

Stumpf, R. P., NOAA/NOS/NCCOS/COASTB, Silver Spring, USA, Richard.Stumpf@noaa.gov

Aikman, F., NOAA/NOS/OCS/CSDL, Silver Spring, USA, Frank.Aikman@noaa.gov

Wynne, T. T., NOAA/NOS/NCCOS/COASTB, Silver Spring, USA, Timothy.Wynne@noaa.gov

Tomlinson, M. C., NOAA/NOS/NCCOS/COASTB, Silver Spring, USA, Michelle.Tomlinson@noaa.gov

Xu, J., NOAA/NOS/OCS/CSDL, Silver Spring, USA, Jiangtuo.Xu@noaa.gov

A HIERARCHY OF PHYSICAL MODELS FOR ECOLOGICAL APPLICATIONS

In addition to the biochemical component, much of the ecological activity in the ocean is heavily influenced by its physical conditions. We will present a summary of the ecological modeling activities conducted at NOAA’s National Ocean Service/Office of Coast Survey/Coast Survey Development Laboratory (CSDL) using physical forcing from numerical ocean models. We will elaborate on the following hierarchy of modeling set-ups embodying different physical processes: (i) a one-dimensional, vertical mixing model of Western Lake Erie to study bacterial transport in the water column; (ii) a two-dimensional, upwelling-based model for the west Florida shelf to account for the vertical and on/off-shore movement of harmful algal blooms (HAB); (iii) a three-dimensional extension of (ii) also for the same geographical region using a system of nested numerical ocean models to study the full movement (on-shore, off-shore, along-shore and vertical) and extent of HAB patches and concentrations; and (iv) water quality models coupled to the CSDL physical models to study the concentrations and spatio-temporal distributions of hypoxia in the Chesapeake Bay and the northern Gulf of Mexico.

Landén, C., University of Miami, Miami, USA, clangdon@smas.miami.edu

Corredor, J., University of Puerto Rico, Mayagüez, Mayagüez, Puerto Rico, jcorredor@uprm.edu

Brocco, B., University of Puerto Rico, Mayagüez, Mayagüez, Puerto Rico, bbrocco@uprm.edu

Antoun, H., University of Puerto Rico, Mayagüez, Mayagüez, Puerto Rico, hanantoun@uprm.edu

Capella, J., University of Puerto Rico, Mayagüez, Mayagüez, Puerto Rico, jcapella@uprm.edu

Yates, K. K., United States Geological Survey, St. Petersburg, USA, kyates@usgs.gov

Gledhill, D., NOAA, AOML, Cooperative Institute of Marine and Atmospheric Studies, Miami, USA, dwight.gledhill@noaa.gov

A YEAR-LONG TIME SERIES OF CALCIFICATION RATES FOR ENRIQUE REEF, PUERTO RICO BASED ON THE EULERIAN METHOD

A year-long time-series of calcification rates were obtained at the NOAA Coral Reef Conservation Program’s Atlantic Ocean Acidification Test-bed located on the south-west corner of Puerto Rico. Weekly transects of total alkalinity were obtained along the Cayo Enriquillo reef from Feb 5, 2009 to Jan 13, 2010. Flow dynamics were constrained using a set of ADCP’s deployed throughout the study period. Calcification rates were calculated from the total alkalinity gradient and current velocity during periods of unidirectional flow parallel to the reef. Hourly rates are well agreed with rates obtained during an inter-comparison experiment using an enclosure method. The time series shows a seasonal cycle with calcification peaking in late August and declining to a minimum during late December and January. The calculated rates (10⁻³ mmol m⁻² d⁻¹) are reasonable for a reef with only 8% live coral cover. We conclude that this method may prove useful in establishing baseline calcification rates for certain reefs against which future change due to climate change can be judged.

Langehaug, A. T., Aarhus University, Aarhus, Denmark, alice.thoft@biology.au.dk

Alperin, M. J., University of North Carolina at Chapel Hill, Chapel Hill, USA, alperin@email.unc.edu

Niggemann, J., Aarhus University, Aarhus, Denmark, jniggemann@mpi-bremen.de

Jørgensen, B. B., Aarhus University, Aarhus, Denmark, bjorgjensen@mpi-bremen.de

Lomstein, B. A., Aarhus University, Aarhus, Denmark, bente.lomstein@biology.au.dk

NOVEL DIAGENETIC MODELLING OF BACTERIAL BIOMARKERS TO DEFINE THE HABITAT OF THE CHILEAN UPWELLING REGION

Degradation of sedimentary organic material and bacterial activity was studied at the shelf of the Chilean upwelling region. One sediment core was taken at 800 m water
Lantz, C. A., Leibniz Institute for Marine Sciences, Kiel, Germany, rlantz@imar.de
Mohr, W., Leibniz Institute for Marine Sciences, Kiel, Germany, wmohr@imar.de
Sudhaus, S., Leibniz Institute for Marine Sciences, Kiel, Germany, ssudhaus@imar.de
Bluhm, K., Leibniz Institute for Marine Sciences, Kiel, Germany, bluhm@imar.de
Heller, M., Leibniz Institute for Marine Sciences, Kiel, Germany, mheller@imar.de

Langlois, R. J., Leibniz Institute for Marine Sciences, Kiel, Germany, rlanglois@ifm-geomar.de
Moir, W., Leibniz Institute for Marine Sciences, Kiel, Germany, wmoir@ifm-geomar.de

The biological and photochemical reactivity of DOC plays a key role in determining key ecosystem properties in lakes, such as the partial pressure of CO2 (pCO2) and the associated CO2 fluxes. We have explored the cross-temporal and seasonal patterns in the composition and photo-chemical reactivity of the colored dissolved organic matter (CDOM) from lakes across temperate and boreal landscapes in Quebec, Canada. We carried out standardized measurements of DOC photo-reactivity, determined the excitation/emission spectra of the ambient and irradiated DOC, and identified the major components using PARAFAC modeling. We found marked regional differences in DOC composition and photo-reactivity, and the fluorescence components with the highest variability across regions were also the most light sensitive. Consequently, the relative abundance of these fluorescence components in lakes was the strongest predictor of the DOC losses in the incubations. Regional specificities in the composition of CDOM in aquatic ecosystems result in various degrees of DOC reactivity to solar radiation, which would control the rates of photo-chemical degradation and thus mediate the relationship between DOC and pCO2 in these systems.

Lapiere, J. F., Université du Québec à Montréal, Montréal, Canada, jfrancoislapiere@gmail.com
del Giorgio, P. A., Université du Québec à Montréal, Montréal, Canada, del_giorgio.paul@uqam.ca

DOC OPTICAL PROPERTIES AND PHOTO-CHEMICAL REACTIVITY IN TEMPERATE AND BOREAL LAKES

The Arctic region is experiencing the steepest warming rate on Earth, which is three times faster than the global mean. Here we examine changes of carbon fluxes from bacteria to larger predators by protists, and by viruses due to increased water temperature in the Arctic Ocean. Our aim is to resolve which is the effect of global warming affecting these microbial activity rates. During July 2009, we collected Arctic water to carry out a mesocosms experiment along 10 days and at 7 different temperatures from 1.5 to 10°C. We have detected that all microbial abundances three times faster than the global mean. Here we examine changes of carbon fluxes from bacteria to larger predators by protists, and by viruses due to increased water temperature in the Arctic Ocean. Our aim is to resolve which is the effect of global warming affecting these microbial activity rates. During July 2009, we collected Arctic water to carry out a mesocosms experiment along 10 days and at 7 different temperatures from 1.5 to 10°C. We have detected that all microbial abundances as well as bacterial production and fluxes of bacterial carbon due to grazers and viruses achieved maximum values around 4.5º- 6ºC experimental temperature, and maintained high values even at higher experimental temperatures. The biomass of phototrophs, has also shown maximum values at ca. 5°C and a clear decrease at temperatures higher than 5°C. The obtained results indicate that the increase of the water temperature is followed by a shift towards more heterotrophic community, which could have an impact on carbon storage in the Arctic region.

Lapierre, J. F., Université du Québec à Montréal, Montréal, Canada, jfrancoislapiere@gmail.com
del Giorgio, P. A., Université du Québec à Montréal, Montréal, Canada, del_giorgio.paul@uqam.ca

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environmental conditions and dinoflagellate abundance, the effect of moonlight on bioluminescence, and how the abundance of P. bahamense covaries with that of other dinoflagellates. The pilot study provides baseline data from which an extended program can be established to provide scientific understanding of the bay dynamics and to monitor ecosystem health.

LaVrenyi, P. J., University of Akron, Akron, USA, peter3@uakron.edu Franze, G., University of Akron, Akron, USA, franze@uakron.edu Solovey, K. A., Shirshov Institute of Oceanology RAS, Moscow, Russian Federation, kotsol@gmail.com

MOSQUITO TROPIC SIGNATURE OF TROPICAL STORM EVENTS

Microzooplankton distribution and herbivory were examined in the Barents Sea as part of the ongoing multidisciplinary effort to understand the impact of changing sea ice conditions on the dynamics and structure of pelagic food webs in the Arctic. A set of shipboard dilution experiments was conducted along with bottle grazing experiments using the predominant calanoid copepods, Calanus finmarchicus, C. glacialis, and C. hyperboreus at sea temperatures ranging from -1.8°C to 8.6°C. In both the ice-covered waters east of Svalbard in May and the warmer Atlantic-influenced waters off the Finnmark coast in August-September 2010, microzooplankton herbivory was a significant factor controlling phytoplankton production (60 to 150% of its daily rates based on chlorophyll a). The microzooplankton herbivory rates were equal to and often exceeded those by the copepods. In turn, C. finmarchicus derived up to 40% of its daily carbon ration from microzooplankton, whereas C. glacialis fed almost exclusively on microzooplankton during the spring diatom bloom in the marginal ice zone. Thus, our preliminary data support the hypothesis that the microbial food web is a critical component of this productive shelf ecosystem.

Lawrence, C. M., University of Rhode Island, Narragansett, USA, caitlynl@geo.uri.edu Menden-Deuer, S., University of Rhode Island, Narragansett, USA, smenden@geo.uri.edu

PROTISTAN GRAZING IN NARRAGANSETT BAY, RI, IN RELATION TO PHYTOPLANKTON COMMUNITY COMPOSITION AND ENVIRONMENTAL CONDITIONS

The impact of heterotrophic protist grazing on phytoplankton abundance was measured in a coastal estuary from winter to fall 2010 in Narragansett Bay, RI, USA. Concurrent with weekly dilution experiments, samples assessed phytoplankton species composition and environmental conditions. Plankton samples were collected within the long-term phytoplankton monitoring project in Narragansett Bay initiated in the 1950s. Results show that grazing removed an average of 110% (range 10% - 500%) of primary production. There was no relationship between grazing rates and initial Chl a concentration, phytoplankton growth rates and temperature or salinity. Phytoplankton growth was severely nutrient limited in 11 of the 35 weeks, predominately in winter and spring months. Over the past 12 years, there were no significant seasonal patterns in Chl a abundance in spite of order of magnitude changes in concentration. The significant impact of grazers on phytoplankton production implies that grazing contributes to the observed patterns. Seasonal patterns in phytoplankton abundance, community composition and relation to environmental conditions may be better understood when examined in relation to species composition rather than bulk measures of biomass, including Chl a.

Lawrence, F., University of South Carolina, Columbia, USA, evelyn.lawrenz@gmail.com Richardson, T. L., University of South Carolina, Columbia, USA, richardson@biol.sc.edu

HOW DOES THE SPECIES USED FOR CALIBRATION AFFECT CHLOROPHYLL A MEASUREMENTS BY IN SITU FLUOROMETRY?

We determined how the species used for calibration affects the accuracy of in situ chlorophyll a (chl a) measurements by fluorometry using single-species cultures and natural phytoplankton populations from Winyah Bay, South Carolina, USA. When a diatom was used for calibration, chl a in a dinoflagellate culture was overestimated by 66 ± 7% whereas concentrations of a cryptophyte, chlorophyte, and cyanobacteria were underestimated by 16 ± 20%, 40 ± 7% and 71 ± 33%, respectively. In natural populations, the combination of species-specific and environmentally-induced variation in the ratio of fluorescence to chl a (F Chl a) led to an overestimate by the in situ fluorometer of 40 to 169% for an April experiment and an underestimate of 4 to 50% in July. Even when field samples were dominated by diatoms, environmental effects resulted in highly variable predictions of chl a. Thus, while a carefully-selected calibration species can improve estimates of in vivo chl a in the laboratory, calibra-
tion of in situ fluorometers should be done with natural communities collected from the site of interest.

Le Moigne, E. A., National Oceanography Centre, Southampton, United Kingdom, E.LeMoigne@noc.soton.ac.uk
Sanders, R. J., National Oceanography Centre, Southampton, United Kingdom, rics@noc.soton.ac.uk
Villa Alfageme, M., Universidad de Sevilla, Sevilla, Spain, mvilla@us.es
Morris, P. J., National Oceanography Centre, Southampton, United Kingdom, pjmorris@noc.soton.ac.uk

DOES A BALLAST EFFECT OCCUR IN THE OCEAN?
The efficiency and time scales for oceanic CO₂ sequestration through the marine biota (biological carbon pump) depends critically on how much particulate organic carbon (POC) is exported below the winter mixed layer. The aggregation of biominerals (calcite and opal) with POC might play a key role in ballasting POC that may promote efficient particle export to the ocean interior. Indeed, recent studies have shown that relationships exist between the fluxes of POC with biominerals to the deep sea. However, the paucity of data from the upper ocean means that the potential ballasting mechanisms that may promote particle export from the upper ocean are poorly understood. This therefore prevents the determination of a potential relationship between POC and biominerals fluxes in an analogous manner. Here we present positives correlations of biomineral and POC. Th234U derived export numbers and evidences of biomineral ballasted POC-sinking particles from 5 high and mid latitude cyanobacteria in the Atlantic and the Southern ocean.

Leandre, M. Y., Hampton University, Hampton, USA, mleandre01@odu.edu
Gibson, D. M., Hampton University, Hampton, USA, deidre.gibson@hamptonu.edu
Kirchman, D. L., University of Delaware, Lewes, USA, kirchman@udel.edu
Frischer, M. E., Skidaway Institute of Oceanography, Savannah, USA, Marc.Frischer@skio.usg.edu
Thompson, M. E., Skidaway Institute of Oceanography, Savannah, USA, Megan.Thompson@skio.usg.edu

POPULATION DYNAMICS OF THE BACTERIAL COMMUNITY DURING TUNICATE DECOMPOSITION
Consideration of the trophic interactions that link species requires study of the decomposition process to reveal different pathways for nutrient regeneration, elemental recycling, and microbial production in the water column. In a pilot study, we assessed the presence and activity of Gammaproteobacteria, Alphaproteobacteria, and Sphingomonas bacteria during decomposition of the filter-feeding doliolid, Dolioletta gegenbauri. Gammaproteobacteria often increase in micro- and mesocosms, Alphaproteobacteria are more abundant in increased salinity, and Sphingomonas bacteria increase with levels of high molecular weight. Within the first 18 hours of decomposition, Gammaproteobacteria dominated the water column; however, the Alphaproteobacteria became more abundant between 24 and 168 hours. Throughout the study, Sphingomonas bacteria maintained slightly lower concentrations than the other two groups. By 215 hours all 3 bacterial types show highest concentrations and evidences of biomineral ballasted POC-sinking particles from 5 high and mid latitude cyanobacteria in the Atlantic and the Southern ocean.

Leavitt, P. R., University of Regina, Regina, Canada, Peter.Leavitt@uregina.ca
Bogard, M., University of Regina, Regina, Canada, Bogard2m@uregina.ca
Donald, D. B., University of Regina, Regina, Canada, Donald1d@uregina.ca
Finlay, K., University of Regina, Regina, Canada, Keri.Finlay@uregina.ca
Phillips, V. J., University of Regina, Regina, Canada, philipv@uregina.ca

NEW INSIGHTS ON UREA BIOGEOCHEMISTRY AND ITS ROLE IN EUTROPHICATION
Urea accounts for 50% of nitrogen (N) fertilizer applications, and its use is expected to double within 40 years, yet little is known of its biogeochemical regulation or effects on aquatic ecosystems. To address these issues, biweekly measurements of urea, water chemistry, biotic production, and mass fluxes were conducted in a 52,000 km2 basin in Canada. Urea contributed 10-50% of bioavailable N (30-150 ug N/L) in 7 lakes and was derived from a combination of novel lotic inputs and regener-ated sedimentary sources. Mass flux analysis revealed that river urea was composed of periodic agricultural sources driven by precipitation, and continuous urban inputs. Monthly 3000-L mesocosm experiments during 3 years showed that urea pollution increased cyanobacterial biomass and toxin production by up to 600%, but only when soluble phosphorus (P) concentrations exceeded 50 ug P/L. Urea effects on algae asymptote at 3 mg N/L, whereas microbial production is stimulated to 18 mg N/L, leading to net heterotrophy at >8 mg N/L. We conclude that pollution with urea from farms and cities threatens water quality of P-rich lakes.

Lebrato, M., IFM-GEOMAR. Leibniz Institute of Marine Science, Kiel, Germany, mlebrato@ifm-geomar.de
Pitt, K. A., Australian Rivers Institute, Coast and Estuaries. Griffith University, Brisbane, Australia, k.pitt@griffith.edu.au
Sweetman, A. K., Norwegian Institute for Water Research, Bergen, Norway, andrew.kvassnes.sweetman@niva.no
Pahlow, M., IFM-GEOMAR. Leibniz Institute of Marine Science, Kiel, Germany, mmpahlow@ifm-geomar.de
Oschlies, A., IFM-GEOMAR. Leibniz Institute of Marine Science, Kiel, Germany, aoschlies@ifm-geomar.de
Jones, D. O., National Oceanography Centre. Southampton, Southampton, United Kingdom, dj1@noc.soton.ac.uk
Condon, R. H., Dauphin Island Sea Lab, Dauphin Island, USA, rcondon@dils.org
Molinero, J. C., IFM-GEOMAR. Leibniz Institute of Marine Science, Kiel, Germany, jmoliner@ifm-geomar.de

THE FATE OF GELATINOUS ZOOPLANKTON PARTICULATE ORGANIC MATTER (JELLY- POM) IN THE BIOLOGICAL PUMP: A MODELLING STUDY
The downward flux of particulate organic matter (POM) affects the distribution of chemical properties, ultimately governing the resources fuelling benthic ecosystems. Gelatinous zooplankton POM originates in jelly-falls (a post-bloom process) that have received little attention in observational oceanography and modelling. We assess all information available on jelly-POM export and derive a new parameterization applicable to regional/global biogeochemical models. The formulations are constraint by k data (decay rate), temperature, and sinking speed, predicting the jelly-POM % arriving at any depth. The model relies on a concept referred to as “death-depth”, governing the starting point of a jelly-fall. Using WOCE-A16/P16 (Atlantic/Pacific) transects we provide maps of the predicted k and t 0.01 (remineralization time of 99% of jelly-POM). Using VERTIGO project data (ALOHA St#) we compare our jelly-POM results with the Martin curve, with a particle-based parameterization, and sediment trap data. We conclude that temperature is the most important factor driving jelly-POM remineralization and we discuss similarities with particle-based formulations. Our results inform the community on the difficulty to study jelly-falls in the field and the interdisciplinary efforts needed in the future.

Lechtenfeld, O. J., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, oliver.lechtenfeld@awi.de
Koch, B. P., University of Applied Sciences and Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, boris.koch@awi.de
Schmitt-Kopplin, P., German Research Center for Environmental Health, Munich, Germany, schmitt-kopplin@helmholtz-muenchen.de
Flerus, R., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, ruth.flerus@awi.de
Kattner, G., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, gerhard.kattner@awi.de

PRODUCTION AND SEQUESTRATION OF DISSOLVED ORGANIC CARBON IN THE WEDDELL SEA: TRACING DEEP-WATER FORMATION WITH FT-ICR-MS
The Antarctic shelf areas, especially the Weddell Sea, are highly important regions for oceanic deep water formation where in addition high primary production occurs. Thus, the downward flux of DOC (dissolved organic carbon) is critical for the export of carbon to the deep ocean. To date, tracing dissolved remnants of biological productivity in these areas is largely restricted to bulk chemical parameters such as DOC and nutrients. Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR-MS) analysis is a powerful tool to analyze the recently produced carbonaceous material (DOC) with the downwelling water masses could represent an important sink in the global carbon cycle. To date, tracing dissolved remnants of biological productivity in these areas is largely restricted to bulk chemical parameters such as DOC and nutrients. Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR-MS) analysis is a powerful tool to analyze the recently produced carbonaceous material (DOC) with the downwelling water masses could represent an important sink in the global carbon cycle. To date, tracing dissolved remnants of biological productivity in these areas is largely restricted to bulk chemical parameters such as DOC and nutrients. Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR-MS) analysis is a powerful tool to analyze the recently produced carbonaceous material (DOC) with the downwelling water masses could represent an important sink in the global carbon cycle.
contribution of fresh, oxygen-rich compounds to the exported DOC, compared to the refractory background levels of aged water masses. These results indicate that the mechanism of a “DOM-pump” exists in the Weddell Sea.

Lee, T. A., University of Delaware, Lewes, USA, tlee@udel.edu

Coyne, K. J., University of Delaware, Lewes, USA, kcoyne@udel.edu

USING MOLECULAR METHODS TO EVALUATE DIATOM COMMUNITY STRUCTURE IN DELAWARE’S INLAND BAYS

The investigation of biological indicators in marine systems is an important conservation tool. In this study, we developed molecular methods to evaluate diatom community structure with the goal of identifying species that can predict changes in environmental conditions. Denaturing gradient gel electrophoresis (DGGE) and terminal-restriction fragment length polymorphism (T-RFLP) were used to analyze diatoms in sediment cores taken throughout Delaware’s Inland Bays. Statistical analyses were used to evaluate differences in community structure between sites across a nutrient gradient. Preliminary results show distinct clustering of replicate samples taken from individual sites and in multiple samples taken from the same site through time, indicating a shift in diatom community structure as a result of site-specific factors such as nutrient input, salinity, and temperature. Mesocosm experiments were also conducted to evaluate the effects of light attenuation and N:P ratios on community structure. Light attenuation resulted in decreased diversity, with Skeletonema sp. dominating the community under low light conditions. Preliminary results also indicated a community shift with increases in N:P ratios. Further research will be done to identify species that characterize this shift.

Lee, P. O., University of Wisconsin-Milwaukee, Milwaukee, USA, polee@uwm.edu

McelLellan, S., University of Wisconsin-Milwaukee, Milwaukee, USA, mcelellan@uwm.edu

Young, E. B., University of Wisconsin-Milwaukee, Milwaukee, USA, ebyoung@uwm.edu

EXAMINING EFFECTS OF DREISSENID MUSSELS AND BENTHIC ALGAE ON BENTHIC BACTERIAL DIVERSITY IN NEARSHORE LAKE MICHIGAN

Freshwater nutrient cycling and benthic-pelagic coupling can be dramatically altered by invasive species. While some changes have been well characterized, less is known about the effects of aquatic invasive species on benthic microbial diversity. This research aims to examine how invasive dreissenid mussels and benthic filamentous algae influence benthic bacterial diversity in Lake Michigan. Benthic bacterial populations were examined in field samples and during a microcosm experiment over 30 days. During the microcosm trial, the water column, pore water and sediments were sampled for measurement of dissolved nutrients, along with 16S rDNA analysis of bacterial diversity. Both dreissenid mussel and filamentous algae influenced nutrient concentrations in microcosms. Many bacterial taxa were common to all treatments, but bacterial diversity differed between control microcosms and those with algal or mussel additions. Increased occurrence of cyanobacteria and taxa in Clostridiaceae and Nitrospiraceae were found in microcosms with Skeletonema sp. dominating the community under low light conditions. Preliminary results also indicated a community shift with increases in N:P ratios. Further research will be done to identify species that characterize this shift.

Lee, T. A., Washington State University Vancouver, Vancouver, USA, tamiyy.lee@email.wsu.edu

Rollwagen-Bollens, G. C., Washington State University Vancouver, Vancouver, USA, rollboll@washu.rr.com

Bollens, S. M., Washington State University Vancouver, Vancouver, USA, sbollens@washu.rr.com

ENVIRONMENTAL INFLUENCES ON PHYTOPLANKTON COMMUNITY COMPOSITION AND TOXIC CYANOBACTERIA BLOOMS IN A SHALLOW, TEMPERATE LAKE (VANCOUVER LAKE, WASHINGTON, USA)

Understanding the environmental and ecological factors influencing cyanobacteria blooms and associated plankton community dynamics remains a major challenge for ecologists and natural resource managers. We therefore undertook an observational field study over four years (2007-2010) in Vancouver Lake, Washington, to quantify phytoplankton and zooplankton community composition and related environmental conditions (i.e., nutrients, temperature, and pH). Sampling was performed weekly during summer, biweekly during spring and fall, and monthly during winter. Abundance and biomass of phytoplankton during summer months were initially dominated by Anabaena (peak of 652,213 cells/mL on July 31, 2009) and then shifted to Aphanizomenon (peak of 6,530,362 cells/mL on October 2, 2009). Non-metric multidimensional scaling (NMS) revealed significant interannual differences in overall phytoplankton community composition. Preliminary NMS results suggest several environmental factors, especially the timing of peak NO3 levels, contributed to observed interannual variation in phytoplankton. Future directions include analyses of microcystin levels and zooplankton community composition. Our results will lead to a better understanding of the environmental conditions that control cyanobacteria blooms and declines, and will therefore be of broad interest to ecologists and natural resource managers.

LeFebvre, R., Umeå University, Umeå, Sweden, robert.lefebvre@emg.umu.se

Degerman, R., Umeå University, Umeå, Sweden, richard.degerman@emg.umu.se

IMPACTS OF CLIMATE CHANGE ON PELAGIC FOOD WEB EFFICIENCY AND FISH PRODUCTION

Climate change scenarios predict that both a higher temperature and higher levels of river runoff could affect community structure and function of the Baltic Sea. An increased temperature, combined with an excess influx of terrestrial carbon from fresh water sources is predicted to favor aquatic bacterial growth to such a degree that the pelagic system could end up being driven primarily by bacterial production. These heterotrophic systems have been shown to have a lowered food web efficiency (FWE) and consequently, less energy would be available for production in higher trophic levels, impacting planktonic fish. To test this hypothesis, an indoor mesocosm study will be conducted in the fall of 2010, where the effects of increased temperature and increased dissolved organic carbon (DOC) concentrations on pelagic FWE and fish production will be tested. The Threepine Stickleback (Gasterosteus aculeatus) will be used as a model fish. By investigating changes to food web dynamics as well as effects on fish physiology, this study will yield empirical results on the potential impacts of climate change on Baltic Sea food web dynamics and fish performance.

LeFebvre, R. C., San Francisco State University, Tiburon, USA, stephane@rce.sfsu.edu

Bennett, L., San Francisco State University, Tiburon, USA, ina.benner@rce.sfsu.edu

Drake, M. K., San Francisco State University, Tiburon, USA, michidrake@gmail.com

Rossignol, P. E., San Francisco State University, Tiburon, USA, rossignol.p@hotmail.com

Okimura, K. M., San Francisco State University, Tiburon, USA, kokimura@sfsu.edu

Komada, T., San Francisco State University, Tiburon, USA, tkomada@sfsu.edu

Stillman, J. H., San Francisco State University, Tiburon, USA, stillmaj@sfsu.edu

Carpenter, E. J., San Francisco State University, Tiburon, USA, ecarpent@sfsu.edu

NITROGEN SOURCE AND PCO2 SYNERGISTICALLY AFFECT CARBON ALLOCATION, GROWTH AND MORPHOLOGY OF THE COCCOLITHOPHORE EMILIANIA HUXLEYI

Emiliania huxleyi is the most abundant cocolithophore in the world’s ocean, and plays a major role in the global carbon cycle by regulating the exchange of CO2 across the ocean-atmosphere interface through photosynthesis and calcium carbonate precipitation. In future climate, ammonium concentration in seawater is expected to rise due to ocean acidification. To examine the synergistic effect of elevated PCO2 and increased ammonium/nitrate ratio on E. huxleyi, we maintained continuous cultures for at least 200 generations under different conditions of PCO2 and ammonium source. Assimilation of nitrogen as ammonium depresses calcification at both ambient and elevated PCO2, alters cocolith size and shape, and increases primary production. We observed that both nitrogen source and PCO2 synergistically drive growth rates, cell size and the ratio of inorganic to organic carbon. At present, anthropogenically-driven increases in ammonium concentrations occur primarily in coastal and low nutrient waters. However, with increased acidification and nitrogen oxide emissions, increased ammonium availability may extend to more open waters and could reduce bio-mineralisation by calcifying organisms, while increasing primary production in these species, thus exerting feedback on climate.

Lefort, S., McGill University, Montreal, Canada, slefort@eps.mcgill.ca

Gratton, Y., INRS-ETE, Quebec City, Canada, yves.gratton@ete.inrs.ca

Mucci, A., McGill University, Montreal, Canada, alfonso.mucci@mcgill.ca

Dadou, I., LEGOS-UPS, Toulouse, France, isabelle.dadou@legos.obs-mip.fr

Gilbert, D., IML, Mont-Joli, Canada, Denis.Gilbert@dfo-mpo.gc.ca

MODELING OXYGEN DYNAMICS IN THE ST. LAWRENCE ESTUARY SYSTEM

Oxygen depletion in the bottom waters of the Laurentian Channel results from the refractory background levels of aged water masses. These results indicate that open waters and could reduce bio-mineralisation by calcifying organisms, while increasing primary production in these species, thus exerting feedback on climate.
the bottom waters is replenished by diffusion from the oxygenated surface layer and by advection from the oxygenated Atlantic waters. Nevertheless, the mechanisms regulating oxygen dynamics in the hypoxic bottom waters of the Lower St. Lawrence Estuary are poorly known. A laterally integrated advection-diffusion two-dimension-
al model of dissolved oxygen distribution, coupled to a one-dimensional diagenetic model, was implemented to evaluate the relative contributions of oxygen supply and consumption by pelagic and benthic respiration. Physical, biological and diagenetic processes were included in the model. Preliminary results of our simulations reveal that hypoxia in the bottom waters of the Lower St. Lawrence Estuary is mainly generated by a combination of physical and diagenetic processes, whereas pelagic respiration seems to play a lesser role in the oxygen depletion.

**Legendre, L.**, UPMC, Villefranche Oceanography Laboratory, Villefranche-sur-Mer, France, legendre@obs-vlfr.fr
Coppola, L., UPMC, Villefranche-sur-Mer Oceanology Observatory, Villefranche-sur-Mer, France, coppola@obs-vlfr.fr
Gattuso, J. P., CNRS, Villefranche Oceanography Laboratory, Villefranche-sur-Mer, France, gattuso@obs-vlfr.fr
Goyet, C., University of Perpignan, Perpignan, France, c.goyet@univ-perp.fr
Deaden, A., UPMC, Villefranche Oceanography Laboratory; Villefranche-sur-Mer, France


Physical and chemical variables were measured in the Northwestern Mediterranean at 20 depths down to 2000 m over the decade 1998-2008 (no data for 2001 and 2002). Data were used to compute pO2 and pCO2, which were combined into RI (respiration index, proposed in 2009). pO2 and pCO2 were not correlated over the dataset, and pO2 minimum and pCO2 maximum occurred generally at different depths. In the Mediterranean, RI is not expected to reach critically low values for oxygenic respiration, and RI varied between <3.0 (surface) and >2.5 (subsurface min-
imum). Over the dataset, the pCO2 maximum occurred at 60-80 m, and the pO2 and RI minima at 300-400 and 300 m, respectively. Among years, highest median pCO2 occurred in 2003 and 2004, lowest pO2 in 1998, and lowest RI in 1998, 2003 and 2004. Among months, highest median pCO2 occurred in August to October, lowest pO2 in March, September and October, and lowest RI in March, August and September. Although RI was more influenced by pO2 than pCO2, vertical profiles of the three variables provided different information on water-column processes.

**Leguerre, J.**, Université de Montréal, Montreal, Canada, jb.leguerre@umontreal.ca
Cardillé, J., Université de Montréal, Montreal, Canada, jeffrey.cardille@umontreal.ca
Del Giorgio, P., Université du Québec à Montréal, Montréal, Canada, del_giorgio.paul@uqam.ca

REMOTE SENSING OF CARBON CONTENT OF LAKES IN QUEBEC: EARLY SUCCESSES AND LIKELY LIMITS

Lakes play a major role in boreal carbon dynamics, and estimation of carbon content of boreal lakes is highly desirable. In the water-rich boreal landscapes of Quebec, there are millions of lakes and a remote sensing approach may be the most viable way to estimate lake properties. Previous studies in northern Europe with the experimental American satellite sensor ALI (Advanced Land Imager) have established the feasibility of estimating dissolved carbon concentrations using lake color. Here we explore the application of ALI to determine DOC in boreal lakes, by combining six summer 2010 ALI images with five years of DOC measurements in two of Quebec’s boreal regions. We tested different combinations of sampling dates and image acqui-
sition dates. Relationships between imagery and multiple-date field samples indicate that (1) the ALI sensor can produce a good-quality model of DOC concentration, (2) availability of multiple image dates can both complicate and improve the process of estimating DOC, and (3) more development is needed to understand the spatial and temporal limits of estimating carbon in lakes with advanced satellite imagery.

**Lehman, P. W.**, CA Department of Water Resources, West Sacramento, USA, plehman@water.ca.gov
Poulton, N., J. Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA, npoulton@bigelow.org
Marr, K., CA Department of Water Resources, West Sacramento, USA, kmarr@water.ca.gov

USING THE FLOWCAM TO QUANTIFY MICROCYSTIS ABUNDANCE IN SAN FRANCISCO ESTUARY

This paper summarizes the use of the FlowCam a digital imaging flow cytometer produced by Fluid Imaging Technologies to quantify Microcystis abundance in San Francisco Estuary. *Microcystis* forms thick blooms on the surface of freshwater and brackish water habitats in the estuary. Quantifying abundance in these blooms using microscopic techniques is difficult because samples are dense, turbid and contain wide diameter colonies reaching 2500 μm in diameter. Lugol’s preserved samples were diluted to 200 cells/ml and size fractionated into three size categories: <3 μm, 36-300 μm and >300 μm. Microcystis volume in each size fraction was quantified at 2X, 4X and 20X magnification using 600, 300 and 50 ml flow cells. Volumes from each size fraction were combined to produce a final volume and converted to cell abundance. Sample error averaged 20% for processing times less than 20 minutes. Correlation between volumes or density and chlorophyll a concentration or micro-
scope counts supported the accuracy of the estimates. Colony images were clear and easy to identify using internal libraries despite high levels of suspended solids.

**Lehrter, J. C.**, EPA, Gulf Breeze, USA, lehrter.john@epa.gov
Ko, D., NRL, Stennis, USA
Murrell, M. C., EPA, Gulf Breeze, USA, murrell.michael@epa.gov
Hagy, J. D., EPA, Gulf Breeze, USA, hagy.jim@epa.gov
Greene, R. M., EPA, Gulf Breeze, USA, greene.rick@epa.gov

THE PRACTICAL LIMITATIONS OF A 3-D HYDRODYNAMIC MODEL AND THE IMPLICATIONS FOR SIMULATING BOTTOM-WATER HYPOXIA ON THE LOUISIANA SHELF

A hydrodynamic model of the Louisiana shelf has been developed to provide the physical forcing for a water quality model. Here we evaluate hydrodynamic model output versus field observations to assess model skill in reproducing physical features that play a role in the onset and maintenance of hypoxia. These features include profiles of temperature, salinity, and sigma-t and depth and strength of stratification. Evaluations were performed by comparing observational data collected during 12 cruises (2002-
2007) with model output from the same period. Data versus model comparisons were conducted at station, transect, and shelf-wide scales. At the transect and shelf-wide scales, the model provided accurate estimates of average temperature, salinity, and sigma-t. The model was less accurate at predicting the depth and strength of stratification. Limitations of the model were due to boundary conditions, both freshwater and marine, and the vertical layering of the model. The implications of the strengths and limitations of the model for simulating hypoxia will be presented.

**Lehto, N. J.**, Lancaster University, Lancaster, United Kingdom, niklas.lehto@lancaster.ac.uk
Larsen, M., Scottish Association for Marine Sciences, Oban, United Kingdom, morten.larsen@sams.ac.uk
Davison, W., Lancaster University, Lancaster, United Kingdom, w.davison@lancaster.ac.uk
Glad, R. N., University of Southern Denmark, Odense, Denmark, rmglad@biology.sdu.dk
Zheng, H., Lancaster University, Lancaster, United Kingdom, h.zheng@lancaster.ac.uk

DETERMINATION OF TRACE METAL DYNAMICS IN MARINE SEDIMENTS USING A JOINT OXYGEN SENSING OPTODE-DGT PROBE

High resolution images of trace metal concentrations in marine sediments obtained by 2D DGT probes have identified localised sources (microniches) of metals. The exact processes responsible for the increased metal availability are not yet clearly known. One hypothesis posits that metals are mobilized as a result of rapid oxidisa-
tion of organic carbon. In this work ultra-thin DGT binding layers using SIR-IDA resin were combined with an oxygen sensing optode as a joint probe in order to observe oxygen concentrations in a sediment in real time while obtaining a measure-
ment of metal availability. The probe was deployed against a well defined sediment

**Lema, K. A.**, Australian Institute of Marine Science, James Cook University, Townsville, Australia, kлемa@aims.gov.au
Willis, B. L., James Cook University, Townsville, Australia, bette.willis@jcu.edu.au
Bourne, D. G., Australian Institute of Marine Science, Townsville, Australia, d.bourn@aims.gov.au

NITROGEN FIXING BACTERIA ASSOCIATED WITH CORALS OF THE GREAT BARRIER REEF

**Lemasson, E.**, Australian Institute of Marine Science, James Cook University, Townsville, Australia, ejlemasson@aims.gov.au
Copley, M., Australian Institute of Marine Science, James Cook University, Townsville, Australia, mcopley@aims.gov.au
Lawless, J., Australian Institute of Marine Science, James Cook University, Townsville, Australia, julawless@aims.gov.au

GREAT BARRIER REEF

NITROGEN FIXING BACTERIA ASSOCIATED WITH CORALS OF THE GREAT BARRIER REEF
Nitrogen fixation is proposed as one key functional role of coral associated bacteria. Coral reefs are nitrogen limited and, therefore, nitrogen fixing diazotrophic bacteria provide an important source of nitrogen to corals, specifically to their symbiotic algae (zooxanthellae). Diazotrophic bacterial communities associated with three coral species (Acropora millepora, Acropora muricata and Pocillopora damicornis) were investigated among three mid-shelf reefs on the Great Barrier Reef (Australia) to better understand the nature and specificity of this coral–diazotroph symbiosis. Diversity of diazotrophic populations was assessed by profiling of the nifH fragment of the nitrogenase gene and corals were found to maintain similar communities along locations, indicating coral species-specific diazotroph associations. Phylogenetic analysis revealed the dominant diazotrophic bacteria (40% of total retrieved sequences) to be closely related to plant symbionts, further suggesting a close relationship between diazotrophs and zooxanthellae. Relative abundance of dominant coral-associated diazotrophs has been investigated through quantitative real time PCR (qPCR). Coral associated diazotrophs have also been isolated to further investigate the functional role and benefits these organisms provide to the coral holobiont.

Lenes, J. M., University of South Florida, St. Petersburg, USA, lenes@marine.usf.edu
Darrow, B. A., University of South Florida, St. Petersburg, USA, bdarrow@marine.usf.edu
Walsh, J. I., University of South Florida, St. Petersburg, USA, jwalsh@marine.usf.edu
Dieterle, D. A., University of South Florida, St. Petersburg, USA, dwdid@marine.usf.edu
Weisberg, R. H., University of South Florida, St. Petersburg, USA, weisberg@marine.usf.edu
Zheng, L., University of South Florida, St. Petersburg, USA, lzheng@marine.usf.edu

A SIMULATION ANALYSIS OF THE DEVELOPMENT AND MAINTENANCE OF THE 2001 RED TIDE ON THE WEST FLORIDA SHELF

Harmful algal blooms of the toxic dinoflagellate, Karenia brevis, occur annually on the West Florida shelf with downstream implication for the South Atlantic Bight and northern Gulf of Mexico. A sequence of phytoplankton succession leads to blooms of these dinoflagellates. The growth and decay of Trichodesmium within low N/P waters can provide a nutrient source for red tides within the GOM. These nutrients in the form of DON and DOP can be utilized by K. brevis, giving them a competitive advantage over faster growing phytoplankton that prefer inorganic sources. Once K. brevis biomass exceeds a concentration great enough to cause fish kills, high fish decomposition rates prevail within warm Florida waters, converting nutrients to the dissolved pool. In order to examine the initiation and maintenance of K. brevis on the WFS, an ecological model (HABSIM) was developed using 22 state variables. Competition parameters among 4 phytoplankton pools were modeled to reproduce the observed HAB bloom from August to December 2001. We present the results and sensitivity for the 1-d hindcast simulations. Preliminary results of the 3-d simulations are also discussed.

LEON SOON, S. G., UNIVERSITY OF HAWAII AT MANOA, HAWAII INSTITUTE OF MARINE BIOLOGY, KANEHOE, USA, leonsoon@hawaii.edu

THOMAS, F. L., UNIVERSITY OF HAWAII AT MANOA, HAWAII INSTITUTE OF MARINE BIOLOGY, KANEHOE, fithtaking@hawaii.edu

INVESTIGATING THE EFFECTS OF BENTHIC ALGAL CANOPIES OF VARYING STRUCTURE ON WATER FLOW AND CHEMICAL EXCHANGE

Benthic structures such as macroalgal canopies interact with water flow resulting in attenuation of current and turbulence within the canopy. This attenuation of flow may modify rates of exchange between within-canopy and overlying water. Reduced exchange may help to explain observed vertical distributions of geochemical parameters such as dissolved nutrients (nitrate and ammonium) and pH. Hydrodynamic profiles were taken through Acanthophora spicifera and Gracilaria salicornia canopies in Kane‘hoe Bay, Hawaii, along with measures of within-canopy retention time and nutrient concentrations. Results demonstrated that the presence of benthic canopies can attenuate current flows by 32% to 64% (A. spicifera) and 89% to 99% (G. salicornia). There was a marked increase in nitrate (54% maximum) and ammonium (80% maximum) concentrations corresponding to increased attenuation and retention time. These results demonstrate that the interaction of algal morphology and overlying water flow can impact geochemical processes at the sediment water interface. This has implications for nutrient availability to other organisms in the system and suggests a possible mechanism driving the differential success of native and invasive species.

Leen Zayas, R. J., Scripps Institution of Oceanography–UCSD, San Diego, USA, rleonzay@ucsd.edu
Bartlett, B. H., Scripps Institution of Oceanography–UCSD, San Diego, USA, dbartlett@ucsd.edu

ISOLATION AND CHARACTERIZATION OF NOVEL PIEZOPHILIC MICROORGANISMS FROM PERU CHILE TRENCH SEDIMENT SAMPLES USING CHEMICAL GRADIENT CULTURING TECHNIQUES

Deep-sea microbial communities experience extreme conditions including low temperature, high pressure and absence of sunlight. Their adaptations render them both scientifically intriguing and difficult to culture in vitro. In this study, chemical gradient culturing was used to grow and isolate novel piezophiles (high-pressure-requiring microbes) from the Peru Chile Trench (PCT). Sediment samples from 6.1 km were collected (72°38’W, 32°10’S) using a multicore apparatus; sub-samples were re-pressurized on board and incubated at 4°C. A buffered basal salts minimal medium combined with gelatin produced slush gelatin chemical gradient cultures, in which inoculated microbes can migrate to their preferred concentrations of electron donors and acceptors. Tested electron donors and acceptors in various combinations included ammonium, manganese, sulfide, iron, nitrate and sulfate. Cultures were maintained in butyl rubber-stopper glass vials and at 62 megapascal (MPa) to simulate PCT conditions. From these it was possible to isolate pure cultures and determine their phylogenetic affiliations following 16S rRNA gene sequencing. Preliminary results indicate the isolation of two novel phyla of piezophiles: Fusobacter and Bacteroidetes. Detailed characterization and continued pursuit of new piezophiles are underway.

Lescaze, M. M., University of Vermont, Burlington, VT, USA, miranda.lescaze@uvm.edu
McCabe, D. J., Saint Michael’s College, Colchester, VT, USA, dnmccabe@smcvt.edu
Haselton, A. R., University of Vermont, Burlington, VT, USA, areiss@uvm.edu

ENGAGING HIGH SCHOOL AND UNDERGRADUATE STUDENTS IN WATERSHED RESEARCH: VT EPSCOR’S STREAMS PROJECT

Vermont EPSCOR’s Streams Project engages high school teachers and students and undergraduates in watershed research. The project enables students to experience the process of science, while providing the workforce necessary to build a large spatial dataset. The project is the mechanism by which workforce development, education and outreach, and diversity efforts are integrated into the Complex Systems Modeling for Environmental Problem Solving research program, an NSF-funded program at the University of Vermont. Streams Project participants collect and analyze water quality data and conduct a research study of their own design. The number and diversity of participants has increased to include high school teams from the Bronx, upstate NY, CT, RI, DE and Puerto Rico in addition to VT. 54 high school teams, 52 Vermont undergraduates, and 21 Puerto Rican undergraduates have participated in the program. Immediate outcomes include 70 student research projects, an online shared dataset including data from 168 sites on 65 streams, and web-based macroinvertebrate identification keys.

Letcher, R. T., University of Miami/RSMAS, Miami, USA, rletcher@rsmas.miami.edu
Hansell, D. A., University of Miami/RSMAS, Miami, USA, dhansell@rsmas.miami.edu

DISTRIBUTION AND DYNAMICS OF DISSOLVED ORGANIC NITROGEN IN THE SURFACE ARCTIC OCEAN

Little is known about the distribution and dynamics of the dissolved organic nitrogen (DON) pool within Arctic surface waters although it is likely that seasonal to interannual variability in both riverine transport and nutrient inputs are important. Here we combine multiple datasets to provide the first quasi-synoptic view of DON concentrations in the summertime Arctic Polar Surface Layer (PSL) and infer controlling processes. Distributions indicate inputs of DON by Arctic rivers but net consumption of this terrigenous material is observed across the resulting salinity gradients. Coupling of DON losses to PSL residence times indicate first order decay constants for tergigenous DON on the order of 0.05-0.1 yr⁻¹. In contrast, net biological production of ~1 µM DON is observed in the marine dominated PSL over the outer Chukchi shelf following seasonal sea ice retreat. These findings highlight the contrasting role of terrigenous versus marine derived DON in the elemental cycling of nitrogen in the surface Arctic Ocean.
Levas, S. J., The Ohio State University School of Earth Sciences, Columbus, USA, levas.1@osu.edu
Schoepf, V., The Ohio State University School of Earth Sciences, Columbus, USA, schoepf.4@osu.edu
Warner, M. E., University of Delaware College of Earth, Ocean, and Environment, Lewes, USA, mwarner@udel.edu
Grottioli, A. G., The Ohio State University School of Earth Sciences, Columbus, USA, grottioli.1@osu.edu

ENERGY RESERVES AND CALCIFICATION OF BLEACHED MONTASTREA FAVEOLATA, PORITES ASTREOIDES, AND PORITES DIVARICATA.

With the frequency of bleaching events predicted to increase, corals that are able to withstand and/or effectively recover from bleaching are more likely to persist in a changing global climate. In a study to determine strategies of bleaching survival, the effect of bleaching on energy reserve concentrations and calcification rates were determined for the Caribbean corals Montastrea faveolata, Porites astreoides and P. divaricata.

Coral fragments were experimentally bleached in outdoor flow-through tanks at temperatures of 31.5°C for 2.5 weeks. A suite of physiological parameters were measured on all fragments (lipid, carbohydrate, and protein concentrations as well as buoyant weight). Interestingly, bleached M. faveolata fragments had similar calcification rates and lipid concentrations than non-bleached fragments. Protein and carbohydrate concentrations were also similar for bleached and non-bleached M. faveolata. This is in contrast to previous work on three Pacific corals where at least one of not all energy reserve pools significantly decreased after bleeding events. Thus, energy reserve management in bleached Caribbean corals may differ from that of Pacific corals. Energy reserve concentrations for P. astreoides and P. divaricata will be presented.

Levy, J. L., Lancaster University, Lancaster, United Kingdom, jlevy@lancaster.ac.uk
Zhang, H., Lancaster University, Lancaster, United Kingdom, h.zhang@lancaster.ac.uk
Davison, W., Lancaster University, Lancaster, United Kingdom, w.davison@lancaster.ac.uk

USING DGT TO PROVIDE KINETIC SIGNATURES FOR METAL COMPLEXES: IN SITU CASE STUDIES

Diffusive gradient in thin films, while traditionally used to determine time-averaged concentrations of contaminants, can also be used to gain information on the kinetics of dissociation of metal-ligand complexes. DGT devices with different diffusion layer thicknesses are deployed simultaneously, the concentrations of a suite of trace metals measured and, from a series of calculations, a kinetic signature derived. The aim of this work was to investigate the kinetics of dissociation of metal-organic complexes for a variety of water bodies, where water quality parameters like pH, concentration of dissolved organic carbon (DOC) and the metal-to-ligand ratio differed. A number of headwater streams from non-impacted or mining-impacted regions were tested, along with an acidic lake and a productive lake. The productive lake was sampled before, during and immediately after the spring phytoplankton bloom, and again in winter to look at the seasonal influence of aquagenic DOC production on kinetic signatures. The relationship between Fe and Al with organic matter generally defines all signatures, but in some cases the dissociation of Cu, Co, Mn and Pb complexes were also partially kinetically limited.

Lewis, J. R., University of Maryland University College, Norfolk, USA, Lewisjr3@hotmail.com
Johnson, A. K., University of Maryland Eastern Shore, Princess Anne, USA, A-KJohnson@umes.edu

EFFECTS OF ACUTE HYPOXIA ON THE ATLANTIC CROAKER

Hyponcemia or low dissolved oxygen (D.O. ≤ 2.5 mg/l) is present all around the globe including the Chesapeake Bay. The Chesapeake Bay experiences summertime hypoxia annually with some parts of the Bay experiencing D.O. levels of 1 – 2 mg/l. Atlantic croaker, Micropogonias undulatus, is a bottom dwelling fish commonly collected from the hypoxic zone in Chesapeake Bay. In this study, we collected Atlantic croaker (n = 32) by hook-and-line off Deal Island, Maryland. Fish were acclimated to 1 mg/L (hypoxic; n = 16) and 5.5 mg/L (normoxic; n = 16) for 24 hrs under laboratory conditions. We determined that there were no significant changes in Atlantic croaker blood indices with the exception of aspartate aminotransferase (AST). Spleno-somatic indices were significantly lower in hypoxic fish than normoxic. The behavior of Atlantic croaker was different between hypoxic and normoxic treatments. Hypoxic fish were lethargic and appeared to conserve as much energy as possible. Obvious changes in physiological response were detected at 24hrs but some blood indices may require a longer timeframe for significant changes to be observed.

Li, B., Texas A&M University, College station, USA, acelibo@gmail.com
DiMarco, S., Texas A&M University, College station, USA, dimarco@tamu.edu
Guinasso, N. L., GERG, Texas A&M University, College Station, USA, guinasso@geos.tamu.edu

IN SITU TOWED OBSERVATIONS OF THE HYPOXIA ON THE TEXAS-LOUISIANA SHELF DURING THE YEAR 2010

Hypoxia, defined as 1.4 mg/L (2.0 mg/L) of dissolved oxygen (DO) on the Texas-Louisiana shelf, occurs seasonally and is believed to be largely the result of organic and nutrient loading from the Mississippi River and coastal wetlands and the increased vertical stratification and reduced mixing that occurs in the summer months. We present observations in summer 2010 by using an undulating towed vehicle containing a CTD, fluorometer, turbidity, and two dissolved oxygen sensors. Current velocity measurements were obtained using a ship-mounted 300-KHz ADCP. Compared to the year 2009, a much larger hypoxia area was found. Instead of the regular continuous low oxygen band along coast, this year’s hypoxia water mass was divided into several different parts and strong hypoxia was found in patches near and west of the Galveston Bay, Texas. Vertical structure of water column stability and vertical current shear show small spatial structures (scales of the order of several km) and a strong correlation is found between the stability of the water column and the near bottom dissolved oxygen.

Li, Q., Xiamen University, Xiamen, China, guodongqianqian@hotmail.com
Wang, G., University of Hawaii at Manoa, Honolulu, USA, guangyi@hawaii.edu
Jiao, N., Xiamen University, Xiamen, China, jiao@xmu.edu.cn

ECOLOGICAL STUDY AND MOLECULAR CHARACTERIZATION OF THRAUSTOCHYTRIDS IN HAWAIIAN WATERS

Thraustochytrids are ubiquitous and exclusive marine fungi-like osmo- and phototrophic microorganisms, which can reach up to 1,000,000 cells per liter water. Their special characterization such as the ability of accumulating lipids up to 50% of their body weight and the signature omega-3 polyunsaturated fatty acid (DHA) which are very important for human health and infant nutrition; the presence of carotenoid pigments and catalobic enzymes and utilization of a wide range of carbon and nitrogen sources indicate they may play an important role in the oceanic carbon storage and biotic carbon cycling. Besides, the trend of oil production by microbes has even increased interest in thraustochytrids as PUFAs sources. Thus our study focus on the occurrence and abundance of thraustochytrids in the water column in Hawaiian waters; the correlation analysis between thraustochytrids abundance and bacteria abundance and other environmental parameters; molecular characterization based on the rRNA gene of specific 18S primers; diversity comparison spatially and temporally with DGGE method, in order to help us understand their ecological niche and roles.

Lichtschlag, A., Max-Planck-Institute for Marine Microbiology, Bremen, Germany, allehs@mpi-bremen.de
Wenzhöfer, F., Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven, Germany, fwenzhoe@mpi-bremen.de
Janssen, F., Max-Planck-Institute for Marine Microbiology, Bremen, Germany, janssen@mpi-bremen.de
Struck, U., Museum for Natural History, Berlin, Germany, ulrich.struck@mfn-berlin.de
Donis, D., Max-Planck-Institute for Marine Microbiology, Bremen, Germany, ddonis@mpi-bremen.de

EFFECT OF VARIABLE OXYGEN CONDITIONS ON BENTHIC ACTIVITY AT THE CRIMEAN SHELF (BLACK SEA)

Benthic community activity and functioning strongly depends on the bottom-water oxygen level, which thus also influences the degradation of organic matter at the seafloor. Here we present data from a study that was performed on the Crimean Shelf (Black Sea), and investigated an area between 100-400 m water depths that was subjected to highly variable water column oxygen concentrations (0-150 μmol L⁻¹) oxygen). To study how benthic fluxes and processes react on daily changes in oxygen availability, measurements with microprofilers, an Eddy correlation system, and benthic chambers were carried out. Benthic oxygen fluxes were comparably low (dif- fusive fluxes: 1-9 mmol m⁻²d⁻¹; total fluxes 8-12 mmol m⁻²d⁻¹) and oxygen penetrated mostly less than 5 mm into the seafloor. This low benthic flux is in contradiction with the high content of freshly sedimented organic matter in the upper sediment
horizon. Apparently, the rapid fluctuation of bottom water oxygen concentration has a negative effect on benthic community activity including the microbial component. This study analyzes the link between temporal shifts in hypoxia and benthic performance and was done within the EU project HYPOX.

Liefie, J. D., University of South Alabama/ Dauphin Island Sea Lab, Dauphin Island, AL, USA, jliefer@disl.org
Macleay, H. L., Dalhousie University, Halifax, NS, Canada, hugo.macleay@dal.ca
Burnett, W. C., Florida State University, Tallahassee, FL, USA, bwburnett@fsu.edu
Viso, R., Coastal Carolina University, Conway, SC, USA, rviso@coastal.edu
Peterson, R., Coastal Carolina University, Conway, SC, USA, rpeters2@coastal.edu
McCoy, C., Coastal Carolina University, Conway, SC, USA, cmccoy@coastal.edu

THE INFLUENCE OF GROUNDWATER DISCHARGE AND BENTHIC COUPLING ON THE POTENTIALLY-TOXIC DIATOM PSEUDO-NITZSCHELIA SSP. AND OVERALL PHYTOPLANKTON COMMUNITY STRUCTURE

The potentially-toxic diatom *Pseudo-nitzschia* spp. is common in the northern Gulf of Mexico (NGOM). An area near Little Lagoon, AL, has been shown to be a hot-spot for *Pseudo-nitzschia* spp. blooms linked to aquifer discharge. Little Lagoon has been monitored bi-weekly since June 2007 to determine the environmental correlates of phytoplankton community structure and *Pseudo-nitzschia* spp. abundance. Seasonally, community structure and total nutrients appear to be driven primarily by temperature. Changes in the fucoxanthin:zeaxanthin ratio indicated a shift from diatom- to cyanobacterial-dominance at 26-29°C. Total N and P were also better correlated with temperature than with salinity and a poor correlation between nutrient levels and local precipitation/river discharge suggests that benthic coupling dominates nutrient inputs. High *Pseudo-nitzschia* abundance occurred over a wide temperature range (14-29°C) during periods of high groundwater elevation. Covariance between discharge and measurements of CTD moorings, surveys of radion and radon isotopes associated with submarine groundwater discharge (SGD), and sub-surface resistivity mapping are consistent with SGD and benthic coupling being the drivers of community composition and *Pseudo-nitzschia* abundance in the lagoon.

Liljehalv, B. L., Gothenburg University, Gothenburg, Sweden, beli@oce.gu.se
Steigerandt, A., Gothenburg University, Gothenburg, Sweden
Rahm, L., Linköping University, Linköping, Sweden
Hall, P., Gothenburg University, Gothenburg, Sweden

OXYGENATION OF LARGE NATURAL BASINS FOR NUTRIENT MANAGEMENT - THE BOX PROJECT

In future it might be interesting to oxygenate large natural basins for different reasons like nutrient management. In the 1990ies, the phosphorus content of the water column in the Baltic proper (horizontal surface area 250,000 square kilometers) was reduced by ca 40 % due to natural oxygenation of usually anoxic bottoms. This was caused by a short but strong climate change during which the top of the halocline was eroded from its usual depth at 60 m to about 100 m. It has been suggested that this ‘large-scale natural experiment’ could be used as a raw model to reduce the phosphorus concentration in the Baltic proper. Before such an enterprise in geo-engineering should be undertaken, one must know the long-term biogeochemical and ecological response of the Baltic proper upon oxygenation. Crucial biogeochemical, ecological and technological questions and risks are investigated by the pilot experiment BOX in which two coastal basins are oxygenated. Early oceanographic and biogeochemical research results from the coastal basins and from the assessments of risks with a full-scale pumping facility in the Baltic proper will be presented.

Lilly, L. A., Center for Watershed Protection, Ellicott City, USA, lal@cwp.org
Sturm, P. E., Center for Watershed Protection, Ellicott City, USA, pes@cwp.org

FINDING SOURCES OF CONTAMINATION IN TROPICAL WATERSHEDS: ILLICIT DISCHARGE DETECTION & ELIMINATION & SHORELINE SURVEY TECHNIQUES

Nutrient enrichment and fecal contamination can cause environmental degradation to coral reefs, sea grass beds and drinking water and also cause significant threats to public health. The Center for Watershed Protection (CWP) and local partners are continuing efforts to work with tropical watershed stakeholders to reduce land based sources of pollution by tracking sewage, septime and other sources of pollution to their source. Existing methodologies are being amended to detect illicit discharges in freshwater and the near shore environment in southwest Puerto Rico. A framework is being developed to define a replicable methodology for identifying and tracking down these problems in a cost effective and efficient manner. Results of initial field surveys indicate nutrient and bacteria hotspots in certain areas of the Rio Loco watershed, Guánica Bay and shoreline of La Parguera. Based on surrounding land use, physical indicators and water quality data collected in the field, sewage and other sources of pollution are implicated. Our initial data set and approach to detecting and eliminating these sources of pollution will be presented.

Lima, F. P., University of South Carolina, Columbia, USA, fpilma@biol.sc.edu
Wetley, D. S., University of South Carolina, Columbia, USA

ANALYSIS OF THREE DECADES OF HIGH-RESOLUTION COASTAL SEA TEMPERATURES

Coastal marine ecosystems are expected to be affected as the Earth warms, with important consequences for biodiversity, economy, and for the global supply of ecosystem goods and services. A better understanding of the warming process requires finer resolution temperature data, which has been hindered by the lack of global, accurate, high-resolution observations obtained by means of standardized methods. Recently, however, NOAA has released a cloud-free product offering unparalleled temporal and spatial resolution (Optimum Interpolation 1/4 Degree Daily SST Analysis data). Here we show that the rate of coastal warming has been highly heterogeneous worldwide, and that warming trends have varied not only regionally but also seasonally. We demonstrate that, in most of the world’s coastlines, the frequency of extremely cold events has significantly decreased while the frequency of extremely hot days has increased. Also, we show that the onset of the warm season is significantly advancing earlier in the year in most temperate coastal regions. For the first time, it is possible to analyze local patterns within the global context, which is extremely important for a broad array of scientific fields, policy makers and even for the general public.

Lima, V. N., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, vnicusbus@gmail.com.br
Oliveira, A. F., Instituto Estadual do Ambiente, Rio de Janeiro, Brazil, andreafranco-live@yahoo.com.br
Machado-Silva, F., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, fausto_msgs@yahoo.com.br
Sato, C. Y., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, yuji-sato@gmail.com
Andrade, P. M., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, pedrock_br@yahoo.com
Silva-Junior, E. F., Universidade Federal de São João del-Rei, São João del-Rei, Brazil, eduardobiodaventure@gmail.com
Lima, R. F., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, feijo_uer@hotmail.com
Moulton, T. P., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, moulton_uer.br

USE OF STABLE ISOTOPES OF CARBON AND NITROGEN FOR IMPACT AND BASAL FOOD RESOURCES ASSESSMENT IN STREAMS OF GUAPI-MACACU WATERSHED RIO DE JANEIRO, BRAZIL

We used the natural distribution of stable isotopes of carbon and nitrogen to investigate basal food resources for the food web of 21 forested streams in the Guapi-Macacu watershed system, Rio de Janeiro, and we evaluated if isotopic signatures of aquatic consumers responded to the land use and occupation in the catchment (agriculture, pasture and urban occupation). We collected periphyton, fine particulate organic matter and animals for stable isotope analyses. Aerial photos were used to classify and calculate the area of human impact. Allochthonous materials were the main source for one shredder and one collector filterer, both Trichoptera, that were uncommon in the streams studied. Autochthonous materials were the major basal resource for fishes, shrimps, crabs, Plecoptera and Odonata. The stable isotopes signatures of the majority of the consumers were not related to local impact area. Theses results suggest that delta13C and delta15N of aquatic consumers were not good indicators of local impact in this watershed system and that autochthonous materials were the principal energy source for the food web.

Lin, W., National Taiwan University, Taipei, Taiwan ROC, weiting.lin.lin@gmail.com
Miki, T., National Taiwan University, Taipei, Taiwan ROC, dsmk@mgtu.edu.tw
Hsieh, C., National Taiwan University, Taipei, Taiwan ROC, chsieh@ntu.edu.tw

EFFECTS OF ADAPTIVE DISPERSAL ON THE COEXISTENCE OF COMPETING CONSUMERS

Random dispersal has been considered to promote species coexistence in spatially structured habitats. However, the effects of nonrandom, especially adaptive dispersal...
on the coexistence of competing species remain unclear. We address this important problem by constructing a two-patch metacommunity model of two consumers competing for a single resource. We compared the effects of dispersal on the coexistence of consumers between three different modes: a random mode and two nonrandom modes using local or global information of resource availability. (i) With the random mode or nonrandom mode using the local information, fast dispersal of the superior competitor allows the coexistence with the inferior competitor, due to the maladaptive fashion of these dispersal modes. However, (ii) with the nonrandom mode using the global information (i.e. adaptive dispersal), fast dispersal of the superior competitor excludes the inferior competitor. (iii) With this adaptive dispersal, species coexistence is possible when the inferior competitor moves much faster than the superior competitor. These results strongly imply the importance of adaptive behavior in dispersal-mediated coexistence of species.

Lincoln, S. A., MIT, Cambridge, MA, USA, slincoln@mit.edu
DeLong, E. F., MIT, Cambridge, MA, USA, delong@mit.edu
Summons, R. E., MIT, Cambridge, MA, USA, rsummons@mit.edu

BIOMARKER INSIGHTS INTO ARCHAEOAL ECOLOGY IN OXYGEN MINI-
MUM ZONE WATERS OFF THE CHILEAN COAST

Persistently low dissolved oxygen levels (<10µM) in the Eastern Tropical South Pacific give rise to microbially-dominated communities which impact marine nitrogen, sulfur and carbon cycles. In particular, recent work has shown Marine Group I Crenarchaeota appear to be important nitrifiers in the oxycline. To investigate distributions and roles of marine archaeal groups in this environment we collected a depth profile of suspended particulate matter (0.3-3.0µm and >3µm fractions; >500 U/sample at 13 depths from 10 to 600m). Ether-bound glyceral dialkylglycerol tetraether (GDGT) lipids derived from marine archaea were measured by high performance liquid chromatography mass spectrometry. A significant spike in the lipid crenarchaeol, considered unique to crenarchaeota, was detected in the oxycline; by contrast, crenarchaeol was below the limit of detection in the deep OMZ where GDGT patterns atypical of marine environments emerged. A general trend toward GDGT-particle association with depth was observed. We employ intact polar lipids as a proxy for living biomass in order to distinguish between active archaean communities and detrital lipid material. Correlations between GDGT abundances, nutrients, cell counts and metatranscriptomic data are also explored.

Lind, O. T., Baylor University, Waco, TX, USA, oewen_lind@baylor.edu
Davalos-Lind, L. O., Baylor Univ. & Univ. Veracruzana, Waco, TX, USA, laura_davalos-lind@baylor.edu
Gantar, M., Florida International University, Miami, FL, USA, gantarm@fiu.edu
Berry, J., Florida International University, Miami, FL, USA, berryj@fiu.edu

NITROGEN DETERMINATION OF CYLINDROSPERMOPSIS RACIBORSKII
TRICHOME MORPHOTYPE

C. raciborskii, a potentially toxin-producing cyanobacterium, is expanding its range from tropical to temperate zones. Its tri- chomes are polymorphic within and among lakes and cultures. In Lake Catemaco, Veracruz, Mexico, it was described as a new species, C. catemaco. Sequencing has confirmed that it is C. raciborskii, but of different morphology than in other lakes and cultures. We previously reported a correlation of morphotype with lake nitrogen concentration (between wet and dry seasons). To test this observation we conducted controlled experiments using Lake Catemaco isolates. In the lake, straight, circular, and spiral morphotypes co-exist. Beginning with a culture containing all three, BG-II media cultures containing nitrogen lost circular morphotypes after two weeks. BG-I without nitrogen maintained a significant proportion of the circular morphotype. In the lake, heterocysts occur only on the circular morphotype suggesting a connection between ambient nitrogen and morphotype proportions. In experimental cultures, heterocysts initially appeared on circular trichomes, but later also on straight trichomes. Although the same three morphotypes occur in cultures and lake, the trichome sizes, structures and heterocyst shapes differ.

Linhoff, B. S., Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program, Woods Hole, USA, blinhoff@mit.edu
Breier, C., Woods Hole Oceanographic Institution, Woods Hole, USA, cbreier@whoi.edu
Charette, M., Woods Hole Oceanographic Institution, Woods Hole, USA, mcharette@whoi.edu

SUBMARINE GROUNDWATER DISCHARGE AS A SINK FOR URANIUM Submarine groundwater discharge (SGD) is an important vector for land-ocean chemical transport; fluxes are often modulated by biogeochemical cycling within the coastal aquifer’s seawater-freshwater mixing zone. We measured 234U/238U activity ratios (AR) and U concentrations at Waquoit Bay, a permeable sand subterranean estuary (STE) with steep gradients in salinity and redox conditions. Time series groundwater profiles across the STE were collected from fixed well points (2.4-5.5 m) during both summer and winter months. At 2.4 m, U was depleted (0.03 nM at salinity 0.61) and the 234U/238U AR was above secular equilibrium suggesting reduction of U in the STE. The deepest depth was enriched in U (22.0 nM at salinity 25.61) with a 234U/238U AR of 0.9617 suggesting U oxidation. Because U concentrations in the deepest profile were higher than seawater and groundwater, U must be sourced from a redox boundary in which U(VI) is periodically reduced to the immobile U(IV) and subsequently oxidized at depth. These data support U removal during SGD in Waquoit Bay and suggest SGD may be an important mechanism for U removal in the ocean.

Lionard, M., Université Laval, Québec, Canada, marie.lionard@bio.ulaval.ca
Pequin, B., Université Laval, Québec, Canada, bpequin@gmail.com
Lovejoy, C., Université Laval, Québec, Canada, connie.lovejoy@bio.ulaval.ca
Vincent, W. F., Université Laval, CEN, Québec, Canada, warwick.vincent@bio.ulaval.ca

CYANOBACTERIAL MATS FROM THE HIGH ARCTIC: MICROSENSOR
CHARACTERIZATION AND FLUORESCENCE RESPONSES TO A SALINITY
GRADIENT.

Cyanobacterial mats often dominate the total ecosystem biomass and productivity in polar lakes, ponds and streams. In this study we examined the mat communities in Canada’s northernmost lake, Ward Hunt Lake (83°11’ N, 74° 11’W) in Quttinirqaq National Park, Nunavut. Immediately after sampling, in vivo fluorescence of the community was measured using a PAM 2000 and oxygen and pH profiles were made throughout the mat using Universe microsensors. DNA, RNA and photosynthetic pigments derived using HPLC will be used to further characterize the mat communities. The microsensor profiles showed a decrease in oxygen concentrations and marked changes in pigment composition with depth in the mat. Moreover, this region is experiencing rapid climate warming which may lead to a negative precipitation / evaporation balance and thereby an increase in salinity. Additionally, salinity increases may occur during freeze-up. Our experimental analysis of salinity effects on the in vivo fluorescence parameters showed that the mats were extremely tolerant of osmotic shifts up to 15000 µS.cm-1 after 30 mins, up to 30000 µS.cm-1 over 8 h and up to 10000 µS.cm-1 over 24 h.

Lisi, P. J., University of Washington, Seattle, USA, pjlisi@u.washington.edu
Schindler, D. E., University of Washington, Seattle, USA, deschind@u.washington.edu

SPAWNING IN THE RAIN: GEOMORPHIC CONTROLS AND BIOLOGICAL
RESPONSES TO WATER SOURCE IN ALASKA SALMON BEARING STREAMS Heterogeneity in stream thermal regimes is driven by geomorphic and hydrologic characteristics of individual tributaries with potentially substantial implications for organisms living in these systems. We examined 30 first to third order streams in the Wood River system of Southwestern Alaska, which varied in average summer temperatures from 5 to 15°C. Oxygen stable isotopes of water were used to trace the relative contributions of rain and snow to surface discharge. Spawn-timing of sockeye salmon populations was correlated with seasonal stream temperatures where populations spawn early in cold, snow dominated streams while populations in warm, rain dominated streams spawn 2 to 3 weeks later. This variation in spawn timing is propagated to the phenologies of riparian plants and insects that rely on seasonal availability of salmon resources. Assessments of future climate conditions on salmon stocks will need to account for changes in the inputs of rain versus snow and how these interact with geomorphic features that maintain thermal regimes relevant to biology. Broad scale climate projections wash over the importance of such fine scale heterogeneity observed in naturally functioning watersheds.

Litchman, E., Michigan State University, Hickory Corners, USA, litchman@msu.edu
Klausmeier, C. A., Michigan State University, Hickory Corners, USA, klausme1@msu.edu

LINKING TRAITS AND ECOLOGICAL NICHES OF PHYTOPLANKTON TO
RESPONSES TO WATER SOURCE IN ALASKA SALMON BEARING STREAMS

Heterogeneity in stream thermal regimes is driven by geomorphic and hydrologic characteristics of individual tributaries with potentially substantial implications for organisms living in these systems. We examined 30 first to third order streams in the Wood River system of Southwestern Alaska, which varied in average summer temperatures from 5 to 15°C. Oxygen stable isotopes of water were used to trace the relative contributions of rain and snow to surface discharge. Spawn-timing of sockeye salmon populations was correlated with seasonal stream temperatures where populations spawn early in cold, snow dominated streams while populations in warm, rain dominated streams spawn 2 to 3 weeks later. This variation in spawn timing is propagated to the phenologies of riparian plants and insects that rely on seasonal availability of salmon resources. Assessments of future climate conditions on salmon stocks will need to account for changes in the inputs of rain versus snow and how these interact with geomorphic features that maintain thermal regimes relevant to biology. Broad scale climate projections wash over the importance of such fine scale heterogeneity observed in naturally functioning watersheds.

Litchman, E., Michigan State University, Hickory Corners, USA, litchman@msu.edu
Klausmeier, C. A., Michigan State University, Hickory Corners, USA, klausme1@msu.edu
groups. Major niche axes include resources, such as nutrients and light, physical parameters and grazing. Individual species and key functional groups of phytoplankton differ in their ecological niches and strategies, in part due to eco-physiological trade-offs, thus allowing coexistence of multiple species and promoting diversity. Some traits are conserved at high taxonomic levels and others are more labile. There are quantitative relationships between trait values of different taxonomic groups and their distributions along major environmental gradients. Changes in environmental conditions, including anthropogenic perturbations, may alter niches in a group-specific way, thus, affecting species packing and diversity.

Liu, H., Research Center for Environmental Changes, Nankang, Taipei, Taiwan ROC; bettyliu@gate.sinica.edu.tw
Chien, C., Research Center for Environmental Changes, Nankang, Taipei, Taiwan ROC; ctcchien@gate.sinica.edu.tw
Ho, T., Research Center for Environmental Changes, Nankang, Taipei, Taiwan ROC, tyho@gate.sinica.edu.tw

DISTRIBUTION AND SOURCES OF CU, CD, MN, & CO IN THE EAST CHINA SEA

We determined dissolved trace metal concentrations for Cd, Cu, Mn, and Co in the East China Sea in July 2010. The 32 isololineine in the surface water of the shell sea generally reaches 30°N during high discharge summer season. However, in July 2010, the isololine extended to 27°N due to severe rains and flooding in the upper and middle streams of the Changjiang River. Both Cd and Cu exhibited strong inversed correlations with salinity in horizontal and vertical distribution, demonstrating that the riverine discharge is the major source for Cd and Cu in the seawater. The Kuroshio water, also serves as the other end members to mix with the high Cd riverine discharge. Because Mn and Co are scavenging type metals they precipitate in the inner mouth region so that they do not correlate with salinity. The vertical distribution of Mn shows elevated concentrations originating from coastal sediments, particularly located in the coasts of sections 27-29°N. Co distribution generally shows a surface maximum feature, suggesting that aerosol transport is the major source for Co in the region. For both Mn and Co, their vertical profiles at one coastal station exhibit abnormally high concentration profiles. Elevated major nutrients concentrations have also been observed at the station for years, suggesting that there is a sedimentary source or submarine groundwater discharge source for Mn and Co at the coastal station.

Liu, H., The Hong Kong University of Science and Technology, Hong Kong, Hong Kong ROC; liuhb@ust.hk
Jing, H., The Hong Kong University of Science and Technology, Hong Kong, Hong Kong ROC; hongmei@ust.hk
Wong, T., The Hong Kong University of Science and Technology, Hong Kong, Hong Kong ROC

THE DIVERSITY AND IMPORTANCE OF PC-CONTAINING SYNECHOCOCUS IN SUBTROPICAL ESTUARINE WATERS

Picocyanobacteria of the Synechococcus group span a range of different colors, depending on their pigment composition. In order to prove the existence of Pc-rich Synechococcus, quantify their biomass, and reveal the diversity of picocyanobacteria in the estuarine waters, we used the phyocyanin cpeBA operon and phycoerythrin cpeEA operon to study the phylogenetic diversity and abundance of PC- and PE-rich Synechococcus in the estuarine and coastal waters of Hong Kong. Preliminary results revealed high diversity of both PC-only and PE-containing Synechococcus in Hong Kong waters. Results of quantitative PCR confirmed that PC-rich Synechococcus prevailed in the low salinity turbid water and during summer wet season, whereas PE-rich Synechococcus dominated in the high salinity coastal water and winter dry season. Our study is the first to demonstrate the importance of PC-containing Synechococcus in the subtropical estuarine environments. Understanding the spatial and temporal variations in the distribution of various ecotypes of Synechococcus in estuaries of large rivers is essential for the understanding of the biogeochemical cycle of carbon in estuaries, which play a key role in connecting the terrestrial and oceanic carbon cycles.

Liu, Y., Stony Brook University, Stony Brook, USA, yliu@ic.sunysb.edu
Collier, J. L., Stony Brook University, Stony Brook, USA, jcollier@notes.cc.sunysb.edu

HOW DO BLOOMS OF AUREOCOCCUS ANOPHAGEFFERENS (BROWN TIDE) AFFECT PLANKTONIC COMMUNITY STRUCTURE?

Resolving the biotic and abiotic factors that govern the distributions of organisms is a fundamental problem in microbial ecology. This study focuses on temporal and spatial patterns of microbial community structure within a coastal embayment that intermittently experiences brown tides, Great South Bay of Long Island, NY. Water samples were collected weekly from May to October in 2008 (a brown tide year) and May to December in 2009 (a no brown tide year). Terminal restriction fragment length polymorphism (TRFLP) of 185 and 186 rDNA amplicons was used as a fingerprinting technique to follow changes in plankton community structure. Results of multidimensional statistical analyses (NMS) conducted for each year separately showed that microbial community structure changed throughout the sampling season during both 2008 and 2009. Temperature, salinity and wind were important for shaping the community structure in 2008 while temperature seemed to be the most important factor in explaining patterns seen in 2009. NMS of all TRFs from both years combined suggested that the two years were separated along an axis associated with the abundance of Aureococcus anophagefferens.

Liu, Z., The University of Texas at Austin, Port Aransas, USA, zhanfei.liu@mail.utexas.edu
Liu, J., The University of Texas at Austin, Port Aransas, USA, jiqing.liu@mail.utexas.edu
Gardner, W. S., The University of Texas at Austin, Port Aransas, USA
Ostrom, N. E., Michigan State University, East Lansing, USA, ostromn@msu.edu

THE IMPACT OF DEEPWATER HORIZON OIL SPILL ON ORGANIC COMPOSITION OF THE SEA SURFACE IN THE NORTHERN GULF OF MEXICO

The Deepwater Horizon oil spill released about 4.9 million barrels of crude oil into the Gulf waters, and a large fraction of the oil stayed on sea surface at the initial stage of the spill, causing detrimental effects on marine ecosystem. Therefore, it is important to understand how organic composition of the surface water was affected by the oil spill. In May and August 2010, surface water (~10 cm, without visible oil) was collected from 6 stations within approximately 300 km to the spill site. We analyzed alkalines on these samples, and compared these components with the oil collected at Station OS, where extensive oil globs and sheens were observed. Our alkaline and other chemical analyses indicated that the surface water at these 6 stations was not affected much by the oil when oil was not visible. However, we observed that concentrations of dissolved free amino acids in the surface water at Station OS were greatly enhanced relative to other stations, and we attributed this to the inspired microbial activities due to addition of labile oil carbon.

Liu Yingwen, J. W., Jimei University, Xiamen, China, ljwsbch@yahoo.com.cn
Zhang /Zhihan, Z. L., Jimei University, Xiamen, China
Jiao /Nianzhi, N. Z., Xiamen University, Xiamen, China
Zheng /Tianling, T. L., Xiamen University, Xiamen, China

MOLECULAR CLONING, SEQUENCING AND EXPRESSION IN ESCHERICHIA COLI OF THE MAJOR CAPSID PROTEIN (MCP) GENE FROM MARINE EMILLIANIA HUXLEYI VIRUS (COCCOLITHOVIRUS)

We describe the cloning and expression in Escherichia coli of the major capsid protein (MCP) from Emiliania huxleyi virus EV-H991 isolate. The ORF of MCP encodes a protein of 497 amino acids with a calculated molecular mass of 55 kDa and IP 6.34. There is about 93%~100% identity in the conserved domain of nucleotide and 100% deduced amino acid sequence with other EVH isolates. Bioinformatic analysis shows that the conserved region of EVH strains MCP has high similarity in secondary structure and transmembrane domains which allow us to develop a specific marker for EVHs Phenotypes detection. Then, the MCP gene is subcloned into expression vector pGEX-4T-3 for overexpression in E. coli as GST-L1 fusion protein. Anti sera raised against purified GST-MCP fusion protein reacted specifically with purified EVH-991 virions, which could offer the potential to develop immunofluorescence techniques for the detection of EVHs infected cells. It is helpful for valuing EVH mediated death and its contribution to marine carbon pump due to the sinking of the coccoliths and associated organic matter in marine environment.

Ljungberg, P., Lund University, Lund, Sweden, peter.jungberg@linno.lux.se
Berg Hasper, T., Lund University, Lund, Sweden, thomas.haspen@gmail.com
Persson, A., Lund University, Lund, Sweden, anders.persson@linno.lux.se
Nilsson, P. A., Lund University, Lund, Sweden, anders.nilsson@linno.lux.se

THE EFFECTS OF HABITAT FRAGMENTATION ON TWO TROPHIC LEVELS WITHIN THE SEAGRASS COMMUNITY

Coastal environments are subjected to heavy disturbances and prerequisites for life are continuously altered, potentially influencing trophic interactions between its inhabitants. We have tested how increasing patchiness in seagrass beds (Zostera
UV-B exposed animals at all temperatures and of unexposed animals at 30°C. UV-B irradiated ovary showed evidence of reduced oogonial size and vacuolation in ovary tissue. At 30°C, UV-B exposed ovary showed no recognizable oocytes and very little organized germinal tissue. This is the first report of UV-B and temperature-induced histological damage of the germinal tissue which could explain the observed reduction in reproductive output.

Logan, C. A., Princeton University, Princeton, USA, cal2@princeton.edu
Donner, S. D., University of British Columbia, Vancouver, Canada, simon.donner@geog.ubc.ca
Dunne, J., NOAA/GFDL, Princeton, USA, john.dunne@noaa.gov
Eakin, C. M., NOAA/Coral Reef Watch, Silver Spring, USA, Mark.Eakin@noaa.gov

MODELING GLOBAL CORAL REEF BLEACHING UNDER CLIMATE CHANGE

Climate warming threatens to increase the frequency of mass coral bleaching events. Previous estimates suggest that corals will experience biannual bleaching by mid-century unless they can “adapt” at a rate of ~0.2–1.0°C per decade. However, corals living in more variable thermal environments appear to have higher resistance to bleaching. Regional variability in coral responses may also be sensitive to shifts in biogeographic provinces. Due to the sensitivity of coral reefs to extremes of warming, assessing how the statistics of extremes may change for individual regions is critical. Evaluated here are the latest predictions of global coral bleaching rates due to rising SST and associated climate changes based on a coupled climate earth system model forced by the newly established RCP scenarios for the next IPCC assessment (AR5). Building on previous bleaching models, these results incorporate thermal history and adaptability into a modified Degree Heating Month bleaching threshold. Earth System Model results will be presented for the RCP 8.5 scenario and discussed in the context of previous Special Report on Emissions Scenarios estimates.

Loh, A. N., Florida Gulf Coast University, Fort Myers, USA, anloh@fgcu.edu
Tomasello, L. L., Florida Gulf Coast University, Fort Myers, USA, lltomase@eagle.fgcu.edu
Ketover, R., Florida Gulf Coast University, Fort Myers, USA, rdketove@eagle.fgcu.edu

BENTHIC SOURCES OF NUTRIENTS AND CARBON TO THE GULF OF MEXICO

Nutrients can enter the water column through benthic flux by regeneration and remineralization. In the Gulf of Mexico (GOM), benthic sources of nutrients are not yet quantified. Understanding these sources (and sinks) is necessary to provide greater insights into various biogeochemical processes. In order to quantify this source, triplicate sediment cores from two Southwest Florida GOM sites and one inshore site were collected bi-monthly over 24 months. These cores were incubated at ambient temperature over four hours. Water samples were collected for dissolved organic carbon, nitrogen and phosphorus, and dissolved inorganic nitrogen and phosphorus analyses every 45 minutes; three in the light and three in the dark. Chamber nutrient fluxes were extrapolated to represent daily fluxes of dissolved organic matter between the sediment and water column. Daily dissolved nutrient fluxes did not exhibit a clear trend and varied by chemical species and season. Preliminary results indicate that ammonium fluxes from the sediments may be an important source of nitrogen to the water column, particularly during the summer and early fall months.

Lomas, M. W., Bermuda Institute of Ocean Sciences, St George’s, Bermuda, Michael.Lomas@ Bios.edu
Church, M. J., University of Hawaii at Manoa, Honolulu, USA, mjchurch@hawaii.edu
BATS AND HOT: COMPARATIVE ANALYSIS OF SIMILAR YET DIFFERENT MARINE ECOSYSTEMS

Much of our understanding of temporal variability associated with ocean biogeochemistry derives from sustained, systematic, shipboard time-series observations. Two of these time-series, the Bermuda Atlantic Time-series Study (BATS) and the Hawaii Ocean Time-series (HOT), have made measurements in the subtropical North Atlantic and North Pacific, respectively, for two decades. Interestingly, both time-series have similar daily rates of eutrophic zone integrated primary production and have observed a similar ~50% increase in these rates during their lifetimes. In both cases, increased primary production is driven in large part by increases in phytoplankton standing stock (derived from chlorophyll) despite large differences in other important ecosystem variables such as nutrients. For example, dissolved inorganic nitrogen and phosphorus inventories at HOT are nearly an order of magnitude greater than at BATS, yet particulate nitrogen and phosphorus inventories are the same. Phytoplankton communities also exhibit different trends with eukaryotes.
becoming an increasingly larger fraction of the autotrophic biomass at HOT, while at BATS the opposite is happening and carbon export fluxes at the base of the euphotic zone are increasing. These two systems seem to be ideal case studies due to data density as well as more complete datasets of ecosystem parameters, to understand how such drastically different systems can propagate nearly identical trends in carbon fixation.

Lomstein, B. B., University of Aarhus, Aarhus, Denmark
BACTERIAL ACTIVITY AND ORGANIC MATTER REACTIVITY IN SEDIMENTS OFF PERU

The spatial distribution of sulfate reduction activity and organic matter composition—changes were investigated at contrasting water depth in the Peru margin, at 14°S, the Danish Galathea 3 expedition. The objective was to study bacterial activity in parallel to bacterial alteration of the organic matters. Bacterial activity was assessed from sulfate reduction and diagenetic changes were evaluated from decreases in the contribution of amino acid carbon to total organic carbon and the production of non-protein amino acids from their protein precursor. Bacteria and their remains were traced by analysis of unique bacterial biomarkers (D-amino acids and muramic acid). The study clearly demonstrated a strong bacterial imprint in organic matter during early diagenesis in the form of living cells and bacterial necromass. Hence, the key players in organic matter mineralization became an increasingly important component of organic matter with ongoing degradation.

Long, M. H., University of Virginia, Charlottesville, USA, mhb4a@virginia.edu
Berg, P., University of Virginia, Charlottesville, USA
Rheuman, J. E., University of Virginia, Charlottesville, USA
Ziemann, J. C., University of Virginia, Charlottesville, USA
WHOLE REEF SYSTEM METABOLISM MEASURED IN SITU BY EDDY CORRELATION

Coral reefs present a challenging environment for in situ measurements of oxygen metabolism due to their complex three-dimensional structures, varying flow regimes, and hard surfaces. This makes it difficult or impossible to apply standard in situ methods such as chambers and microprofiling, and is why many coral reef studies have been conducted ex situ. The eddy correlation technique can be deployed non-destructively over reefs and produce integrated oxygen fluxes for the whole reef environment representing the natural composition of corals, algae, and other benthic organisms. Our measured net oxygen fluxes due to reef respiration and photosynthetic production reveal a very active and highly variable environment with oxygen fluxes significantly larger than those previously reported in the literature. The magnitude and direction of our reef fluxes are controlled by variables such as light, flow, temperature, and waves. We expect the eddy correlation technique to become widely instrumental in the future studies of coral reef metabolism due to its advantages over traditional methods as well as our observations of true in situ variations in productivity and respiration due to dynamic environmental parameters.

Longnecker, K., Bishop Museum, Honolulu, USA, klongenecker@bishopmuseum.org
Langston, R., Windward Community College, Kaneohe, USA, langston@hawaii.edu
EXPLORING THE FISHERY-ENHANCEMENT POTENTIAL OF HAWAII'S MESOPHOTIC CORAL ECOSYSTEMS

The deep-reef-as-refuge concept, combined with reigning views on marine reserve regimes, and hard surfaces. This makes it difficult or impossible to apply standard in situ methods such as chambers and microprofiling, and is why many coral reef studies have been conducted ex situ. The eddy correlation technique can be deployed non-destructively over reefs and produce integrated oxygen fluxes for the whole reef environment representing the natural composition of corals, algae, and other benthic organisms. Our measured net oxygen fluxes due to reef respiration and photosynthetic production reveal a very active and highly variable environment with oxygen fluxes significantly larger than those previously reported in the literature. The magnitude and direction of our reef fluxes are controlled by variables such as light, flow, temperature, and waves. We expect the eddy correlation technique to become widely instrumental in the future studies of coral reef metabolism due to its advantages over traditional methods as well as our observations of true in situ variations in productivity and respiration due to dynamic environmental parameters.

Loo, W. T., University of Southern California, Los Angeles, USA, wesley.loo@gmail.com
Soehn, J. A., University of Southern California, Los Angeles, USA, sohn@usc.edu
Webb, E. A., University of Southern California, Los Angeles, USA, eawei@usc.edu
INVESTIGATION OF NITROGEN FIXATION BY SULFATE REDUCERS IN AN INTERTIDAL MICRORIAL MAT

Marine intertidal mats represent a small-scale ecosystem of microbes, which include cyanobacteria and sulfate reducing bacteria (SRB). Though SRB are known diazotrophs, the extent to which they contribute to overall nitrogenase activity (NA), and how it fluctuates across the diel cycle is not well understood. Using the acetylene reduction assay, we investigated diazotroph communities during two timepoints with two experiments: the contribution of SRB to total NA was determined by molybdate inhibition and acetate was supplemented to investigate carbon limitation of NA. In June, NA strongly related to light availability, but showed increased activity overnight. Molybdate inhibition suggested that nighttime NA was likely due to SRB activity. Additionally, acetate additions showed carbon limitation of NA. In July, NA was lower overall, with no obvious diel pattern, and little NA attributable to SRB. Although there were clear contributions of the SRB to NA in June, the conflicting data from the same site later in the summer suggest large temporal variation in the diazotrophic community and emphasize the need for further study.

Lopez, O. L., University of Puerto Rico, Mayaguez, Puerto Rico, omarlopez2@upr.edu
Canals, M. F., University of Puerto Rico, Mayaguez, Puerto Rico, miguelc.canals@upr.edu
NUMERICAL SIMULATIONS AND FIELD OBSERVATIONS OF SURFZONE CURRENTS AT SELECTED RECREATIONAL BEACHES IN PUERTO RICO

Approximately 60% of Puerto Rico’s population does not know how to swim and an average of 25 people drown every year, most of them as a result of dangerous surf zone currents. This project seeks to study the hydrodynamics of several frequently visited beaches where surfzone current danger is present in an effort to warn and teach people how to prevent or what to do if they get trapped in these currents. The experiments consist of deploying GPS-equipped drifters in the surf zone and then plotting their trajectories. We then use a fully nonlinear Boussinesq wave model, BOUSS2D, to simulate the surfzone conditions for the deployment period. The modeled currents patterns are then compared with the surf zone drifter data and also with the trajectory of a real human body in the water. The next step, after thoroughly analyzing the results and validating the model, is to provide our data to local agencies so that they may prepare beach warning signs depicting the most likely current patterns at selected beaches in an effort to increase the public’s awareness of hazardous ocean conditions.

Lopez-Veneroni, D., Instituto Mexicano del Petroleo, Mexico City, Mexico, dgllopez@imp.mx
Salazar-Coria, L., Instituto Mexicano del Petroleo, Mexico City, Mexico, isalazar@imp.mx
OIL-RELATED BASELINE LEVELS IN TRIANGULOS REEF, BANK OF CAMPECHE (MEXICO)

Polycyclic aromatic hydrocarbons (PAHs) and stable carbon isotope were measured in coral (Montastraea cavernosa) and sponge samples from Triangulos Reef (Bank of Campeche). The reef is adjacent to Bay of Campeche, where 80% of Mexico’s crude oil is extracted, and a nearby offshore terminal loads petroleum to oil tankers. Six coral and six sponge samples were collected at depths between 8 and 19 m. δ¹³C values varied between -19.0 and -16.2 permil, which are significantly different from typical crude oil from Bay of Campeche reservoirs (-28 to -26 permil). Total PAH averaged 4.5 µg/Kg (wet-weight) in coral and 11.7 µg/Kg in sponge (excluding a sample with 147.4 µg/Kg), suggesting a relatively pristine environment similar to those from other reefs. Except for measurable concentrations of naphthalene and its alkylated homologues, most individual PAH concentrations in coral samples were below detection limits. The data suggests the presence of oil-derived compounds from either the oil field or Cayo Arcas marine terminal. These data, collected in September 2001, provide a baseline value, and may be used as reference for future impact studies.
tion states of calcite and aragonite were 3.2 and 2.1 respectively at the surface. As the carbonate chemistry of the upwelling water changed under the influence of biologi-

hexafluoride, as part of the NERC UK SOLAS programme, to determine how the filament off the coast of NW Africa was followed using drifting buoys and sulphur upwelling can lead to low calcium carbonate saturation states at the surface which to the surface triggering phytoplankton blooms. It has been shown, however, that upwelling can lead to low carbonate saturation states at the surface which can potentially adversely affect marine organisms, especially calcifiers. An upwelled filament off the coast of NW Africa was followed using drifting buoys and sulphur hexafluoride, as part of the NERC UK SOLAS programme, to determine how the carbonate chemistry of the upwelling water changed under the influence of biological and physiochemical processes. To our knowledge, this lagrangian study is the first of its kind. The initial (day 0) pH of the upwelling plume was 7.9 and the saturation states of calcite and aragonite were 3.2 and 2.1 respectively at the surface. As the plume migrated offshore over a period of 10 days, biological uptake of DIC reduced pCO2 concentrations from 600 to 400 ppm increasing pH to 8.05.

A star (*) represents Tutorial presentations

**BIOGEOCHEMICAL CYCLING OF CARBON DIOXIDE ALONG AN UPWELLING FILLAMENT OFF CAPE BLANC, NW AFRICA: RESULTS FROM A LAGRANGIAN STUDY**

The Mauritanian upwelling region is one of the most biologically productive systems of the world's oceans. Even so, it remains one of the least investigated upwelling systems. Coastal upwelling drives nutrients, and dissolved inorganic carbon (DIC) to the surface triggering phytoplankton blooms. It has been shown, however, that upwelling can lead to low carbonate saturation states at the surface which can potentially adversely affect marine organisms, especially calcifiers. An upwelled filament off the coast of NW Africa was followed using drifting buoys and sulphur hexafluoride, as part of the NERC UK SOLAS programme, to determine how the carbonate chemistry of the upwelling water changed under the influence of biological and physiochemical processes. To our knowledge, this lagrangian study is the first of its kind. The initial (day 0) pH of the upwelling plume was 7.9 and the saturation states of calcite and aragonite were 3.2 and 2.1 respectively at the surface. As the plume migrated offshore over a period of 10 days, biological uptake of DIC reduced pCO2 concentrations from 600 to 400 ppm increasing pH to 8.05.

**Louvorn, J. R.** Southern Illinois University, Carbondale, USA, louvorn@siu.edu

**Cooper, L. W.** University of Maryland, Solomons, USA, cooper@umes.edu

**Raisbeck, M. F.** University of Wyoming, Laramie, USA, raisbeck@uwyo.edu

**Chamberlain, K. R.** University of Wyoming, Laramie, USA, kchamber@uwyo.edu

**Brooks, M. L.** Southern Illinois University, Carbondale, USA, mlbrooks@siu.edu

**Grebmeier, J. M.** University of Maryland, Solomons, USA

**EXCEPTIONAL TRACE ELEMENT BURDENS OF EIDERS WINTERING IN THE BERING SEA MAY REFLECT OCEANOGRAPHIC CONCENTRATING MECHANISMS**

During late winter in the Bering Sea, levels of Se, Cu, and Cd in spectacled eiders were extraordinarily high (up to 489, 260, and 385 μg/g dry mass, respectively). Organ and blood samples during late winter, early spring migration, and breeding suggest that the eiders’ wintering site is a region of exceptionally high exposure to these elements. Lead isotope ratios suggest that high Se, Cu, and Cd in the eiders’ prey reflect levels in local sediments. However, element concentrations in bilevare prey in the core wintering region of eiders were up to 35%, 37%, and 20% higher, respectively, than in surrounding areas. This pattern may result from scavenging of these elements by blooming phytoplankton, and bedload advection into a persistent eddy of bloom materials deposited over a larger area. Strong uptake of limiting elements by blooming phytoplankton, and bedload advection into a persistent eddy

**Lucas, M. Q.** University of Puerto Rico, Mayaguez, USA, matthew.lucas@upr.edu

**Weil, E.** University of Puerto Rico, Mayaguez, USA, eweil@upr.edu

**Smith, M.** University of Puerto Rico, Mayaguez, USA, matthew.smith@upr.edu

**Schizas, N.** University of Puerto Rico, Mayaguez, nschizas@upr.edu

**GENETIC VARIATION OF SYMBIODINIUM SPP AND THE CORAL HOST HOST AGARICARIA LAMARCKI FROM MESOPHOTIC AND SHALLOW WATER POPULATIONS**

A recent study on the Great Barrier Reef has revealed strong patterns of association between coral host and symbiont lineages according to specific habitats (0-27 m). Mesophotic coral ecosystems (MCEs, reef habitats found in > 30 m) of southwestern Puerto Rico and their adjacent shallow water counterparts provide a unique system to examine the patterns of genetic connectivity for scleractinian corals and their algal symbionts (Symbiodinium spp.). Agaricaria Lamarcki (Scleractinia: Cnidaria) harbors symbionts and inhabits both shallow and mesophotic habitats. In this study, host-symbiont associations and patterns of genetic connectivity for A. Lamarcki were estimated among shallows (< 25 m) and mesophotic populations (50-70 m) of Mona Island, southwestern Puerto Rico, and St. Thomas, USVI. DNA sequences for

**Lukas, M.** University of Potsdam, Institute of Biochemistry and Biology, Potsdam, Germany, lukas@uni-potsdam.de

**Wacker, A.** University of Potsdam, Institute of Biochemistry and Biology, Potsdam, Germany, wacker@uni-potsdam.de

**STOICHIOMETRIC REGULATION OF D. MAGNA UNDER CHANGING FOOD QUANTITY AND QUALITY.**

The energy and nutrient transfer from autotrophs to herbivores is a key process in ecosystems, and depends on the concentration and nutritional quality of autotrophs. While recent studies documented the important role of biochemicals such as sterols as determinant of nutritional quality, we know little about the regulation mechanisms of the consumers concerning this essential food compound. Here we analyzed how the freshwater keystone genus Daphnia may deal with different concentrations and qualities of their food. Using 14C radio-labeling at two food quantity and two cholesterol levels, we measured the growth rates of Daphnia magna and investigated their stoichiometric regulation mechanisms such as assimilation, excretion and respiration. While animals grew fastest under best (high food, high cholesterol) and slowest under worst growth conditions (low food, low cholesterol), they showed the same growth under crosswise changed conditions. D. magna was able to compensate changing food conditions to some degree by regulating their rates of ingestion, defecation and respiration. This delivers further insights in the primary producer – consumers interface at changing environmental conditions.

**Luna, G. M.** Polytechnic University of Marche, Department of Marine Science, Ancona, Italy, g.luna@univpm.it

**Dell’Anno, A.** Polytechnic University of Marche, Department of Marine Science, Ancona, Italy, a.dellanno@univpm.it

**Bianchelli, S.** Polytechnic University of Marche, Department of Marine Science, Ancona, Italy, silvia.bianchelli@univpm.it

**Danovaro, R.** Polytechnic University of Marche, Department of Marine Science, Ancona, Italy, r.danovaro@univpm.it

**THE DARK PORTION OF THE MEDITERRANEAN SEA IS A BIOREACTOR OF ORGANIC MATTER CYCLING**

Total prokaryotic abundance, prokaryotic heterotrophic production (PHP) and extracellular enzymatic activities (EEAs) were investigated in epi-, meso- and bathypelagic waters along a longitudinal transect covering the entire Mediterranean Sea. EEAs and PHP in deep waters were among the highest reported worldwide at similar depths, indicating that the peculiar physical-chemical characteristics of the basin support high rates of OC degradation and utilisation by prokaryotes. The easternward decreasing pattern of trophic conditions in epipelagic waters was reflected by higher EEAs and PHP rates in the Western than the Central-Eastern basin. While all variables decreased significantly from epi- to meso- and bathypelagic waters, cell-specific EEA and cell-specific PHP significantly increased. In addition, deep-waters were characterized by low values of half-saturation constant (Km) of all EEAs. These findings suggest a high efficiency of prokaryotes in channeling degraded carbon into biomass in the dark portion of the Mediterranean and let hypothesize that the deep Mediterranean basin is a bioreactor of organic matter cycling. EEAs and PHP in deep waters were primarily controlled by oxygen availability and temperature. Since climate change is expected to rise deep-water temperatures and alter the overall circulation of the basin, we conclude that these processes will result in faster carbon cycling and altered biogeochemical processes at the basin scale.

**Lunden, J. J.** Temple University, Philadelphia, USA, jlunden@temple.edu

**Cordes, E. E.** Temple University, Philadelphia, USA, ecordes@temple.edu

**LOW ARAGONITE SATURATION STATES SURROUNDING DEEPWATER CORAL COMMUNITIES IN THE NORTHERN GULF OF MEXICO**

One consequence of ocean acidification is the reduction of the CaCO3 saturation state of seawater and the subsequent shoaling of the aragonite saturation horizon (ASH). This value is significant to aragonite-secreting organisms, and several investigators have reported a direct correlation between calcification and omega. In the northern GoM, the scleractinian Lophelia pertusa forms expansive bioliths at depths from 300-600m. We recently sampled bottom waters and conducted CTD casts from sur-
face to 2600m at 14 stations across a range of 600km. We measured total alkalinity and pH and discovered coral sites that are nearly undersaturated with aragonite. In waters deeper than 300m, pH ranged from 7.85-8.03, TA ranged from 2264.17-2381.51 μmol/kg-SW, and aragonite ranges from 0.98 to 1.69. Furthermore, the ASH in the northern GoM is presently at 2600m. Despite the low omega conditions encountered in this work, L. pertusa persists and sustains bioherm formation at the lowest saturation states yet documented for scleractinian corals. Furthermore, these results represent the first empirical measurements of omega in deep waters of the northern GoM, which is frequently omitted in future OA scenarios.

Lundin, E., Umeå University, Umeå, Sweden, erik.lundin@emg.umu.se
Giesler, R., Umeå University, Umeå, Sweden, reiner.giesler@emg.umu.se
Persson, J., Umeå University, Umeå, Sweden
Thompson, M., Umeå University, Umeå, Sweden

Karlsson, J., Umeå University, Umeå, Sweden, jan.karlsson@emg.umu.se

CO2 EMISSIONS FROM LAKES AND STREAMS IN A SUBARTIC CATCHMENT
The partial pressure of CO2 (p CO2) was sampled monthly in 27 lakes (14.5-0.1 ha) and biweekly in streams (width: 1-9 m) at 23 locations during the ice-free season (May-Oct). Emission of CO2 to the atmosphere was estimated from p CO2 and gas exchange coefficients for respective system. The CO2 emission from lakes during ice break-up in spring was estimated from accumulated CO2 under ice during winter. Our results show that all aquatic systems were net sources of CO2 to the atmosphere on an annual basis but also on considerable spatial and temporal variability. The CO2 emission during ice break-up was the most important efflux event from lakes accounting for more than half of the annual lake CO2 emission. During the ice-free season lakes ranged from being net sources to being net sinks of CO2, resulting in low average summer CO2 emission from lakes compared to the total annual aquatic emission from the catchment. Instead, streams, even though they only account for approximately 4% of the total aquatic area, dominated the annual aquatic CO2 emission from the catchment.

Luria, C. M., Brown University, Providence, USA, cmluria@gmail.com
Franklin, R. B., Virginia Commonwealth University, Richmond, USA, rfranklin@vcu.edu
Ozaki, L. S., Virginia Commonwealth University, Richmond, USA, lsozaki@vcu.edu
Bukaveckas, P. A., Virginia Commonwealth University, Richmond, USA, pabukavecka@vcu.edu

SHIFTS IN BACTERIOPHARKTON COMMUNITY COMPOSITION AND ACTIVITY STATE IN RESPONSE TO CHANGING ENVIRONMENTAL CONDITIONS IN THE TIDAL-FRESHWATER JAMES RIVER
Aquatic bacterial assemblages are frequently dominated by dormant individuals, while the bulk of ecosystem material and energy cycles are mediated by relatively small, metabolically active segments of the community. Shifting between dormant and active states may allow bacteria to persist under unfavorable conditions and react quickly to environmental gradients. In order to examine how the size and composition of the active segment of the community responded to changing environmental conditions in the tidal-freshwater James River, we contrasted water column bacterial abundance, community composition, and activity state between sites with varying levels of nutrient and organic matter availability. Additionally, we conducted a series of microcosm experiments wherein we manipulated resource availability in order to identify those factors which were most strongly linked with bacterial community characteristics. Simultaneous high throughput sequencing on 16S rDNA and rRNA showed that the rRNA-generated profiles of active taxa shifted even while overall community composition did not. Surprisingly, taxa with low rank abundance were more likely to be active. However, assessment of activity state based on RNA:DNA ratios merits further discussion.

Lutz, B. D., Duke University, Durham, USA, brian.lutz@duke.edu
Bernhardt, E. S., Duke University, Durham, USA, ebernhardt@duke.edu
Roberts, B. J., Louisiana Universities Marine Consortium, Chauvin, USA, broberts@lumcon.edu
Mulholland, P. J., Oak Ridge National Laboratory, Oak Ridge, USA, mulhollandp@ornl.gov

EXAMINING THE COUPLING OF CARBON AND NITROGEN CYCLES IN APPALACHIAN STREAMS: THE ROLE OF ORGANIC NITROGEN
The small watershed ecosystem approach has been central to understanding element fluxes within the landscape. For essential elements, such as nitrogen (N), biogeochemical theory for predicting ecosystem losses is rooted within stoichiometric principles derived from Leibig's Law—as demand for an element decreases relative to its supply we expect increased watershed export. This prediction presupposes that elements, prior to uptake, comprise discrete pools with independent dynamics. But many essential elements within ecosystems are bound in a matrix of heterogeneous organic molecules derived from one living biomass. Organically bound nutrients may be governed not only by direct biological demand, but also by indirect demand for the elements to which they are attached. We present data from repeated stream water surveys along an N-deposition gradient in which organic-N concentrations unexpectedly decreased under elevated N-loading. Laboratory experiments indicate this non-intuitive decline in organic-N could result from increased microbial demand for reduced carbon. Our results both provide important insight into understanding the nuances of element cycle coupling, and for how organic-N losses—the dominant form of riverine N export globally—might respond to anthropogenic N-loading.

Lyons, B. R., Hollings Marine Laboratory, Medical University of South Carolina, Charleston, USA, bryon@musc.edu
Lee, P. A., Hollings Marine Laboratory, College of Charleston, Charleston, USA, leep@cofc.edu
DiTullio, G. R., Hollings Marine Laboratory, College of Charleston, Charleston, USA, dittullo@cofc.edu
Janek, M. G., Dept. of Medicine, Medical University of South Carolina, Charleston, USA, janechmg@musc.edu

DIATOM PROTEOMICS IMPLICATE IMPORTANT OF ACTIVATED METHYL CYCLE IN DMSP PRODUCTION
The biogenic compound dimethylsulphoniopropionate (DMSP) plays important roles in carbon, sulphur and climate cycles. Diatom-dominated sea-ice communities have high DMSP, in contrast to typical low levels in temperate species. Extreme conditions within the sea-ice, such as salinity, temperature, light and CO2 limitation could trigger production of this proposed compatible solute and antioxidant. Salinity experiments with the polar diatom Fragilariaopsis cylindrus show intracellular DMSP increases 70% under hypersaline conditions. Two-dimensional gel electrophoresis and tandem mass spectrometry identified a subset of proteins with significant changes in relative abundance (p<0.02, 5 biological replicates). Results include decreases in light-harvesting complex protein and increases in general stress response, amino acid synthesis and S-adenosyl methionine (SAM) active methyl cycle proteins. This later group of proteins indicates the activated methyl cycle could be an important part of DMSP synthesis. Quantitative PCR showed genes for active methyl cycle proteins are up-regulated in high salinity/DMSP conditions. Understanding the impact of environmental parameters on the cellular biology associated with DMSP production is of critical importance to predicting effects of climate change and sea-ice loss on global biogeochemical cycles.

Lyons, M. M., Old Dominion University, Norfolk, USA, mmylons@odu.edu
Dobbs, F. C., Old Dominion University, Norfolk, USA, fdobbs@odu.edu
Ward, J. E., University of Connecticut, Groton, USA, eward@uconn.edu

MICROSCOPIOC ISLANDS: THE ROLE OF ORGANIC AGGREGATES IN THE ECOLOGY OF BACTERIA IN RECREATIONAL WATERS
Understanding the microbial ecology of aquatic pathogens that are associated with organic aggregates is important with respect to (1) environmental monitoring of recreational waters, (2) the persistence and dispersal of pathogens in the environment, (3) the accumulation of pathogens in suspension-feeding bivalve mollusks (e.g., oysters and clams), and (4) the mathematical modeling of transmission of waterborne diseases from aquatic reservoirs to humans. In the context of the MacArthur-Wilson Theory of Island Biogeography, we earlier demonstrated that detrital-based organic aggregates (e.g., marine snow, organic detritus, and bioflocs) provided a favorable microhabitat (i.e., an “island”) for bacteria in general, and specifically for potential aquatic pathogens such as sucrose-fermenting vibrio species and fecal indicator bacteria. Aggregate-associated microbes were more metabolically active and functionally diverse than their freely suspended counterparts. In addition, potential pathogens persisted at higher concentrations and for longer periods of time when associated with organic aggregates. Building upon these results, we have now evaluated the role that the distance from a likely source and founder effects contribute to the distinctiveness of individual aggregates. Our results support the importance of organic aggregates in the concentrations and persistence of the microbial community in aquatic ecosystems.
Kingsbury, K. V., Paleoecological Environmental Assessment and Research Laboratory (PEARL), Queen’s University, Kingston, Canada, susan.ma@queensu.ca

Ma, S., ASLO 2011 ASLO Aquatic Sciences Meeting (PEARL), Queen’s University, Kingston, Canada, lairdk@queensu.ca

Laird, K. R., Paleoecological Environmental Assessment and Research Laboratory (PEARL), Queen’s University, Kingston, Canada, lairdk@queensu.ca

Wolanski, E., James Cook University/Australian Institute of Marine Science, Townsville, Australia, bpalenik@ucsd.edu

Macduff, S. D., University of Hawaii/Kewalo Marine Laboratory, Honolulu, USA, maceduff@hawaii.edu

Zeigler, L., J. Craig Venter Institute, San Diego, USA, lzeigler@jcvi.org

Palenik, B., Scripps Institution of Oceanography, University of California, San Diego, USA, bpalenik@scripps.edu

METAGENOMIC ANALYSIS REVEALS THE DIVERSITY AND GENOME DYNAMICS OF CYANOPHAGES IN OCEANIC ENVIRONMENT

yanophages are abundant in the oceanic environment. Two samples were collected from coastal Maine 2009 and flow cytometry was used to enrich Synechococcus cells for metagenomic sequencing. An unexpected result was that almost half of the reads were assigned as cyanophage sequences. Using several important protein sequences of cyanophages as markers (T4-DNA polymerase, T7 DNA polymerase, T7 RNA polymerase, g20, g23, terminase and primase-helicase), we found that cyanophages are more diverse than their cultured counterparts. Comparison of the cyanoviral contigs with the known cyanophage genomes indicated that genetic exchange occurs with high frequency among the cyanophage community. Analysis of the cyanobacterial host-derived genes showed the different extent of genetic exchange of different genes between phage-host and phage-phage. In addition to the well-studied host-derived genes, many novel host-derived genes were found. CRISPR-PRIS-like analysis in the Maine metagenomes surprisingly indicated many CRISPR sequences and possibly associated proteins suggesting that these cyanophages may supply their hosts with the ability to resist other viruses.

Moore, C. M., National Oceanography Centre, Southampton, United Kingdom, c.moore@noc.soton.ac.uk

Macey, A. J., National Oceanography Centre, Southampton, United Kingdom, a.macey@noc.soton.ac.uk

Bibby, T. S., National Oceanography Centre, Southampton, United Kingdom, tsb@noc.soton.ac.uk

ASSESSING COMMUNITY LEVEL PHYSIOLOGICAL RESPONSES TO IRON AVAILABILITY IN THE HIGH LATITUDE NORTH ATLANTIC THROUGH QUANTIFICATION OF KEY METABOLIC PROTEINS

Iron (Fe) has not traditionally been considered to play a major role within the biogeochemistry of the high latitude North Atlantic. However, recent research in the Iceland basin suggests the formation of a seasonal High Nutrient Low Chlorophyll (HNLC) condition after the spring bloom. Here we present data from a series of Fe addition bioassay experiments (120 hour) performed on 2 cruises in the Iceland and Irmingier Basins in May and July 2010. These data show changes in photochemical efficiency (Fv/Fm) and in the abundance of key proteins that can set an upper limit on community production. Fv/Fm was observed to increase in response to Fe addition. The abundance of Photosystem II (PsbA protein) also increased upon Fe addition (5.4 pmol mg\(^{-1}\) total protein) compared with control communities (1.4 pmol mg\(^{-1}\) total protein), with similar trends observed in the abundances of RuBisCO (RbcL protein) and ATP synthase (AtpB protein). Our results indicate that the community level microbial physiological response to Fe addition is driven by increases in the abundance of these proteins and hence the potential maximum capacity of photosynthesis.

Maunala-Bay, H. S., University of Hawaii/Kewalo Marine Laboratory, Honolulu, USA, maceduff@hawaii.edu

Wolanski, E., James Cook University/Australian Institute of Marine Science, Townsville, Australia, richmond@hawaii.edu

Sedimentation from adjacent watersheds is an increasing problem for coastal marine ecosystems. With increased coastal development, increased sediment loads are being deposited onto adjacent coral reefs, seagrass meadows, and other biological communities. Maunala Bay has a sedimentation problem exacerbated by the presence of the invasive alga, *Avrainvillea amadelpha*. Community based groups, in partnership with local and federal agencies, have attempted to restore Maunala Bay by manually removing 22 acres of *A. amadelpha* at Kalakaua Lagoon Peninsula (PLP). This study investigated the effectiveness of algal removal as a means to reduce sediment accumulation and re-suspension. A sediment re-suspender and turbidity-meter were used to measure re-suspendable sediment in cleared and uncleared plots at PLP. Data showed some significant differences in the amount of sediment between cleared and uncleared plots and among sample days. There was significantly more fine sediment in shallow plots compared to deep plots. A relatively mild south shore surf season and typical coastal current conditions were possibly responsible for the re-occupation and retention of sediment at PLP.

Macleay, A. J., National Oceanography Centre, Southampton, United Kingdom, a.macey@noc.soton.ac.uk

Bibby, T. S., National Oceanography Centre, Southampton, United Kingdom, tsb@noc.soton.ac.uk

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Macedo-Silva, F., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, fausto_ms@yahoo.com.br

Lima, V. N., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, viniciusbusig@gmail.com

Sato, C. Y., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, yuji-sato@gmail.com

Oliveira, A. F., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, andreafrancomil@yahoo.com.br

Andrade, P. M., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, pedrock_br@gmail.com

Silva-Junior, E. F., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, eduardobioadventure@gmail.com

Lima, R. F., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, rafael.feijo.bio.uerj@gmail.com

Moulton, T. P., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, moulton@wb.com.br

DETECTING ENVIRONMENTAL IMPACT USING STABLE ISOTOPES IN PERiphyton AND FPOm OF COASTAL FOREST STREAMS IN RIO DE JANEIRO STATE, BRAZIL.

We investigated if isotopic composition of system components of streams can respond to anthropogenic alterations in a river landscape. Environmental managers have sought biomonitoring tools that reflect ecosystem functioning as well as correlate sensitively with impacts. Stable isotope ratios of carbon and nitrogen relate to food webs and nutrient cycling as well as to potential sources of pollution. We tested if the stable isotopic composition of carbon (delta13C) and nitrogen (delta15N) of periphyton, fine particulate organic matter and filamentous algae responded to anthropogenic impacts in this hydrologic basin. The anthropogenic impacts were riparian deforestation, agriculture, pasture and urban occupation. We quantified these using satellite imagery and measurement of water chemistry. Delta13C values of periphyton, FPOM and algae did not respond to anthropogenic alteration. Delta15N values of periphyton and macroalgae increased with landscape alteration. This is probably because these components assimilate enriched inputs such as sewage and fertilizers. Delta15N of periphyton was very sensitive to small changes in landuse and was linearly related to percent alteration. It can be a powerful tool for monitoring and restoration programs of this region.
MacIntyre, H. L., Dalhousie University, Halifax, Canada, hugh.macintyre@dal.ca

Cox, R., Kaitech Inc., Wellesley, USA, tooque@earthlink.net

LASER-INDUCED FLUORESCENCE EMISSION SPECTRA AS A TOOL FOR ASSESSING MICROALGAL COMMUNITY COMPOSITION IN VIVO

Taxonomically-based differences in pigment complement and fluorescence excitation signatures were described in the 1990s and have been tested as a means to discriminate between groups in vivo since the 1970s. Several commercially-available instruments use LED excitation with single-channel detection. We propose an alternative approach based on spectral emission signatures, excited by lasers centered at 532, 635 and 650 nm. These were selected to maximize discrimination between cyanobacteria, cryptophytes, chlorophytes and chromophytes, based on the distributions of phycoerythrins, phycocyanins, photosynthetic carotenoids, and b and c chlorophylls. The use of relatively long-wavelength and narrow-bandwidth excitation minimizes biases introduced by other optically-active components in natural waters. Quenching due to absorption by chromophoric dissolved organic material and pathlength enhancement due to suspended particles are both maximal at short wavelengths. No difference in instrumentation can surmount within-taxon variability, which confounds attempts to classify populations by assigning a single unique fluorescence signature to each taxonomic group. We propose an alternative approach that accounts for within-group variability. The signature of the unknown sample is compared to discrete clusters of known signatures and community composition is described using categorical analysis.

MacIsaac, H. J., University of Windsor, Windsor, Canada, hughm@uwindsor.ca

Sylvestre, F., University of Windsor, Windsor, Canada, 56@uwindsor.ca

Kalaci, O., University of Windsor, Windsor, Canada

MODELS TO PREDICT INVASION RISK VIA SHIPS’ HULL FOULING

Vector regulation is an effective way to manage invasive species (NIS) and their impacts. While ships’ ballast water is well studied and managed, hull fouling has received less attention and regulation. We conducted in situ sampling and video recording of hulls of 40 transoceanic vessels to assess propagule and colonization pressure in Vancouver and Halifax, Canada’s largest ports, and of harbour fouling communities. Hull and harbour communities were highly divergent, with Sørensen’s similarity values of 0.03 in Halifax and 0.01 in Vancouver, suggesting invasion risk remains high. Propagule (up to 600,000 ind./ship) and colonization pressure (up to 156 species/ship) were high and varied significantly between ports, with Vancouver receiving much higher abundances and diversity of potential NIS. The higher risk of fouling introductions in Vancouver is consistent with historical patterns of successful foul-ing invasions. Propagule pressure increased with time spent in ports of call and time since last application of antifouling paint, whereas colonization pressure increased with time since last painting and the number of regions visited by the ship. Propagule and colonization pressure were negatively related to time at sea and latitude of ports visited. Hull fouling has a strong potential for introduction of NIS to coastal, marine habitats and management should be considered.

Mackenzie, F. T., University of Hawaii, Honolulu, USA, fredm@soest.hawaii.edu

DeCarlo, E. H., University of Hawaii, Honolulu, USA, edecarlo@soest.hawaii.edu

LAND-SEA BIOGEOCHEMICAL INTERACTIONS GLOBALLY AND IN TROPICAL SMALL MOUNTAINOUS ECOSYSTEMS

A disproportionately large amount of fluvial water and sediment, 65% and 58%, respectively, of total discharges is delivered to subtropical and tropical shelf areas. Small mountainous rivers probably account for more than 50% of total sediment discharge to the ocean, which is often storm related. Since the Last Glacial Maximum, freshwater material inputs to the coastal ocean have risen and coastal waters acidified. Subtropical/tropical watershed-coastal ocean ecosystems exhibit spatially and temporally variable water quality characteristics, and area specific coastal water nutrient, CO2, and O2 fluxes. From our many years of work in Kaneohe Bay, Hawaii, and its watersheds, we postulate some biogeochemical principles that are applicable worldwide to mountainous watershed-coastal ocean ecosystems. Expected patterns of climatic change and land-use practices in the 21st century will significantly modify the characteristics of mountainous watersheds, freshwater material inputs to their coastal zones, and proximal coastal ocean biogeochemistry.

Mackey, K. R., University of California, Santa Cruz, Santa Cruz, USA, kmackey@stanford.edu

Casey, J., Bermuda Institute of Ocean Science, St George, Bermuda, jrcasey@bихaw.edu

Chen, Y., Fudan University, Shanghai, China, yinchhen@fudan.edu.cn

Lomas, M. W., Bermuda Institute of Ocean Science, St George, Bermuda, michael.lomas@bios.edu

Post, A., Marine Biological Laboratory, Woods Hole, USA, apos@nbbl.edu

Parcasio, C. A., Institute for Chemical Research, Kyoto University, Uji, Kyoto 611-0011, Japan, ashibagilli@inter5.kuic.kyoto-u.ac.jp

Sohrin, Y., Institute for Chemical Research, Kyoto University, Uji, Kyoto 611-0011, Japan, sohrin@escl.kyoto-u.ac.jp

Paytan, A., University of California, Santa Cruz, Santa Cruz, USA, apaytan@ucsc.edu

PICOPHYTOPLANKTON GROWTH AND TOXICITY RESPONSES TO ATMOSPHERIC METAL DEPOSITION

There is mounting evidence that different metal requirements and toxicity thresholds among phytoplankton species and strains help determine their distribution and abundance in the ocean. We review the results of two studies that assessed the impact of atmospheric metal deposition on phytoplankton in the northern Red Sea, a region with very high deposition, and the western Sargasso Sea, a region with less deposition. We added aerosols with different metal contents to natural phytoplankton assemblages in each of these regions and monitored growth responses. Some additions enhanced growth, while others resulted in toxicity. Sensitivity differed among taxa and with location. To determine the range of toxicity responses in coastal and oceanic phytoplankton, culture experiments were performed using pure metal additions. Oceanic strains generally had lower toxicity thresholds and decreased growth rates at sub-toxic metal concentrations, whereas coastal strains were more robust. These strain-specific responses have likely arisen from different environmental pressures and evolutionary forces in the coastal and open ocean, and suggest that aerosol metal deposition could potentially alter patterns of primary production and phytoplankton community structure throughout the world’s oceans.

Madsen, K., AIME Earth & Environmental, Nashville, USA, keld.madsen@aime.com

Zimmer, B., PBS&J, Miami, USA, bizimmer@pbsj.com

Deis, D., PBS&J, Jacksonville, USA, ddeis@pbsj.com

Lindsey, J., AIME Earth & Environmental, Nashville, USA, jodi.lindsey@aime.com

Gelber, A., PBS&J, Miami, USA, agelber@pbsj.com

Hearme, L., AIME Earth & Environmental, Nashville, USA, Lonnie.hearme@aime.com

Fritze, B., AIME Earth & Environmental, Nashville, USA, brett.fritze@aime.com

Sloger, W., CSA International, Stuart, USA, wslsomer@consshelf.com

Sinclair, J., Department of Interior/Bureau of Ocean Energy Management Regulation and Enforcement, New Orleans, USA, james.sinclair@boemre.gov

Rasser, M., Department of Interior/Bureau of Ocean Energy Management Regulation and Enforcement, Herndon, USA, michael.rasser@boemre.gov

Metzger, K., CSA International, Stuart, USA, kmetzger@consshelf.com

Phillips, N., CSA International, Stuart, USA, nphillips@consshelf.com

DEVELOPMENT OF THE ECOSPATIAL INFORMATION DATABASE (ESID) FOR THE BUREAU OF ENERGY MANAGEMENT, REGULATION AND ENFORCEMENT ATLANTIC PLANNING AREAS

To support ecosystem-based management activities for offshore energy leasing, the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) is managing an innovative program to compile existing ecological data for the Atlantic outer continental shelf. A scientific protocol was developed and applied to identify and prioritize relevant source materials (literature and GIS data) for acquisition and geospatial characterization. Data were identified by searching numerous bibliographic and library sources, as well as relevant agencies, institutional, and project websites/databases, resulting in over 30,000 potentially relevant ecological resources. Priority data have been incorporated into the Ecological Information Database (ESID), a geodatabase providing access (both geographically and semantically) to ecological data previously not readily available to BOEMRE scientists. The importance of ensuring a robust geospatial data structure required enhancement of the Esri ArcMarine data model to support the ecological project nature and expansion requirements. This presentation will discuss the scientific approach utilized for ecological data collection and evaluation, geospatial characterization and development of the database and applications, and the detailed documentation and quality assurance/control process developed for the project.

155 (*) represents Invited presentations
DEPTH ALGAL ACCESSORY PIGMENT DISTRIBUTIONS IN CASE 2 WATERS

Depth distributions of accessory (i.e. photosynthetic and photoprotecting) pigments are the result of algae adaptation to different environmental conditions, especially light. The aim of this work was to find a simple mathematical description of the depth distributions of algal accessory pigments in Baltic seawater (as example of case 2 waters). In order to achieve the objectives of this work, empirical data gathered in various regions of the Baltic Sea during about 40 cruises in 1999–2010 was used. The statistical relationships between the concentrations of accessory pigments and the trophic index of waters (as measured by the surface concentrations of chlorophyll a) and the optical depths and seasons in the Baltic Sea were analysed. Analysed pigments were selected as useful identification markers of the species of algae. The following pigments were analyzed: chlorophyll b, chlorophyll c, alloxanthin, diadinoxanthin, diatoxanthin, fucoxanthin, peridinin, zeaxanthin. Knowledge of the depth distribution of algae accessory pigments in natural waters is important in environmental analysis and can be used both in remote sensing algorithms and to model species composition of algae in the sea.

Malfatti, F., Scripps Institution of Oceanography, UCSD, La Jolla, USA, fmalfatt@ucsd.edu

ASAM, F., Scripps Institution of Oceanography, UCSD, La Jolla, USA, fazam@ucsd.edu

SINEHOCOCCUS-HETEROTROPHIC BACTERIA ASSOCIATION IN THE OCEAN AND IMPLICATIONS FOR CARBON BIOGEOCHEMICAL CYCLE

Marine bacteria are important players in biogeochemical cycles in the ocean. They interactively interact with the size continuum of organic matter, that includes truly dissolved molecules, colloids up to organisms. Using atomic force microscopy (AFM) we discovered that a substantial, and variable, fraction (on average 30% ±17.8 with a range 0% to 55%) of “free-living” bacteria in our samples from California coastal and open ocean environments were intimately associated with other bacteria at nm-µm scale. Twenty-one percent to 43% bacteria, including Synechococcus (a major primary producer), were conjoint. Moreover, a substantial fraction (4-55%) of bacteria was connected by pili and gels into cell-cell pairs or occurred in networks of up to 20 cells. We have challenged the Synechococcus-heterotrophic bacteria association with the addition of EDTA, sugars and amino acids in order to start addressing the molecular bases of the recognition and interaction and exchange of C and N. We will discuss our results in the context how marine heterotrophic bacteria interact with Synechococcus cells and what are the biogeochemical consequences of these interactions in the carbon cycle.

Manley, S. L., California State University - Long Beach, Long Beach, USA, slmanley@csulb.edu

Lin, C. Y., California State University - Long Beach, Long Beach, USA

LIFE AFTER DEATH: IS BROMOFORM PRODUCED IN SEAWATER FROM BROMOPEROXIDASE RELEASED FROM DEAD PHYTOPLANKTON?

Hypothesis: Bromoform is produced in seawater by bromoperoxidases released from lysed phytoplankton. We describe the results of two experiments: 1. where polybromomethanes were produced in incubated microfree coastal surface seawater in the presence of added algal bromoperoxidase, and hydrogen peroxide, and 2. where peroxidase activity (possibly bromoperoxidase activity), measured as a decline in hydrogen peroxide at nM concentrations using FIA-AE method, was detected in microfree coastal surface seawater. Bromoform, dibromomethane and chloro-bromomethanes were produced in seawater incubated with algal bromoperoxidase. Bromoform was the predominant compound produced with dibromomethane and the chloride substituted bromochloromethanes produced in lower amounts. Production was influenced by sampling location, salinity; and season and can be explained by changes in DOM quality and quantity. Significant peroxidase activity was detected in near-shore seawater. It was inhibited by azide, enhanced in the presence of organic substrates or added iodide, and enriched 3-18x in the marine microlayer. The possibility that bromoperoxidases, independent of living cells (“cell-free”, attached to cell debris or sequestered on colloidal particles) could remain catalytically active in seawater and produce polybromomethanes prior to biological degradation is discussed.

Mannino, A., NASA Goddard Space Flight Center, Greenbelt, USA, antonio.mannino@nasa.gov

Hooker, S. B., NASA Goddard Space Flight Center, Greenbelt, USA, stanford.b.hooker@nasa.gov

Hyde, K., NOAA NEMFS, Narragansett, USA, kimberly.hyde@noaa.gov

Novak, M. G., NASA GSFC/SSAI, Greenbelt, USA, Michael.Novak@nasa.gov

Pan, X., Academy Sinica, Taipai, Taiwan ROC, xpan@gate.sinica.edu.tw

Friedrichs, M., VIMS, Gloucester, USA, mary@vims.edu

Cahill, B., Rutgers University, New Brunswick, USA, bronwyn@marine.rutgers.edu

Wilkin, J., Rutgers University, New Brunswick, USA, wilking@marine.rutgers.edu

SATELLITE-DERIVED DISTRIBUTIONS, INVENTORIES AND FLUXES OF DISSOLVED AND PARTICULATE ORGANIC MATTER ALONG THE NORTH-EASTERN U.S. CONTINENTAL MARGIN

Estuaries and the coastal ocean experience a high degree of variability in the composition and concentration of particulate and dissolved organic matter (DOM) as a consequence of riverine and estuarine fluxes of terrigenous DOM, sediments, detritus and nutrients into coastal waters and associated phytoplankton blooms. Our approach integrates biogeochemical measurements, optical properties and remote sensing to examine the distributions and inventories of organic carbon in the U.S. Middle Atlantic Bight and Gulf of Maine. Algorithms developed to retrieve colored DOM (CDOM), Dissolved (DOC) and Particulate Organic Carbon (POC) from NASA's MODIS-Aqua and SeaWIFS satellite sensors are applied to quantify the distributions and inventories of DOC and POC. Horizontal fluxes of DOC and POC from the continental margin to the open ocean are estimated from SeaWIFS and MODIS-Aqua distributions of DOC and POC and horizontal divergence fluxes obtained from the Northeastern North Atlantic ROMs model. SeaWIFS and MODIS imagery reveal the importance of estuaries outflow to the export of CDOM and DOC to the coastal ocean and a net community production of DOC on the shelf.

Mano, C., Department of Arctic and Marine Biology, University of Tromso, Tromso, Norway, clara.mano@uit.no

Morata, N., Department of Arctic and Marine Biology, University of Tromso, Tromso, Norway, nathalie.morata@uit.no

Bellerby, R., Bjerknes Centre for Climate Research, University of Bergen, Bergen, Norway, richard.bellerby.unic.no

SYNERGIC EFFECT OF OCEAN ACIDIFICATION AND GLOBAL WARMING ON ARCTIC CALCIFYING ZOOPLANKTON: IMPLICATION FOR THE MARINE CARBON PUMP

Anthropogenic increase of atmospheric carbon dioxide is making the oceans more acid reducing their degrees of calcium carbonate saturation. Because of the freshening and increased carbon uptake in response to sea ice retreat, pH should decrease by more than 50% by 2050 in the Arctic. Arctic calcifying zooplankton largely contribute to the carbonate flux and their shells play a dominant role in the carrying organic matter along the water column. Here we investigated the combined effect of induced ocean acidification and global warming on Arctic foraminifera (calcite producers), gastropods and bivalves (aragonite producers). Perturbation experiments were performed by an air-CO2 bubbling system. The main aim was to identify changes in calcification and dissolution rates of those organisms at the forecasted carbonate undersaturation scenario. Under high CO2 level, a decrease of calcification rates was always observed, but the decline in calcification was slower under the combined effect (High T and CO2). Those results suggest that global warming could act a mitigation to the ocean acidification impact, juveniles stage showed higher sensitivity respect to the adults highlighting a life stage species-specific response.

Mano, C., University of Tromso, Tromso, Norway, clara.mano@uit.no

Pecchiar, I., Liceo Statale di Trieste, Trieste, Italy

ITALIAN HIGH SCHOOL FOLLOWING IN THE FOOTSTEPS OF THE ARCTIC

“Italian high school following in the footsteps of the Arctic” is a project involving 25 students coming from the High school F. Prešeren (Italy). The project consist in two main steps. During the first step, the students will spend 10 days in Tromso where they will be involved in various interactive routes to the discovery of the Arctic environment. A part of their stay will be dedicated to learn on the arctic “human dimension” by interviewing the economist and political experts in the Arctic issues. After 10 days the student have collected enough material and they will be ready for the second step of the project: back to Italy they will organize an Itarctic exhibition in various Italian schools to pass on their polar experience. The aim of this project is to awareness the high schools
**Manrique-Hernández, H.**, University of Puerto Rico, San Juan, USA, harold_river19@hotmail.com

**Guerrero-Díaz, C.**, Metropolitan University of Puerto Rico, San Juan, USA, kali-cami14@yahoo.com

**Hart, T.**, University of Vermont, Burlington, USA, ehart1@uvm.edu

**Simard, M. J.**, EPSCoR Streams Project at the University of Vermont, Burlington, USA, meredith.simard@gmail.com

**Ecker, M. T.**, Saint Michael's College, Burlington, USA, mecker@smcvt.edu

**IMPACTS OF CROSSROADS ON STREAM WATER QUALITY DURING BASE FLOW AND STORM FLOW IN BURLINGTON, VERMONT**

Road crossings represent a major point source of pollutants for streams. Using a list of potentially heavily impacted sites provided by the Vermont Department of Transportation, we selected three streams to measure the effect of road crossings on stream pollution. We were interested in two questions: 1) are road crossings a source of pollution? and 2) does rainfall affect the strength of the effect a road crossing has? We measured total phosphorus (TP), *Escherichia coli* (E. coli) and total suspended solids (TSS). Two replicates were taken for each parameter; one downstream (impaired) and one upstream (control), and this was done twice for each stream, once during base-flow and once during storm flow. As a result we found that the parameters measured increased as we move downstream during storm flow but not in base flow. We can conclude that stream site and stream location doesn’t have a significant effect on water quality, this means that road crossings are a source of pollution only during storm events.

**MARA, P.**, UNIVERSITY OF CRETE, HERAKLION, Greece, vmara@chemistry.uoc.gr

**MIHALOPOULOS, N.**, UNIVERSITY OF CRETE, HERAKLION, Greece, mihalo@chemistry.uoc.gr

**PSARRA, S.**, HELLENIC CENTRE FOR MARINE RESEARCH, HERAKLION, Greece, psarra@hercgm.gr

**THE CONTRIBUTION OF THE PHYTOPLANKTON ASSEMBLAGE IN THE SPATIAL AND TEMPORAL DISTRIBUTION OF DMSX COMPOUNDS IN THE NORTH AEGEAN SEA (EASTERN MEDITERRANEAN)**

Over the last few years the biogeochemical cycling and the interface interactions of seawater and atmospheric dimethylsulphide (DMS) have received increased attention due to its possible role in the regulation of the global climate (CLAW hypothesis). The major sources of DMS in the marine environment are DMS-rich which is produced from biological processes occurring in phytoplankton cells and DMSO, which is produced through photo-oxidation and bacterial transformation/consumption of DMS as well as other processes, which are still subjects under discussion. So far, the vast majority of research concerning DMSx compounds has been focused mainly on the Atlantic Ocean, while only a few studies have been conducted in other ecosystems equally important for their unique features, such as the Eastern Mediterranean Sea (EMS). The distinct differentiation of the EMS (described in terms of biomass and primary production) in comparison with other oceanic environments, as well as among the ecosystems’ sub-basins, provided the impetus for this study which focuses on the role of the phytoplankton communities in the emission of DMSx gases in the North Aegean Sea.

**Marandi, L.**, University of Rhode Island / Graduate School of Oceanography, Narragansett, RI, USA, lmrandal@gso.uri.edu

**Sharif, R.**, University of Rhode Island, Narragansett, RI, USA, rahatharif@gmail.com

**Borkman, D., University of Rhode Island / Graduate School of Oceanography, Narragansett, RI, USA, dborkman@gso.uri.edu**

**Berounsksy, V. M., University of Rhode Island / Graduate School of Oceanography, Narragansett, RI, USA, VBerounsksy@gso.uri.edu**

**CHLOROPHYLL THIN LAYERS OF THE NORTHERN BASIN OF THE PETTAQUAMSCUTT RIVER ESTUARY**

The Pettaquamscutt River is a shallow estuary in southern Rhode Island with two deep (12 and 15 m) basins containing almost permanently anoxic bottom waters overlaid with 3-4 m of well-oxygenated waters. In October 2007, a six-week overturn (ventilation) occurred in the northern basin following an unusually dry summer which limited freshwater input. A chlorophyll thin layer (TL) has been observed consistently in both basins for three years with intensities ranging between 20-600 μg/L. Over 50 vertical profiles of dissolved oxygen, salinity, temperature, Secchi disk depth, and chlorophyll and variable fluorescence reveal a pattern of declining TL intensity from summer to winter, but with differences in phytoplankton composition between years. *Procrustenium minimum* dominated immediately after the overturn, while *Euglena proxima* dominated the TL each summer through 2009 but was markedly reduced during summer 2010. Despite a return to a strong stratification, no relationship has yet emerged between the physical characteristics of the water column and the depth and intensity of the chlorophyll maximum.

**Marañón, E.**, Universidad de Vigo, Vigo, Spain, em@uvigo.es

**SEARCHING FOR GENERAL PATTERNS IN THE RESPONSE OF MICROBIAL PLANKTON TO ATMOSPHERIC NUTRIENT DEPOSITION**

Atmospheric deposition of nutrients can have a significant influence on the communities of microbial plankton living in the surface layer of the ocean. The most studied effect, and the one which is better represented in biogeochemical models, is the stimulation of primary production and N₂ fixation by nitrogen, phosphorus and iron. This fertilization mechanism, however, might not be universal, and recent laboratory and field studies suggest a more complex picture. For instance, the abundance of certain groups of phytoplankton and heterotrophic bacteria can actually decrease in response to the input of atmospheric aerosols. Biological production and community respiration may also be stimulated by atmospheric inputs, with potential biogeochemical implications that differ from those expected if only phytoplankton respond. Biogeochemical patterns in the degree to which different nutrients limit the abundance and metabolic activities of key microbial groups may result in a mosaic of diverse ecological responses. By reviewing recent findings from both observational and experimental studies, this contribution attempts to identify general patterns in the way the biomass, community structure and metabolic activity of microbial plankton change as a result of atmospheric nutrient deposition.

**Marcinko, C. L.**, National Oceanography Centre Southampton, Southampton, United Kingdom, cjm110@noc.soton.ac.uk

**Allen, J. T., National Oceanography Centre Southampton, Southampton, United Kingdom, fja@noc.soton.ac.uk**

**Painter, S. C., National Oceanography Centre Southampton, Southampton, United Kingdom, stuart.painter@noc.soton.ac.uk**

**Martin, A. P., National Oceanography Centre Southampton, Southampton, United Kingdom, apml1@noc.soton.ac.uk**

**DIURNAL VARIATION OF DINOFLAGELLATE BIOLUMINESCENCE AND ITS IMPACT UPON MEASURING SPATIAL VARIABILITY.**

Surface ocean bioluminescence is of interest both ecologically and for operational purposes. The most prolific organisms recognised as a major source of bioluminescence in the surface ocean are planktonic dinoflagellates. Here we present results from studies carried out in the north-east Atlantic illustrating bioluminescence in mixed dinoflagellate communities varying significantly over 24 hour cycles. These diurnal variations are shown to be influenced by both cellular and environmental factors. Cellular circadian regulation is shown to deteriorate without the presence of a daylight cycle which appears necessary for synchronisation of endogenous timekeeping. We further show that not accounting for diurnal variations in bioluminescence intensity could lead to a misinterpretation of apparent spatial variability. We highlight that measurements should be comparable in terms of the time of day/night they are taken. If this can not be achieved, methods for correcting measurements to sampling time need to be considered. This is particularly the case when relating spatial heterogeneity of the bioluminescent field to other coincident environmental parameters, to avoid masking relationships or attributing false correlations between variables.

**María Morales-Piredo, M.,** University of Cádiz, Puerto Real (Cádiz), Spain, maria.morales@uca.es

**Bárbara Úbeda, B., University of Cádiz, Puerto Real (Cádiz), Spain, barbara.ubeda@uca.es**

**Andrés Cózar, A., University of Cádiz, Puerto Real (Cádiz), Spain, andres.cozar@uca.es**

**José Ángel Gálvez, J. A., University of Cádiz, Puerto Real (Cádiz), Spain, joseang.el.galvez@uca.es**

**AIR-WATER CO₂ EXCHANGE AND PARTICULATE ORGANIC CARBON SEDIMENTATION IN RESERVOIRS WITH DIFFERENT TROPHIC STATUS: A BUDGET BASED ON SIMULTANEOUS MEASUREMENTS**

Reservoirs play an important role in inland waters carbon budgets. In general, they act as CO₂ sources to the atmosphere and, on the other hand, store particulate organic carbon (POC) into the sediments. The balance between settled POC and the one which is better represented in biogeochemical models, is the stimulation of primary production and N₂ fixation by nitrogen, phosphorus and iron. This fertilization mechanism, however, might not be universal, and recent laboratory and field studies suggest a more complex picture. For instance, the abundance of certain groups of phytoplankton and heterotrophic bacteria can actually decrease in response to the input of atmospheric aerosols. Biological production and community respiration may also be stimulated by atmospheric inputs, with potential biogeochemical implications that differ from those expected if only phytoplankton respond. Biogeochemical patterns in the degree to which different nutrients limit the abundance and metabolic activities of key microbial groups may result in a mosaic of diverse ecological responses. By reviewing recent findings from both observational and experimental studies, this contribution attempts to identify general patterns in the way the biomass, community structure and metabolic activity of microbial plankton change as a result of atmospheric nutrient deposition.
not been reported for lakes and reservoirs. The present work aims to estimate the balance of the air-water CO\textsubscript{2} exchange and the POC downward fluxes in two reservoirs with different trophic levels (eutrophic and oligotrophic) in Southern Spain, during the stratified period (from May to September). Hourly pCO\textsubscript{2} measurements were performed using a submersible autonomous moored instrument (SAMI-CO\textsubscript{2}). Whereas POC sedimentation rates were measured using sediment traps located under the mixed layer. Both reservoirs acted as net carbon sinks during the stratification period. Nevertheless, CO\textsubscript{2} emissions rates were up to three times higher in the eutrophic reservoir while settling rates only twice higher.

Markager, S., Aarhus University, NERI, Roskilde, Denmark, markager@dmu.dk
Krause-Jensen, D., Aarhus University, NERI, Roskilde, Denmark, dk@dmu.dk
Dansgaard, T., Aarhus University, NERI, Roskilde, Denmark, td@dmu.dk
TOTAL PRIMARY PRODUCTION AND THE BALANCE BETWEEN BENTHIC AND PELAGIC PLANTS IN DIFFERENT NUTRIENT REGIMES IN A SHALLOW ESTUARY
In this contribution we challenge the hitherto ruling concept that the total gross primary production (GPP) in shallow coastal areas, i.e. the combined production of micro- and macroscopic plants living in the water and at the bottom, does not change systematically with nutrient enrichment. Based on a large monitoring data set in combination with historical information we have quantified and compared the benthic and the pelagic primary production along nutrient gradients in space and time for the shallow estuary Limfjorden. As expected, increases in nutrient load stimulated the pelagic production at the expense of the benthic. Phytoplankton showed a strong positive response to increased nutrient concentrations while benthic primary producers were shaded. The ecosystem thus experienced a regime shift from benthic to pelagic dominance of GPP with increasing load. However, as nutrient load was again reduced, and the ecosystem entered a phase of oligotrophication, pelagic GPP declined gradually while benthic GPP did not increase correspondingly leading to an decline in overall GPP. Instead the ecosystem showed a resistance or time lag against return to a clear water state with benthic dominance.

Marra, J., Brooklyn College, Brooklyn, USA, jfm7788@brooklyn.cuny.edu
Jeffrey, W., University of Western Florida, Pensacola, USA, wjeffrey@uwf.edu
Chevrier, J., Florida A&M University, Tallahassee, USA, jennifercherrier@gmail.com
Valentine, S., Florida A&M University, Tallahassee, USA, sarahkeith.valentine@gmail.com
THE ROLE OF LIGHT IN PHYTOPLANKTON EXTRACELLULAR PRODUCTION AND BACTERIAL CONSUMPTION OF DISSOLVED ORGANIC MATTER: IMPLICATIONS FOR COASTAL CARBON CYCLING.
Dissolved organic matter (DOM) is one of the largest exchangeable reservoirs of carbon in the ocean. Knowledge of its sources, transformations, and ultimate fate (i.e., ‘Microbial Carbon Pump’) is largely unknown, and a matter for considerable debate. Recent work, both with azonic laboratory culture and natural populations, shows that abrupt changes in irradiance (spectral, and intensity) lead to enhanced extracellular release (ER) of DOM from phytoplankton. The enhanced ER has been little appreciated, and often goes unreported. Calculations reveal that it is significant to the ocean’s carbon cycle, particularly in coastal waters whose productivity supports much of the ocean’s food resources. In July 2010, we conducted experiments to examine light-mediated ER and bacterial growth in daytime, time-course incubations, with water from coastal Florida. The results show an increase in ER accompanying increases in irradiance. Bacterial uptake of DOC follows the general trend of ER, but the hour-to-hour variability is not always matched with the availability of substrate (ER DOC). These and previous data (chemical analyses of DOC) suggest a strong dependence of DOC release on positive irradiance change.

Marsay, C. M., University of Southampton, Southampton, United Kingdom, cm1g18@noc.soton.ac.uk
Achterberg, E. P., University of Southampton, Southampton, United Kingdom, eric@noc.soton.ac.uk
Sanders, R. J., University of Southampton, Southampton, United Kingdom, r.sanders@noc.soton.ac.uk
Statham, P. J., University of Southampton, Southampton, United Kingdom, pjs@noc.soton.ac.uk
Lampitt, R. S., University of Southampton, Southampton, United Kingdom, r.lampitt@noc.soton.ac.uk
MESOPELAGIC-DEPTH MEASUREMENTS OF POC, BIOMINERALS AND PARTICULATE TRACE METALS IN THE NORTH ATLANTIC, USING NEUTRALLY BUOYANT, FREE DRIFTING SEDIMENT TRAPS
Particulate material exported from the surface ocean undergoes significant changes in flux magnitude and composition while sinking through the mesopelagic zone (~100-1000m) with implications for biogeochemical cycling of carbon, nutrients and biologically important trace elements. Free-drifting PELAGRA (Particle Export Measurement using a LAGRangian trap) sediment traps were used to collect sinking material at multiple depths in the upper 600m of the water column at the Porcupine Abyssal Plain (PAP) time-series site (49°N 16.5°W) during July – August 2009 and in the Irminger and Iceland Basins during July – August 2010. The collected material was analysed for particulate organic carbon and nitrogen (POC/N), particulate inorganic carbon (PIC), opal and trace metals, including iron, aluminium and manganese. Here we compare the general features of the biogenic and lithogenic fractions of sinking material flux observed at the three sites.

Martin, R. A., Washington State University, Vancouver, USA, rebecca.martin@email.wsu.edu
Harrison, J. A., Washington State University, Vancouver, USA, john_harrison@wsu.edu
DELIVERY OF DISSOLVED ORGANIC NITROGEN TO SURFACE WATER DURING HIGH FLOW EVENTS
Dissolved organic nitrogen (DON) can be a large fraction of total dissolved N in surface water. However, the mechanisms controlling DON’s release from soils and delivery to surface water are poorly characterized. Understanding these mechanisms is critical for predicting DON export to coastal ecosystems. We hypothesized that when hydrologic flowpaths through DON-rich soil horizons are active, such as during high flow events, streams receive DON-enriched water. To test this hypothesis, we compared DON concentrations during high flow events with DON concentrations during base-flow conditions for 44 streams draining watersheds subject to a wide range of climates, hydrologic regimes, and land cover types. Flow-weighted DON concentration increased relative to the preceding base-flow in most (35 out of 50) events (mean=1.8-fold increase), and pulse flow accounted for an average of 54% of total DON export. DON bioavailability during base vs. pulse flow was also examined, but too few studies comparing bioavailability during base- and pulse-flow have been published to generate conclusions about changes during high flow events, suggesting a need for additional research on DON bioavailability dynamics.

Martin-Creuzburg, D., University of Konstanz, Konstanz, Germany, Dominik.Martin-Creuzburg@uni-konstanz.de
Wacker, A., University of Potsdam, Potsdam, Germany, wacker@uni-potsdam.de
ESSENTIAL LIPIDS AND DAPHNIA GROWTH AT DIFFERENT TEMPERATURES
Polyunsaturated fatty acids (PUFAs) and sterols are essential dietary nutrients for all arthropods. They serve as precursors for a number of bioactive molecules and, as structural components of cell membranes, play a crucial role in membrane temperature adaptation. To assess the significance of PUFAs and sterols for the ability to grow at different temperatures, life history experiments were conducted with *Daphnia magna* grown at 10, 15, 20, and 25°C with food sources differing in their PUFA and sterol content. Our data suggest that the availability of dietary PUFAs gains in importance at lower temperatures, whereas a sufficient sterol supply is especially important at higher temperatures. To investigate nutrient-limited growth responses of *Daphnia* and how they are affected by temperature is indispensable for our understanding of population dynamics, particularly in regard to a changing climate.

Martinez, J. A., University of Hawaii at Manoa, Honolulu, USA, jonathan.martinez@noaa.gov
Richmond, R. H., University of Hawaii at Manoa, Honolulu, USA, richmond@hawaii.edu
THE EFFECTS OF ALIEN INVASIVE ALGAL CANKES ON CORAL REEF HABITAT BIOGEOCHEMICAL PROCESSES
Diel cycling of biogeochemical processes on coral reefs are subject to variability through natural processes. Photosynthesis, respiration and calcification can all influence oxygen and carbon dioxide levels on a reef. Gracilaria salicornia is a red alien invasive alga in Hawaii. It can grow in thick canopies associated with epi-organsims and it commonly overgrows coral and sessile benthic organisms. We hypothesized that the algal canopies nocturnally reduce oxygen and pH on the benthos below natural levels. Several algal canopies and reference sites were profiled for oxygen and pH using in situ sensors on the reef flat on Coconut Island, Hawaii for 24 hr cycles.
Oxygen and pH levels were found to be much lower at night and much higher during the day under the algal mats than for the reference sites. These findings demonstrate that these algal canopies may induce substantial hypoxic/hypoxic and basic/acidic variability over diurnal cycles as a function of their own respiration. This underscores the need to understand microhabitat biogeochemical processes, which may exacerbate other stressors and threats such as global climate change.

Martinez-Aguirre, S., University of Puerto Rico, San Juan, Puerto Rico, samartinez@upr.edu

The spatial and seasonal variability of nutrients and associated primary production (i.e., Chla) of the Guajataca and La Plata reservoirs of Puerto Rico were evaluated. Total phosphorus (TP) seems to be a major controlling factor of primary productivity at these reservoirs. Median values for total P and chlorophyll a at the surface (1m) were: 10µg TP/L and 5.04µg Chl a/L for Guajataca, and 62.85µg TP/L and 49µg Chl a/L for La Plata, respectively. A significant positive correlation (r=0.76 (Spearman), p<0.001) was observed between these two parameters with both reservoirs combined. Significant increases in TP were observed with depth, with median concentrations at the hypolimnion being 18µg/L and 148µg/L for Guajataca, and La Plata. TP concentrations were strongly associated with turbidity (NTU) (r=0.91; p<0.001) suggesting that TP contributions were the result of external inputs associated with the intense rain season experienced during this year. A significant portion of the TP measured at the thermocline (5m) of the riverine and mid sections of La Plata was <0.4µm, which contrasts with the size fraction distribution observed at other depths.

Martinez-Colon, M., University of South Florida, St. Petersburg, USA, mmartin8@mail.usf.edu

“POLLUTION” AND BIOAVAILABILITY OF POTENTIALLY TOXIC ELEMENTS IN JOBOS BAY NATIONAL ESTUARINE RESEARCH RESERVE

Pollution studies of Potentially Toxic Elements (PTEs, aka Heavy Metals) in general are done using the bulk sediment fraction. This approach tends to overestimate the potential for toxicity in sediments. The Jobos Bay National Estuarine Research Reserve in Puerto Rico is known to have several point sources of PTEs. Copper concentrations are relatively high, up to 86 ppm, in bulk sediments. However, the bioavailable fraction of copper, up to 18 ppm, is below the ERL (Effect Range Low) concentrations established for other tropical estuaries. Benthic foraminiferal assemblages were evaluated as bioindicators of pollution in Jobos Bay sediments and they show lower faunal densities associated with relatively “higher” concentrations of toxic elements whose bioavailabilities are below ERL levels. Evidence to date indicates that other environmental factors, particularly high organic matter and hypoxia, likely play a more pivotal role in the overall environmental condition of the estuary than toxic elements.

Martinez-Garcia, S., Universidad de Vigo, Vigo, Spain, sandra@uvigo.es

RESPONSE OF CONTRASTING PLANKTONIC MICROBIAL FOOD WEBS TO INPUTS OF INORGANIC AND ORGANIC NUTRIENTS

The effects of inorganic and/or organic nutrient inputs on phytoplankton and heterotrophic bacteria from different planktonic food webs in two contrasting marine environments: oligotrophic central Atlantic and eutrophic coastal waters NW Iberian Peninsula were compared. We studied the effects of inorganic (nitrate, ammonium, phosphate) and organic (glucose, aminoacids) nutrient inputs, added separately or jointly, on microbial plankton biomass and metabolism in two set of microcosm experiments. Positive effects of mixed additions for phytoplankton and heterotrophic bacteria were generally widespread. Heterotrophic bacteria responded faster to nutrient inputs than phytoplankton and appeared to be limited by organic substrates in different planktonic food webs. The autotrophic community seemed to be more efficient in the utilization of external nutrients in herbivore versus microbial food webs. HNA bacteria and phytoplankton cells > 2 µm were responsible for most of the increase in heterotrophic and primary production respectively across the distinct planktonic food webs studied. Increases in bacterial growth efficiency, and a tendency to heterotrophy after organic nutrient additions, more pronounced in herbivore food webs, were registered in contrasting planktonic food webs.

Wood, R. J., NOAA Cooperative Oxford Laboratory, Oxford, USA, Bob.Wood@noaa.gov

Zhang, X., NOAA Cooperative Oxford Laboratory, Oxford, USA, Xinsheng.Zhang@noaa.gov

MODELING ANNUAL-SCALE HYDROCLIMATE EFFECTS ON CHESAPEAKE BAY STRIPED BASS NURSERY HABITAT

Ecosystem-based fishery management requires improved understanding of habitat requirements and how environmental variability affects stock production. Hydroclimate conditions and spatio-temporal variability in zooplankton prey exercise strong environmental controls over Chesapeake Bay striped bass recruitment. Ricker stock-recruitment models were fit using stock biomass alone and with freshwater flow to partition effects of SSB and hydrology on age-0 recruitments in two major spawning seasons and for the entire Chesapeake Bay for years 1985-2010. Models including flow explained more variability in recruitments than models with SSB alone (AICc=507 to AICc=273). Regression models including freshwater flow and temperature also explain a high proportion of variability (r²=0.63) in age-0 recruitment. Estimates of zooplankton abundance and distribution based on net and acoustic sampling coarsely depict annual differences in prey availability, and are indicators of feeding conditions and potential survival of striped bass larvae. The relationship between freshwater flow and recruitment indicates that strong recruitments only occur under moderate to high flows. We evaluated spatial variability in recruitment and differences in environmental effects among spawning locations. Requirements of ecosystem-based fishery management are addressed by evaluating the potential to use these findings for developing indicators of habitat suitability and stock production.
NITROGEN-ENRICHED FOOD WEBS IN TROPICAL URBAN STREAMS, PUERTO RICO

Urbanization drastically impacts stream food webs by altering biotic assemblages and affecting stream productivity. We sampled streams with different % urban cover and affecting stream productivity. We sampled streams with different % urban cover to test if δ15 N values of resources and consumers were influenced by urbanization. δ15 N values were measured in leaves, periphyton, filamentous algae, aquatic invertebrates and fish, in 8 streams within a highly urbanized watershed in Puerto Rico. Food webs appear to be based on algal resources, rather than detritus. We found that δ15 N values were not correlated to % urban cover on the sub-watershed. However, food web components based on periphyton were highly N-enriched. N enrichment found in the periphyton and its consumers is likely to be related to wastewater and sewage leaks, meaning that the enrichment is not related to % urban cover but to where wastewater pipes and sewage system leaks are located.

Martínez, T. R., UCSD, Scripps Institution of Oceanography, La Jolla, USA, tmartza@ucsd.edu
Johnson, K. S., MBARI, Moss Landing, USA, johnson@mbari.org
Send, U., UCSD, Scripps Institution of Oceanography, La Jolla, USA, usend@ucsd.edu
Afin, S., NOAA PMEL, Seattle, USA, simone.rall@noaa.gov
Jannasch, H., MBARI, Moss Landing, USA, jaha@mbari.org
Plant, J., MBARI, Moss Landing, USA, jplant@mbari.org
Elrod, V., MBARI, Moss Landing, USA, elroid@mbari.org
Colletti, L., MBARI, Moss Landing, USA, colletti@mbari.org
Takeshita, Y., UCSD, Scripps Institution of Oceanography, La Jolla, USA, ytakeshi@ucsd.edu

OPERATIONAL CAPABILITIES OF AUTONOMOUS PH SENSORS: REDUCING KEY UNCERTAINTIES IN ENVIRONMENTAL PROPERTIES

As autonomous pH sensor technology matures, it is important to document performance in the field in order to accurately characterize environmental variability and its impact on ecosystem processes. Recently, a number of experiments have been carried out on surface moorings with the goal of pH sensor validation and intercomparison. Here we focus on the results from one coastal mooring deployed ~2 km off Moss Landing, California and one open ocean mooring located 200 km southwest of Point Conception, California. These contrasting sites allow evaluation of sensor stability under vastly different conditions, as the coastal mooring experiences much greater pH variability and rapid biofouling in comparison to the open-ocean mooring. Proximity of the coastal site allowed assessment of sensor accuracy and stability via direct comparison with routine bottle samples. Although routine bottle samples are not possible at the open-ocean site, the presence of a co-located pCO2 sensor allows assessment of relative drift between the two sensors, serving as a powerful quality control on autonomous pH and pCO2 data.

Masura, J. E., University of Washington Tacoma, Tacoma, USA, jmasura@u.washington.edu
Schatz, M., University of Washington Tacoma, Tacoma, USA
Greengrove, C., University of Washington Tacoma, Tacoma, USA, cgreeng@u.washington.edu
Postel, J. R., University of Washington, Seattle, USA, jpostel@u.washington.edu

SPATIAL AND TEMPORAL DISTRIBUTION OF ALEXANDRIUM CATENELLA CYSTS IN QUARTERMASTER HARBOR, PUGET SOUND WA

Alexandrium catenella is a dinoflagellate which is known to produce saxitoxin, a suite of neurotoxins, which when bioaccumulated in benthic filter feeding bivalves can result in Paralytic Shellfish Poisoning (PSP) if the bivalves are consumed by humans. Alexandrium sp. spends part of its lifecycle in a benthic cyst in the sediment until conditions are right to germinate and become a vegetative cell in the water column. A 2005 NOAA ECOHAB surface sediment survey of 32 sites in Puget Sound found that Quartermaster Harbor (QMH), an urban bay in central Puget Sound, had cyst concentrations two orders of magnitude higher than anywhere else in Puget Sound. This study takes a more in-depth look at the spatial and temporal distribution of Alexandrium catenella cysts in surface sediments and sediment cores in QMH. Cyst abundance in QMH surface sediments show that the highest cyst concentrations are found in depositional environments dominated by silt-sized sediment with greater total organic content (TOC). Sediment cores show an exponential decrease in cyst abundance down core, with cysts present down to 84 cm below the sediment/water interface.

Mathisen, P., Umeå University, Umeå, Sweden, peter.mathisen@emg.umu.se
Andersson, A., Umeå University, Umeå, Sweden, agneta.andersson@emg.umu.se

BACTERIAL RESPONSE TO NUTRITIONAL MANIPULATION AND DEVELOPMENT OF GRAZING RESISTANCE

Previous studies have shown that predation pressure on bacteria increases along a gradient from oligotrophic to eutrophic environments. This promotes the development of grazing resistant bacteria, as the high predator-prey ratio and high nutrient levels allow for development of efficient defense mechanisms within bacteria. We performed a series of experiments to further elucidate the role of bacteria in different nutrient regimes. For the main experiment we used a transplantation technique to investigate the impact of the arms race between predators (flagellates and ciliates) and prey (bacteria). Bacteria were fluorescently marked and moved from nutrient rich conditions to nutrient poor conditions and vice versa. If the theory holds true results will show that bacteria from nutrient rich conditions are less affected by predation due to more advanced defense mechanisms. However, if bacterial defense mechanisms are not efficient enough nutrient rich bacteria might be preferred by predators due to their higher nutritional value.

Matsumoto, G. J., MBARI, Moss Landing, USA, mage@mbari.org
Sherlock, R., MBARI, Moss Landing, USA, rob@mbari.org
Robison, B. H., MBARI, Moss Landing, USA, rob@mbari.org

LITTLE RED JELLIES IN THE EASTERN PACIFIC (FAMILY RHopalonematidae)

Almost 20 years of remotely operated vehicle (ROV) observations in the Monterey Submarine Canyon has led to a large dataset of little red jellies’ observations (Family Rhopalonematidae) down to 3500 meters. The lower quality of early ROV video footage limited identification and only with subsequent collections were we able to distinguish between several different species. There are three genera (Crosposta, Benthocodon, and Vorogonema) that have been in a state of taxonomic flux. Improvements in our video capabilities (to High Definition), collections, and laboratory analyses have revealed the presence of all three genera in the Monterey Bay, the Astoria Submarine Canyon off Oregon and the Gulf of California. Based on their abundance and motility, these trachymedusae are likely an ecologically important group. This presentation will review the current taxonomic status, the methods used to differentiate between the genera, and discuss the next steps in our investigations of these interesting gelata.

Matsumoto, G. J., Monterey Bay Aquarium Research Institute, Moss Landing, USA, mage@mbari.org

EDUCATION AND PUBLIC OUTREACH AT THE MONTEREY BAY AQUARIUM RESEARCH INSTITUTE

Education and public outreach at the Monterey Bay Aquarium Research Institute (www.mbari.org) occurs in many different formats. There are two primary formats that engage students - one of these is our internship program which started in 1997 which involves students in both research and education efforts. The second format is our Education And Research: Testing Hypotheses (www.mbari.org/EARTH) teacher workshops which started in 2002 and are focused on providing teachers (and their students) with access to near-real-time data, researchers, and current research topics. This talk will provide a brief overview of both programs.

Maurer, D., IFREMER, Aracachon, France, dmaurer@ifremer.fr
Tun-Ley, A., IFREMER, France
Denis, K., University of Mons, Belgium
Barbies, C., IFREMER, France
Pouvreau, S., IFREMER, France
Grosjean, P., University of Mons, Belgium

important oyster species (French Veliger program). Automation of the identification and quantification of Pacific oyster larvae in the numerous samples collected in Arcachon bay was tested using an innovative approach, which combines the FlowCAM technology for digitisation of the particles and the Zoo/Phytolmage software for semi-automatic classification process. To target the oyster larvae in the highly-concentrated plankton samples, an original composite training set was elaborated: images of Bivalve larvae at different stages, coming from monospecific laboratory cultures, were added to images from natural samples representative of the in situ planktonic community at summertime. The obtained classifier was tested on a sampling site series for qualitative and quantitative comparison with the manual counting method by microscopic examination. The preliminary results showed an efficient discrimination of targeted larvae from the other particles and from stage to stage, although inter-specific confusion was observed between larvae of the smallest size.

Mayo, M., University of South Florida, College of Marine Science, St. Petersburg, USA, mmayo@mail.usf.edu

Mazzillo, A., University of Victoria, Victoria, Canada, mazzumder@uvic.ca

**CONSEQUENCES OF EUTROPHICATION FOR WATER QUALITY AND PUBLIC HEALTH**

Freshwater is the most precious natural resource needed for sustainable human health, society and the economy. Yet, the dependence of the quality of human health and well-being on the services provided by freshwater ecosystems through clean water at home or aquatic resources are still not fully evaluated. Aquatic ecosystems and their watersheds are subjected to variable degrees of human-generated loading of nutrients causing eutrophication. There exists an extensive body of theory and empirical models on the causes and consequences of eutrophication of aquatic ecosystems. One area aquatic scientists do not put enough effort into is the consequence of eutrophication for water quality at home and public health. In this presentation I discuss how the increasing biomass of algae increases the cost of filtration, and increases the concentrations of chlorination byproducts some of which are carcinogenic to humans. Furthermore, eutrophication and associated increase in the concentrations of algal toxins cause major health concerns through drinking water. I also discuss how eutrophication and increased biomass of algae is linked to outbreak of cholera in the tropics.

Mazzillo, A., University of South Florida, College of Marine Science, St. Petersburg, USA, Mazzillo@gmail.com

POMEROY, C., CALIFORNIA SEA GRANT EXTENSION PROGRAM, SANTA CRUZ, USA

KUO, J., UCSC, SANTA CRUZ, USA

RAMONDI, P. T., UCSC, SANTA CRUZ, USA

SILVER, M. W., UCSC, SANTA CRUZ, USA

**ANGELER EXPOSURE TO DOMOIC ACID VIA CONSUMPTION OF CONTAMINATED FISHES**

Domoic acid (DA) is a neurotoxin that causes amnesic shellfish poisoning, and fish are recognized vectors of DA to marine fauna. However, the exposure of anglers through consumption of DA contaminated fish is unknown. We analyzed DA in 11 fish species targeted by Santa Cruz Wharf (SCW) anglers in Monterey Bay, California, and surveyed anglers regarding their fish consumption patterns. The majority of anglers (58% of 565) reported consuming their catch, with a small fraction ingesting the fish viscera. DA was detected in the viscera and muscle tissue fish species, and toxin uptake in fishes varied according to their diet. Total DA levels in fish (i.e., DA in viscera + DA in muscle tissue) decreased significantly after 11 month storage at −20°C. DA concentration in seawater and California mussels was correlated with DA in the viscera of some but not all fish groups. We concluded that SCW anglers who consume their catch are exposed to asymptomatic DA doses. Exposure is a function of the species and parts consumed, storage methods and DA levels in the seawater when the fish are caught.

McCabe, D. J., Saint Michael’s College, Colchester, USA, dmc McCabe@smcvt.edu

Hayes-Pontius, E. M., University of Vermont, Burlington, USA, ehayespo@uvm.edu

Fanning, K. A., University of South Florida, College of Marine Science, St. Petersburg, USA, kalfarine.usf.edu

**DETERMINATION OF THE URANIUM BUDGET IN THE SHARK RIVER ESTUARY SYSTEM, EVERGLADES NATIONAL PARK**

Several radionuclides within the U-238 decay series have been used as particle tracers, providing information concerning sediment dynamics, diagenetic processes, and biogeochemical cycles of other elements. Sediment transported through the coastal zone carries nutrients, metals and pollutants that can subsequently influence the biogeochemical framework of the depositional basin. These sediments also preserve important paleo-environmental records such as climate and land-use changes. This study intends to examine Uranium and other trace metal cycling in the Shark River Slough (Everglades National Park), by quantifying influxes and effluxes of these constituents, and by determining whether the system acts as a net source or sink of uranium and other trace metals including barium, iron, manganese and strontium. Sediment cores were collected along mangrove forests areas and processed for sediment dating, estimation of organic matter content and trace metal concentration profiles. Preliminary results presented here provide insight on how uranium, and other metals of interest, cycle through this environment. Additionally, results obtained during this study will be compared to results from other estuaries and used to identify, if possible, when an estuarine system might act as a source, or a sink, for these elements.

McCabe, D. J., Saint Michael’s College, Colchester, USA, dmc McCabe@smcvt.edu

Hayes-Pontius, E. M., University of Vermont, Burlington, USA, ehayespo@uvm.edu

**FACILITATION OF BENTHIC MACROINVERTEBRATE IDENTIFICATION USING SITE-SPECIFIC WEB SITES: AN AID TO CITIZEN SCIENCE**

Bioassessment engages the public in citizen science, increases understanding of and appreciation for stream habitats, and supports professional monitoring. In Vermont EPSCoR’s Streams Project, we developed stream-specific web sites to simplify macroinvertebrate identification. Tailored web sites display macroinvertebrates collected from rivers being studied by our partner high schools. Stream-specific web sites are based on samples collected by college students or by high school teachers and students. Thumbnail photographs representing >95% of the macroinvertebrates found are displayed on each site. The thumbnails link to full-screen photographs and in many cases to close-ups of features needed for macroinvertebrate identification. Each river web site consists of a table with a cell for each taxon. The table cells reflect differences detectable only at higher abundance levels.

McCabe, D. J., Saint Michael’s College, Colchester, USA, dmc McCabe@smcvt.edu

Hayes-Pontius, E. M., University of Vermont, Burlington, USA, ehayespo@uvm.edu

**USING SITE-SPECIFIC WEB SITES: AN AID TO CITIZEN SCIENCE**

McCannon, M. E., Alaska Ocean Observing System, Anchorage, USA, mccannon@aos.org

Bochner, R., Alaska Ocean Observing System, Anchorage, USA, rob@aliooalaska.com

Dugan, D., Alaska Ocean Observing System, Anchorage, USA, dugan@aos.org

**CMSP IN THE ARCTIC: CHALLENGES AND OPPORTUNITIES**

McCammon, M. E., Alaska Ocean Observing System, Anchorage, USA, mccannon@aos.org

Bochner, R., Alaska Ocean Observing System, Anchorage, USA, rob@aliooalaska.com

Dugan, D., Alaska Ocean Observing System, Anchorage, USA, dugan@aos.org

**CMSP IN THE ARCTIC: CHALLENGES AND OPPORTUNITIES**

161 (*) represents Invited Presentations

ASLO ASLO Book of Abstracts
spatial visualization tools specific to Alaska. The tools will be multidimensional, and include the elements of depth and seasonality. Drawing from data provided by government agencies, non-governmental organizations and tribal communities, they will integrate multiple uses and types of data. This presentation will focus on the challenges of developing tools of this nature for Alaska’s Arctic conditions: the paucity of data in most regions of the state, vast geographic boundaries, extreme weather conditions, presence of seasonal sea ice, and a small but widely distributed population. It will also highlight several initial data products that are currently being tested and refined in Alaska. Broad applications of these tools include subsistence hunting and fishing, multi-billion dollar commercial fisheries, high latitude shipping, offshore oil and gas development and the management of biological resources including endangered species.

McCarthy, M. J., The University of Texas at Austin Marine Science Institute, Port Aransas, USA, markm@mail.utexas.edu
Carini, S. A., University of North Carolina - Wilmington, Wilmington, USA, carini@uncw.edu
Newell, S. E., Princeton University, Princeton, USA, sebulow@princeton.edu
Gardner, W. S., The University of Texas at Austin Marine Science Institute, Port Aransas, USA, wayne.gardner@mail.utexas.edu

DENITRIFICATION, ANAMMOX, AND DNRA IN THE GULF OF MEXICO HYPOXIA ZONE: RESULTS FROM CONTINUOUS-FLOW, INTACT SEDIMENT CORE INCUBATIONS

Sediment-water interface nitrogen (N) transformations were quantified using continuous-flow, intact core incubations in the Gulf of Mexico hypoxia zone. N2 fluxes were highly variable and ranged from net N2 fixation to strong denitrification (up to ~500 µmol N m⁻² h⁻¹). Highest net N2 fixation and denitrification rates both were measured at the normally hypoxic site (C6) during hypoxia. A control site (not usually hypoxic) east of the Mississippi River delta only exhibited significant denitrification in unamended cores after the passage of two hurricanes. Addition of 15N (as bicarbonate NH₄⁺) oxidizers were adapted to episodic substrate limitation. Highest anammox rates were observed during summer hypoxia in 2009 (maximum ~43 µmol N m⁻² h⁻¹) and may have comprised 7 – 45 % of total N₂ production. Molecular analysis of gene expression is needed to confirm anammox. DNRA was measured only sporadically, and rates were always < 7 µmol N m⁻² h⁻¹ except at C6 in May 2010 (~18 µmol N m⁻² h⁻¹) during the Deepwater Horizon spill. Dissolved gas results from May 2010 are pending.

McCulloch, M., The University of Western Australia and ARC Centre of Excellence in Coral Reef Studies, Perth, Australia, Malcolm.McCulloch@uwa.edu.au
Trotter, J., The University of Western Australia, Perth, Australia, Julie.Trotter@uwa.edu.au
Maontagna, P., Lamont-Doherty Earth Observatory of Columbia University, Palisades, USA, maontagna@deo.columbia.edu
Falter, J., The University of Western Australia and ARC Centre of Excellence in Coral Reef Studies, Perth, Australia, Jim.Falter@uwa.edu.au

SENSITIVITY OF CORAL CALCIFICATION TO INCREASING ATMOSPHERIC CARBON DIOXIDE

Rapidly increasing levels of atmospheric carbon dioxide is not only causing global warming, but has the potential to cause major perturbations to biogenic calcification due to ocean acidification. Using boron isotopic systematics we show that scleractinian corals precipitate their skeletons at a significantly higher internal pH than the external seawater, consistent with calcification occurring within the strongly biologically mediated environment of the calcifying epithelium. We find that corals follow a species-specific linear relationship, with a physiologically controlled pH gradient that results in the internal aragonite saturation state being a factor of 2x to 3x higher than ambient seawater. Using the relationship for inorganic aragonite precipitation we show that the sensitivity of coral calcification to ocean acidification is twofold lower than simplistic estimates based on changes in seawater saturation state alone, and calcification is positively enhanced due to increased sea surface temperatures. Our new approach suggests that the sustainability of coral reefs are limited by physiologically-based temperature stress (e.g. coral bleaching), local impacts, together with decreasing carbonate saturation from ocean acidification, and that predation for their imminent demise may be premature.

McDaniel, L. D., USF College of Marine Science, St Petersburg, FL, USA, medaniel@marine.usf.edu
Young, E., USF College of Marine Science, St Petersburg, FL, USA
Paul, J. H., USF College of Marine Science, St Petersburg, FL, USA
Ritchie, K. B., Mote Marine Laboratory, Sarasota, FL, USA
Miller, A., Mote Marine Laboratory, Sarasota, FL, USA

ECOLOGICAL EFFECTS OF GENE TRANSFER AGENTS OF MARINE ALPHA-PROTEOBACTERIA

Gene Transfer Agents (GTAs) are host-encoded virus-like elements that package random fragments of host chromosome in viral capsids. We obtained several sequenced α-Proteobacterial strains with known GTA genes from culture collections. Additionally, several strains were isolated from the coral endosymbiont dinoflagellate Symbiodinium. Strains Roseovarius marinus and Reugeria mobilis 45A6 were selected for further experimentation. GTA-mediated gene transfer frequencies ranged from 5.2 x 10⁻⁶ in culture to 2.8 x 10⁻⁷ in natural samples, with up to 47% of a natural reef microbial population confirmed as recipients. Gene transfer between bacterial phyla was documented. GTAs from the 45A6 strain were screened for impact on settlement of coral larvae. Three experiments were performed, with two larvae from the brooding coral, Porites astreoides, and one with larvae from the coral reef building species, Montastraea faveolata. Larvae were cultured for several hours and subjected to GA-feeding. Application of GTA resulted in 40% of larvae responding positively, with larvae exhibiting increased larval settlement compared to controls. These results demonstrate GTA-mediated beneficial gene exchange may facilitate adaptation to environmental change.

McDonald, A. J., Trent University, Peterborough, Canada, alisonmcdonald@trentu.ca
Frost, P. C., Trent University, Peterborough, Canada, paulfrost@trentu.ca

THE NUTRIENT STOICHIOMETRY OF SEDIMENTS AND THEIR RETENTION IN URBAN STORMWATER PONDS

Urban ponds are incorporated into newly urbanized areas to store storm runoff and retain sediments. While sediment retention has been well studied, accumulation rates and ratios of major elements (i.e., carbon, nitrogen and phosphorus) in sediment remain largely unknown. We estimated rates of C, N, and P accumulation in sediments of 25 urban ponds in southern Ontario. Sediment C, N and P concentrations all showed wide ranges among ponds. 1.4-16.1%C, 0.005-0.76%N, and 0.017-0.14%P of sediment dry weight. Core averages show a relatively high C:N ratio (16.6) and low N:P ratio (3.79). Using estimated sediment accumulation rates and the elemental composition, we estimated the annual rates of C, N, and P accumulation in sediments. Accumulation rates of C, N, and P were highly elevated compared to other freshwater ecosystems. Rates decreased with increasing pond age and reduced catchment impervious surface area. Our results suggest that mass sediment retention in urban ponds is not accompanied by proportional retention of C, N or P. Additionally, the results demonstrate that recently developed landscapes are highly nutrient-enriched, and are characterized by perturbed biogeochemical cycles.

McDowell, W. H., University of New Hampshire, Durham, NH, USA, bill.mcadowell@unh.edu
Scatena, F. N., University of Pennsylvania, Philadelphia, PA, USA, fsaten@iernet.edu
Lugo, A. E., US Forest Service IITF, San Juan, PR, USA, alugo@lternet.edu

IMPACTS OF HURRICANES ON ELEMENTAL CYCLES: SEPARATING SHORT-TERM AND LONG-TERM EFFECTS ON STREAM CHEMISTRY

Understanding the effects of disturbance on aquatic ecosystems is a fundamental challenge for limnologists. In much of the world, high-energy tropical storms such as hurricanes (typhoons) can impact forest structure and productivity for decades. Here we address the long-term effects of hurricanes on stream chemistry (nutrients, major cations and anions, and dissolved organic matter) in eight streams of the Luquillo Mountains on the Caribbean island of Puerto Rico. Contrary to what we and others have shown in past short-term studies, our long-term record (up to 25 years) now clearly shows that some of these tropical forest streams can take at least a decade to return to pre-hurricane nutrient levels. In the Rio Icacos, stream chemistry in both the main stem and a tributary have not yet recovered from a hurricane that occurred in 1998. This long response trajectory to damaging tropical storms has important implications for stream ecosystem function and nutrient delivery to nitrogen-limited coastal ecosystems, as hurricane frequency is predicted to increase in the coming decades.
SURFACE SALINITY AND CARBON DIOXIDE DILUTION DURING RAIN

Focused dilution experiments and modeling was conducted using ambient rain samples collected in Long Island Sound. Stations were selected to provide a range of environmental variability, including the Connecticut River and its outflow plume, the stratified open Sound, and shallow nearshore waters. Clone libraries produced the familiar pattern of a few dominant operational taxonomic units (OTUs) and many rare ones, without evidence of saturation. Even so, the total number of OTUs was equal to or greater than the number of morphospecies observed in the Sound, based on past published reports. Pyrosequencing (454 technology) produced > 30,000 sequences from the same samples. When contigs were assembled at 98% similarity and single-sequence contigs were eliminated, results were broadly concordant with the clone libraries, except that more OTUs were observed, especially for 

Symbiodinium

"dominant" symbiont over time. Conversely, both Portes spp. appeared to have a higher level of symbiont stability, wherein a shift in the symbiont population was an infrequent event. The development of a real-time PCR assay utilizing clade-specific primer pairs, which may allow for true clade-specific symbiont quantification, will also be addressed in regards to this study.

EFFECTS OF OCEAN OUTFALLS ON CORAL REEF ECOSYSTEMS

Pollution/excessive nutrient input, is beginning to significantly impact coral reef ecosystems. On a global scale, 37% of human populations are within 100 km of a coastline. New coastal development alters the landscape of the coastline, increasing runoff that may contain large amounts of sediments, pathogens, pesticides, heavy metals and other pollutants. Excess nutrient inputs can cause eutrophication which can lead to rapid algal growth on the reefs and decreased oxygen levels, degrading the ecosystem as a whole. South Florida has six publicly owned wastewater treatment facilities that discharge secondary-treated wastewater effluent into the ocean. Efforts to stop the amount of wastewater spewed into the Florida Current have begun, by the shut off of the Delray Beach outfall on March 31, 2009. Collectively, the six outfalls in South Florida pump more than 300 million gallons of minimally treated sewage offshore every day. While recent studies were able to directly link wastewater discharges in the Florida Keys with detrimental impacts to the nearby coral reef communities, the Southeast Florida Coral Reef Initiative (SECFRI) suggests that research is needed to determine the relative importance of sewage outfall discharges on reef health. This project is a proposal to assess the impacts of near ocean outfalls on reef fish communities, in hopes that results will lead wastewater facilities to stop the spewing of wastewater into oceans.

TEMPORAL DYNAMICS OF SYMBIODINIUM POPULATIONS IN CARIBBEAN CORALS FOLLOWING A REPETITIVE BLEACHING EXPERIMENT

This study examines the impact of coral bleaching on the temporal stability of Symbiodinium populations across three species of Caribbean corals: Montastraea faveolata, Porites astreoides, and Porites divaricata. Following experimental thermal stress (32 °C, 14 days), coral fragments were transplanted back to the reef and sampled at 0, 2, and 11 months post bleaching. Additionally, the same colony fragments were exposed to an experimental thermal stress one year after the initial stress experiment. Symbiodinium populations were identified via denaturing gradient gel electrophoresis (DGGE) of the internal transcribed spacer 2 (ITS2) of the Symbiodinium genome. M. faveolata colonies did not demonstrate a clear path of symbiont succession, but rather a complex and unpredictable pattern in which several different Symbiodinium spp. fluctuated as the "dominant" symbiont over time. Conversely, both Portes spp. appeared to have a higher level of symbiont stability, wherein a shift in the symbiont population was an infrequent event. The development of a real-time PCR assay utilizing clade-specific primer pairs, which may allow for true clade-specific symbiont quantification, will also be addressed in regards to this study.

UNDERSTANDING THE EFFECTS OF URBANIZATION IN 9 METROPOLITAN AREAS OF THE CONTIGUOUS UNITED STATES: ISSUES IN TRANSFERABILITY TO TROPICAL REGIONS

Our understanding of the effects of urbanization on stream ecosystems is currently based on generalizations derived from individual studies generally focused on single metropolitan areas. This understanding can be increased by applying consistent study designs and methods to multiple metropolitan areas across large geographic scales. The US Geological Survey used a gradient approach to study the effects of urbanization on stream ecosystems in 9 metropolitan areas across the contiguous US. Two conclusions are of particular interest. First, there is no safe zone of urbanization. Macroinvertebrate assemblages exhibited linear relations with increasing urban development, suggesting that negative effects occurred at low levels of urbanization. Second, because of regional differences in the effects of urbanization on hydrology, habitat, stream chemistry, and stream biota, caution should be exercised when applying results from one environmental setting to another. Interestingly, the most important determinant of biological response to urbanization appeared to be regional factors such as climate, soils, and pre-development land use. Successful transfer of this study approach to tropical areas will require careful attention to the role of regional and local-scale environmental factors.

DIVERSITY OF PLANKTONIC CILIATES IN COASTAL WATERS: COMPARISON OF CLONE LIBRARY AND PYROSEQUENCING APPROACHES

We designed primers for the dominant clade of coastal planktonic ciliates (oliotrichs plus choreotrichs) and used them to construct SSU clone libraries from samples collected in Long Island Sound. Stations were selected to provide a range in environmental variability, including the Connecticut River and its outflow plume, the stratified open Sound, and shallow nearshore waters. Clone libraries produced the familiar pattern of a few dominant operational taxonomic units (OTUs) and many rare ones, without evidence of saturation. Even so, the total number of OTUs was equal to or greater than the number of morphospecies observed in the Sound, based on past published reports. Pyrosequencing (454 technology) produced > 30,000 sequences from the same samples. When contigs were assembled at 98% similarity and single-sequence contigs were eliminated, results were broadly concordant with the clone libraries, except that more OTUs were observed, especially for the choreotrichs. In both sequence collections, only a few species could be identified by BLAST on GenBank, indicating that most species are yet to be sequenced.

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Water quality degradation is a concern in shallow coastal habitats. Nutrient-rich...
was to follow the progression and relative activity of protists representing different trophic categories: primary producers, grazers, parasitoids and predators, from early winter through summer (November 2007 and July 2008) in the Arctic Surface Mixed layer (ASM). Preliminary work showed that the most rapid changes in protist communities occurred shortly after light became available, with not just the addition of phototrophic groups but changes in overall community trophic structure, including the loss of several predatory ciliates and taxonomic changes in common bacterial grazers. Using 454 tag pyrosequencing of the 18S rRNA genes from 12 samples we test the hypothesis that the summer community persists as part of a rare biosphere throughout winter to reappear and bloom in spring versus it being an advective community that arrives with favourable currents.

Meehoff, E., University of Concepcion, Concepcion, Chile, erikameehoff@udec.cl
Rodríguez-Gallego, L., Facultad de Ciencias, Montevideo, Uruguay
Ginenez, L., University of Wales, Wales, United Kingdom
Conde, D., Facultad de Ciencias, Montevideo, Uruguay
Muniz, P., Facultad de Ciencias, Montevideo, Uruguay

SPATIO-TEMPORAL VARIATION IN MACROBENTHIC COMMUNITIES OF COASTAL LAGOONS FROM URUGUAY

The aim of the study was to determine spatio-temporal variability of macrobenthic communities in Uruguayan coastal lagoons, and to evaluate which environmental variables structure the communities. Sampling was conducted seasonally during 2005, covering 3 scales: lagoons, sites and replicates. The statistical analysis included variance analysis, permutation multivariate variance analysis (PERMANOVA), and non-metric multidimensional scaling (nMDS). Biotic-Environment was performed to analyze the environmental variables determining the benthic communities. Results were in accordance to general patterns defined by low number of species and high dominance, for the estuarine communities in the Uruguayan coast. In lagoons with intermittent connection the benthic community was integrated by estuarine organisms and North–South gradients were observed in the distribution of some species, however in the isolated lagoon, the gradient was of higher abundance in the North with respect to the South area. The higher variability in the community structure was observed at the scale of lagoons and at the replicates spatial scale. The environmental variables that explained the benthic communities were: total suspended solids, conductivity, sediment organic matter, phytoplankton chlorophyll a, and macrophyte total biomass.

Meier, S., University of Oldenburg, Oldenburg, Germany, sa.meier@uni-oldenburg.de
Hillebrand, H., University of Oldenburg, Oldenburg, Germany, hillebrand@chm.de
Ptacinik, R., University of Oldenburg, Oldenburg, Germany, ptacnik@cbm.de

SPATIOTEMPORAL TURNOVER IN PHYTOPLANKTON METACOMMUNITIES IN A NATURAL COASTAL SYSTEM

Communities are structured by interacting processes operating at both local and regional scales, as described in the metacommunity concept. However, the applicability of this concept to pelagic assemblages, which are often considered as homogeneuos, has not been tested yet. Therefore we examined changes in the phytoplankton community as well as in corresponding environmental variables horizontally between sampling sites and vertically with depth in a highly dynamic, open system (Wadden Sea, North Sea, Germany) throughout 2009. Sampling was conducted in a biweekly rhythm around half tide in three different depths at three stations located along a current velocity gradient. In consequence of the strong temporal turnover, which is coupled with different abiotic conditions (most influencial variables were suspended solids, conductivity, sediment organic matter, phytobenthic chlorophyll a, and macrophyte total biomass).

Melack, J. M., University of California, Santa Barbara, Santa Barbara, USA, melack@bran.ucsb.edu

INUNDATION DYNAMICS, METHANE AND CARBON DIOXIDE EVASION AND ORGANIC CARBON SUPPLY IN LAKES AND WETLANDS OF THE AMAZON BASIN

About 20% of the Amazon basin is seasonally inundated, and the aquatic environments are sites of high evasion rates of methane and carbon dioxide. To quantify these rates at a regional scale it is necessary to have estimates of spatial and temporal variability in vegetative cover, inundation and gas evasion. Synthetic aperture radar data obtained for the whole lowland Amazon basin and validated using airborne digital videography were used to determine inundation and major types of aquatic habitats. Passive microwave data and modeling permitted estimation of variations in inundation. In the central floodplains carbon fixed by floating macrophytes and flooded forests make a significant contribution to inputs of organic carbon, a portion of which is returned to the atmosphere as methane and carbon dioxide. Gas evasion from the extensive, interlauvial wetlands of the upper Negro basin are slightly less than that from the central floodplains. Considerable spatial and seasonal differences in carbon dioxide concentrations and evasion occur in the large shallow lakes common in the eastern floodplains. Hydroelectric reservoirs can be large, local sources of methane evasion, which are enhanced by degassing in turbines and downstream of the dams.

Melendez, M., University of Puerto Rico, Mayaguez Campus, Comerio, Puerto Rico, melissamelendez@hotmail.com
Corredor, J. E., University of Puerto Rico, Mayaguez Campus, Lajas, Puerto Rico, jorge.corredor@upr.edu
Gledhill, D., National Oceanic and Atmospheric Administration (NOAA), Miami, USA, dwight.gledhill@noaa.gov

OCEAN ACIDIFICATION AT LA PARGUERA, PUERTO RICO

As a result of the fossil carbon released to the atmosphere, seawater pH and carbonate mineral saturation state (Ω) have decreased. In order to characterize the carbonate biogeochemistry at La Parguera Marine Reserve, the NOAA Coral Reef Conservation Program, established an Atlantic Ocean Acidification Test-bed (AOAT). During the last year the AOAT has served as a resource for monitoring the carbonate chemistry across the Cayo Enriquillo forereef. The present study has yielded a carbonate times series from data collected in 2010 based on observed changes in total alkalinity and pH. Oceanographers traditionally estimate Ω from measurements of the carbonic acid system and an assumed calcium concentration based salinity. However, in response to biogenic and abiotic calcification and coastal processes a conservative behavior of calcium with salinity may not be valid. Furthermore, magnesium can co-precipitate as “high-magnesium” calcites thereby altering the calcium:magnesium ratio and the ion activity product relative to MgCO3, mineral phases. Accordingly we are implementing HPLC methods to accurately measure calcium and magnesium seawater concentrations to investigate the non-conservative nature of these species and the consequence in deriving Ω.

Melin, E., E.C. Joint Research Centre, Ispra, Italy, frederic.melin@ec.europa.eu
SCLEG, G., E.C. Joint Research Centre, Ispra, gert.sclep@ec.europa.eu

UNCERTAINTIES ASSOCIATED WITH GLOBAL DISTRIBUTIONS OF OCEAN COLOR REMOTE SENSING REFLECTANCE

The uncertainties associated with global data sets of remote sensing reflectance Rrs are analyzed using the comparison of daily Rrs distributions from several ocean color missions. Differences in sensor wavelengths are corrected through a band-shift correction scheme. For any spatial bin, the random error σ of the uncertainty budget is derived from the calculation of variance and covariance terms when a sufficiently large inter-comparison data set is accumulated over time. The approach does not provide an estimate of the bias that might affect the satellite-derived R, but it affords a spatial view of σ as well as its main seasonal variations, information that can be propagated through bio-optical algorithms to characterize the uncertainties of ocean color products. The analysis mainly relies on SeaWIFS and MODIS and includes preliminary results with MERIS. The global distribution of σ shows a relative spatial homogeneity with some variations, for instance between coastal and open ocean waters. Generally, σ, in sr-1, decreases with wavelength. The distribution of σ is discussed with respect to validation results obtained from various sources of field data.
organisms to high seawater pCO2. Laboratory experiments confirmed that high rates of calcification can be maintained at pCO2 values of up to 4000 µatm, despite uncompensated reductions in haemolymph and extrapallial fluid pH. However, external shell dissolution can be observed at 4000 µatm when the organic periostracum is damaged. Corrosion of the internal shell surface (hypostracum) could be observed at high seawater pCO2 (4000 µatm) at low temperatures in winter. This internal shell surface corrosion is strongly related to food supply, indicating that maintenance of shell integrity is an energy-intensive process that might be impaired in favor of somatic mass conservation. A transcriptome of mantle regions responsible for hypostracum vs. ostrastracum generation was sequenced for CO2 stressed (4000 µatm) vs. control mussels to identify components of the cellular machinery that enables calcification in an extrapallial fluid that is highly undersaturated with calcium carbonate.

Mercier, M. L., University of Rhode Island, Narragansett, USA, mmercer@gsu.uri.edu

Whitney, L. P., University of Rhode Island, Kingston, USA, leann.pritchard@gmail.com

Jenkins, B., University of Rhode Island, Kingston, USA, bjenkins@uri.edu

Dyhrman, S., Woods Hole Oceanographic Institution, Woods Hole, USA, sdyhrman@whoi.edu

Saito, M., Woods Hole Oceanographic Institution, Woods Hole, USA, mtsaito@whoi.edu

Rynearson, T., GSO University of Rhode Island, Narragansett, USA, rynearson@gso.uri.edu

EXPRESSION AND REGULATION OF A PUTATIVE PHOSPHATE TRANSPORTER IN THALASSIOSIRA PSEUDONANA UNDER PHOSPHATE LIMITATION

Diatoms generate ~40% of carbon fixed annually in the oceans and their productivity can be limited by the availability of macronutrients and trace metals. We conducted P and Fe limitation experiments on the diatom Thalassiosira pseudonana. Transcriptome profiles were obtained using digital gene expression, a high-throughput, short-read sequencing method that yields quantitative gene expression profiles. An inorganic phosphate transporter, which is responsible for sodium-dependent transport of phosphate into the cell, was identified in the sequence libraries and the genome. Gene expression was analyzed across P and Fe limitation treatments, and the phosphate transporter expression was highly upregulated under P limitation but not under Fe limitation, compared to nutrient replete conditions. These results indicate that increased phosphorus transport into the cell may be an important part of phosphorus stress response. Currently, we are using qPCR to elucidate the timing of the phosphate transporter expression in response to changes in phosphorus supply.

Merten, W. B., University of Puerto Rico/The Surfrider Foundation, Rincon, USA, wessley.merten@upr.edu

Steve, T. E., The Surfrider Foundation, Rincon, USA, stevetamar@yahoo.com

A COMMUNITY-BASED PROGRAM FOCUSING ON FECAL POLLUTION MONITORING AND SOURCE IDENTIFICATION ON THE NORTHWEST COAST OF PUERTO RICO

A 17 month survey conducted in 2007/09 evaluated the level, frequency and distribution of fecal contamination of coastal recreational waters in Rincon, including those harboring endangered coral species within the Tres Palmas Marine Reserve. Weekly monitoring of 12 popular beaches along 18km of coastline showed two distinct trends: once local area rainfall was factored out 5% of the 74 testing dates showed transient Enterococci peaks with more than 75% of stations reporting colony forming units (CFU) >150/100ml of water suggesting marine current transport; and 3 stations nearest freshwater outfalls were >35 CFU/100ml, the federal standard for recreational waters, 15-25% of the survey, indicating possible contamination from freshwater sources. Currently, an expanded monitoring program shows freshwater stations to be >400 CFU/100ml 75% of the testing period with certain stations consistently testing >1000 CFU/100ml. Investigation of transport vectors, and monitoring, will continue since such elevated levels of contamination could impose serious health risks to both resource users and the environment, including coral reefs. For that reason, source identification is a top priority towards solution–based implementation of watershed restoration.

Meseck, S. L., NOAA/NMFS, Milford, USA, Shannon.Meseck@noaa.gov

Li, Y., NOAA/NMFS, Milford, USA, Judy.Yaqin.Li@noaa.gov

Dixon, M. S., NOAA/NMFS, Milford, USA, Mark.Dixon@noaa.gov

Wildors, G. H., NOAA/NMFS, Milford, USA, Gary.Wildors@noaa.gov

Chu, D., University of Delaware, Lewes, USA, dwchu@udel.edu

MacDonald, D., University of Delaware, Lewes, USA, uri@udel.edu

Rivara, K., Aeros Cultured Oyster Co, Southold, USA, keeno59@optonline.net

Luther, III, G. W., University of Delaware, Lewes, USA, luther@udel.edu

CAN A COMMERCIAL FLOATING UPWELLING SYSTEM (FLUPSY) HELP IN ECOYSTEM RESTORATION: QUANTIFYING INTERACTIONS WITH THE LOCAL ENVIRONMENT

It is well known that bivalve mollusks, such as oysters, are efficient filter-feeders that ingest and incorporate particulate organic matter, mostly phytoplankton, into soft tissues and shells, thereby influencing many ecological processes. Quantitative measurements of nutrients and phytoplankton were made at multiple sites within East Creek, an embayment of the Great Peconic Bay where a commercial ‘Floating Upwelling System’ (FLUPSY) is used to grow seed oysters. Multiple measurements were made May- September 2008, 2009, and 2010 to determine the effects of the oyster nursery upon the ecosystem. The results showed that East Creek is a highly-productive system, as indicated by diel and tidal variation in chemical and biological properties. Primary production feeding of the oyster nursery occurred within the embayment itself, rather than being imported from Great Peconic Bay. A tight coupling between water-column and sediment chemistry was evident throughout the embayment, not just in the vicinity of the FLUPSY. Influence of oysters on nutrient and plankton dynamics was small relative to overall system functions.

Messe, M., Monterey Bay Aquarium Research Institute, Moss Landing, USA, monique@mbari.org
GLOBAL TEMPORAL AND SPATIAL PATTERNS OF VARIABILITY IN OCEAN COLOR: SYNCHRONY WITH PHYSICAL VARIABLES AND UNDERLYING MECHANISMS.

Satellite-derived ocean color time series are now long enough to enable analysis of worldwide biological variations unattainable presently from in situ measurements. We performed an Empirical Orthogonal Function (EOF) analysis of SeaWiFS chlorophyll and photosynthetically active radiation, together with other global products (sea surface temperature, sea level pressure, sea level anomalies, winds, currents). The datasets exhibit a surprisingly strong temporal coherence, their first mode of variability being associated with the El Niño Southern Oscillation (ENSO). While the temporal correlations are interesting the important question is what processes drive the relationships. The spatial EOF pattern of the first mode reveals different ENSO imprints on each variable. We combine the EOF spatial patterns of physical parameters with a simple phytoplankton model to explore the mechanisms behind observed chlorophyll changes associated with ENSO.

Metsamaa, L., Univ. Tartu, Estonian Marine Institute, Tallinn, Estonia, liisa.metsamaa@sea.ee
Kutser, T., Univ. Tartu, Estonian Marine Institute, Tallinn, Estonia, tiit.kutser@sea.ee

MODEL-BASED ASSESSMENT TO IMPROVE THE USE OF REMOTE SENSING ALGORITHMS IN THE OPTICALLY COMPLEX WATERS.

The Baltic Sea has turned over time to eutrophic water and is very sensitive to the inflow of pollution and other biological and chemical matters. High amount of nutrients is the main character of eutrophication, which expresses in the extent and frequency of phytoplankton blooms. Those blooms cause the organic matter's increase of quantity. The standard products of chlorophyll produced by space agencies irregularly over- and underestimate measured chlorophyll values in turbid waters. Correlation between in situ and satellite chlorophyll is often very low. New approaches and new parameterizations for pigment algorithms are needed. Variability of the optical properties of water in different locations complicates the algorithm development even further.

One approach to finding a solution to ocean colour remote sensing problems is using modelling. The results of modelling may be useful for drawing the attention to the possibilities of how the problems that might arise (e.g. which remote sensing and fieldwork instruments could be used and which presumptions should be kept in mind in those studies) could be solved in the future. Measurements of above-water reflectance collected in the Baltic Sea area were used in this study.

Meunier, C., Alfred Wegener Institute, Helgoland, Germany, cedric.meunier@awi.de
Hantschke, F., Alfred Wegener Institute, Helgoland, Germany, florian.hantschke@awi.de
Boersma, M., Alfred Wegener Institute, Helgoland, Germany, maarten.boersma@awi.de
Malzahn, A., Alfred Wegener Institute, Helgoland, Germany, arne.malzahn@awi.de

SELECTIVITY OF PROTOZOAN AND METAZOAN HERBIVORES FOR IN-TRASPÆCIFIC FOOD QUALITY DIFFERENCES.

Studies on food selectivity in planktonic food webs highlighted that prey size, motility and swimming behavior are among the factors determining the predators choice. Food quality however is not only determined by the physical properties of the prey, but also by its elemental and biochemical composition. We assessed the ability of nauplii and copepodite life stages of the copepod *Oxyrrhis marina* to select for food quality differences within prey species by offering quality manipulated autotrophic *Rhodomonas salina*. We further assessed whether prey selectivity is driven by the nutrient status of the consumer, meaning that the consumer is able to react to specific nutritional demands. We cultured both, predators and prey to either phosphorus or nitrogen limitation, and offered these different prey qualities in a 1:1 mix to the herbivores. We showed that *O. marina* didn’t feed selectively while nauplii and copepodites did. Our results indicate that the consumer’s effects on nutrient and energy fluxes differ tremendously between microzooplankton and mesozooplankton, not only by differences in digestion and recycling, but already by selective removal of certain nutrient rich autotrophs.

Mevsman, F., Netherlands Institute of Ecology, Yerseke, Netherlands, fmeysman@nioo.knaw.nl

A BOTTOM-UP PERSPECTIVE ON THE OCEAN'S ORGANIC CARBON PUMP: O2 CONSUMPTION IN MARINE SEDIMENTS.

The metabolism of the ocean floor ecosystem is fueled by the input of organic matter, which is predominantly supplied by the sinking of organic material that is produced by photosynthesis in the surface ocean. The total oxygen uptake (TOU) of marine sediments forms a proxy for the overall remineralization of organic matter in sediments, and so, TOU values can be used to constrain the flux of organic matter across a certain depth horizon. This bottom-up perspective on the strength of the ocean's organic carbon pump was elaborated by a novel synthesis and model analysis of oxygen uptake rates in marine sediments. A global database of in situ TOU values was assembled. In a first step, a range of regression models of varying complexity was tested that have water depth as the only parameter. In a second step, a two-parameter regression model was fitted that includes both oceanic primary productivity and water depth as independent parameters. This analysis enables a novel organic carbon budget for the ocean floor with global estimates for input, mineralization and burial of organic matter. Results are compared with top-down estimates based on particle flux (ballasting) algorithms and sediment trap data.

Mikhailad, E. D., CNRS, LEMAR (UMR 6539), IUEM, Plouzane, France, emma.michauals@univ-brest.fr
Aller, R. C., SOMAS, Stony Brook university, Stony Brook, USA, raller@notes.cc.sunysb.edu
Zhu, Q., SOMAS, Stony Brook university, Stony Brook, USA, qzhu@notes.cc.sunysb.edu
Stora, G., LMGEM, Université de la Méditerranée, Marseille, France, stora@univmed.fr

DENSITY AND SIZE DEPENDENT EFFECTS OF NEPHTYIS INCISA POPULATIONS ON BIOCHEMICAL FLUXES.

It is recognized that the effects of bioturbation activities on biogeochemical cycling depend on functional biodiversity (e.g., mode of sediment mixing and bioirrigation, burrowing depth and spatial occupation patterns). Some species can, however, belong to multiple functional groups because of population dynamics and size distributions (e.g., adults vs. juveniles), and the consequences for biogeochemical cycling are poorly known. In this study, we examined the effects of four size classes of *Nephys incisa* (*XLarge, Large, Medium, Small*) on solute exchange at the sediment-water interface (*O2, pCO2 and nutrients*) and on burrowing behavior. We manipulated *Nephys* populations in experimental tanks containing sediment with natural remineralization distributions, so that the total biovolume (~biomass) was constant but population density changed as a function of size class. Time series fluxes were measured by simultaneously using planar optodes and direct sampling of water, and burrowing behavior was determined by X-ray radiography. The results indicate that for a similar biovolume, adults enhance fluxes more than juveniles, despite the fact that their space occupation, measured as total burrow volume / biovolume, is smaller.

Middleton, J. K., Fisk University, Nashville, USA, jen.middle@gmail.com
Pyrtle, A., University of South Florida, St. Petersburg, USA

DETERMINATION OF PERCENT MOISTURE, ORGANIC MATTER AND CARBONATE AT EMERSON POINT, TAMPA BAY.

Tampa Bay is the largest estuary in Florida, and it encompasses 400 square miles of open water and associated salt marsh, islands, tidal creeks, and coastal wetlands. Emerson Point is an estuary located in Tampa Bay in manatee county on the gulf coast of Florida. I will analyze and examine data of the sediment and water quality of this site using Loss On Ignition (LOI). Though the sediment cores were both collected from the Tampa Bay area, they exhibited varying characteristics. Hence, a possible explanation for the significant difference in both cores sites visually and physically. One site was collected from an area with the presence of mangroves and oyster mounds, which may be responsible for the higher percentages of organic matter, carbonate, and moisture; unlike the second site, which was inhabited with human populations that may have altered the natural flora.

Mileik, D. M., University of Minnesota Duluth, Duluth, USA, mlkd0022@d.umn.edu
Lj, J., University of Minnesota Duluth, Duluth, USA, ljj0590@d.umn.edu
Crowe, S. A., University of Southern Denmark, Odensee, Denmark, sscrowe1@gmail.com
Katsv, S., University of Minnesota Duluth, Duluth, USA, skaetsv@d.umn.edu

NUTRIENT FLUXES ACROSS THE SEDIMENT-WATER INTERFACE IN LAKE SUPERIOR INVESTIGATED USING A REACTION-TRANSPORT MODEL.

The productivity trends of the last four decades in Lake Superior are unclear. The chlorophyll levels have declined, the nitrate concentrations in the water column have increased, and the phosphorus levels have declined, with the N:P molar ratio in the deep water nearing 10:1. Given the scarcity of historical data, we investigate the sediments' role in the lake’s nutrient budgets using a diagenetic reaction-transport model LSSE-Mega. We determine the effects that the decadal and seasonal variations in organic carbon fluxes, bottom-water oxygen concentrations, and bottom-water...
nitrates and nitrites concentrations on the nutrient fluxes across the sediment-water interface. Sensitivity analysis suggests that a 10% change in the bottom water oxygen concentration could cause the nitrate flux to reverse direction. A decadal-scale decrease in the deposition flux of organic matter could deepen the oxygen penetration into the organic-poor sediments of Lake Superior by several centimeters, drastically affecting the sediment redox reactions. We compare the simulations with the geochemical observations made in the Lake Superior sediment cores over the last two years.

Miller, N. M., Astoria Pacific International, Clackamas, USA, nick.m@astoria-pacific.com
Reynolds, J. C., Astoria Pacific International, Clackamas, USA, jason@astoria-pacific.com

COLORIMETRIC ANALYSIS OF TOTAL NITROGEN IN MARINE AND ESTUARINE WATER USING SEGMENTED FLOW TECHNOLOGY WITH UV/PERSULFATE DIGESTION AND CADMIUM REDUCTION.

Colorimetric analysis for Total Nitrogen was developed on a segmented flow analyzer using UV light and persulfate to oxidize organic and inorganic nitrogen compounds to nitrate. Nitrate is reduced to nitrite via cadmium reduction and detected colorimetrically with NED/sulfanilamide reagent at 540 nm. Samples are dialed after digestion to remove refractive index interference at various salinities. This dialysis step allows open ocean, coastal and estuarine water to be analyzed simultaneously, without the need for an exact matrix match in calibrants, wash solution etc. The total nitrogen method was validated using water from the Pacific Ocean and Columbia River. The coastal and river waters were run straight and also mixed at different levels to achieve varying salinities. These samples were then spiked with a known amount of various nitrogen compounds and percent recovery of N was determined. Sample results had good correlation and were well within EPA matrix spike recovery limits.

Miller, T. W., Ehime University, Center for Marine Environmental Studies, Matsuyama, Japan, toddommiller@gmail.com
van der Lingen, C. D., Department of Agriculture, Forestry and Fisheries, Cape Town, South Africa
Broecker, R. D., NOAA, Northwest Fisheries Science Center, Newport, USA
Omori, K., Ehime University, Center for Marine Environmental Studies, Matsuyama, Japan
Dewar, H., NOAA, Southwest Fisheries Science Center, La Jolla, USA
Snodgrass, O., NOAA, Southwest Fisheries Science Center, La Jolla, USA
Kreiner, A., National Marine Information and Research Centre, Swakopmund, Namibia
Morof, N., National Marine Information and Research Centre, Swakopmund, Namibia
Kinoshita, I., Kochi University, USA Marine Science Center, Kochi, Japan

TROPHIC STRUCTURE AND ECOSYSTEM ATTRIBUTES – A GLOBAL COMPARISON OF LARGE MARINE ECOSYSTEMS USING STABLE ISOTOPE ANALYSIS.

Stable isotope analysis (SIA) is a simple and commonly used tool in ecology for measuring an organism’s source production and δ15N) and relative trophic level. Although numerous studies have applied SIA to examine trophic patterns in marine ecosystems, there are severe limitations to their interpretation in what may ultimately structure the food web. Using SIA we compared the relative trophic levels of fishes across four major ecosystems (Kuroshio and Oyashio, California, and Benguela Current) representing varying levels of primary and secondary production. Major target species were sardine, anchovy, chub mackerel and blue shark covering a range of nekton trophic levels. Results clearly showed a trend of increasing relative trophic level of species from systems with relatively lower primary and secondary production. This global pattern suggests that lower-productive ecosystems have a more linear food web, whereas high-productive systems are more truncated and interconnected. The implications of these novel results are discussed.

Mills, H. J., Texas A&M University, College Station, USA, hmills@ocean.tamu.edu
Reese, B. K., Texas A&M University, College Station, USA, brandi@ocean.tamu.edu
Morse, J. W., Texas A&M University, College Station, USA, morse@ocean.tamu.edu

MOLECULAR AND GEOCHEMICAL CHARACTERIZATION OF SULFUR AND IRON REDUCING POPULATIONS WITHIN AN ESTUARY SALINITY GRADIENT.

Sulfate reduction has long been considered the predominant terminal electron-accepting process (TEAP) under anaerobic conditions in shallow marine environments. However, recent reports suggest that Fe(III) respiration may successfully compete with sulfate reduction to comprise a large percentage of carbon oxidation, especially in low salinity environments. Along the southern Texas coastline, the Nueces River empties into the Corpus Christi and Nueces Bays, providing a unique opportunity to study a range of salinities (0.9 – 45) where sediment microbial metabolic processes are limited by either low sulfate or iron concentrations. Benthic microbial TEAPs and populations were characterized over the top 20 cm of sediment at three sites. Estimates of sulfate reduction rates were determined using standard 35S incubation assays. Iron speciation within the pore water was determined using the colorimetric ferrozine method. Porewater Fe(II) and H2S were measured within the same samples suggesting possible overlapping community function or co-occurrence of different TEAPs. Sulfate and iron reducing bacteria community structure was determined using 454-based pyrosequencing of SSU rRNA transcripts. Phylogenetic analysis indicated a diverse lineage of Deltaproteobacteria and Firmicutes-related sulfate reducers and Desulfuromonadales-related iron reducing communities. Additional functional gene analysis was used to support SSU rRNA data.

MIQUEL, J. C., IAEA - Marine Environment Laboratories, Monaco, Monaco, j.c.miquel@iaea.org
FOWLER, S. W., SoMAS - Stony Brook University, New York, USA, sfowler@free.fr

TRACERS OF PARTICLE AND PLANKTON DYNAMICS IN THE MEDITERRANEAN: AN OVERVIEW OF STUDIES AROUND THE DYFAMED OBSERVATORY SITE.

The DYFAMED station is an open sea observatory site in the NW Mediterranean that has been monitored over the past two decades. Besides regular water column studies and continuous particle flux measurement with sediment traps, several national (DYFAMED, DYNAFROC, BARMED) and international (ICESCAPE) process-oriented projects have focussed on the dynamics of particles and plankton, and how they relate to the flux and export of carbon and other materials in the sea. Within these studies, a wide array of tracers including organic compounds, inorganic substances, trace elements, and natural radionuclides have been measured with the aim of better understanding the dynamics of the system. The presentation will review the tracer data collected in these projects and how they help interpret the annual POC export cycle and plankton dynamics in this region.

Mitchell, R. G., UCSD/Scripps Institution of Oceanography, La Jolla, USA, gmitcheill@ucsd.edu
Seegers, B., UCSD/Scripps Institution of Oceanography, La Jolla, USA
Schieber, B., UCSD/Scripps Institution of Oceanography, La Jolla, USA, bschieber@ucsd.edu
Kabur, M., UCSD/Scripps Institution of Oceanography, La Jolla, USA, m.kabur@ucsd.edu
Arizzo, K. R., Stanford University, Stanford, USA, arizzo@stanford.edu
Mills, M. M., Stanford University, Stanford, USA, mm migli@stanford.edu

BIO-OPTICAL PROPERTIES OF THE CHUKCHI AND BEAUFORT SEAS.

During the summer 2010 NASA-sponsored ICESCAPE cruise to the Chukchi and Beaufort Seas we completed 140 bio-optical stations including analyses of chlorophyll, particle, detrital and soluble absorption (ap, ad, as). At 35 stations we also measured spectral reflectance with a PRR-800 free-fall profiling radiometer. Data were collected for coastal shelves and deeper waters that were partially ice-covered. ICECAPE data were compared to our California Current bio-optical data which have a similar total range in observed chlorophyll. Absorption of soluble and detrital material for ICESCAPE were much higher per unit of total absorption compared to CalCOFI. For 443 nm, median values for the ratio ad/(ap+as) were 0.2885 for CalCOFI and 0.5986 for ICESCAPE. The median values for the ratio ad/(ap+as) were 0.0814 for CalCOFI and 0.1716 for ICESCAPE. Since ocean color reflectance is strongly affected by the absorption coefficients, the strong contributions of ad and as at 443 nm lead to large over-estimates of chlorophyll up to 3x using standard NASA algorithms. Implications for regional satellite estimates of primary productivity will be discussed.

Mitra, C., University of South Florida, Tampa, USA, cmitra@usf.edu
Crisman, T. L., University of South Florida, Tampa, USA, tcrisman@usf.edu

BENTHIC INVERTEBRATE COMMUNITIES ON LAKES CREATED ON PHOSPHATE MINED LANDS IN CENTRAL FLORIDA.

Created lakes are mitigation features on reclaimed phosphate mined lands in central Florida. This study investigated profundal and littoral benthic community composition and succession for 24 created lakes, 1-45 years old. Quantitative samples were collected from the deepest point of the profundal zone (2-9m) and at 1 m in the littoral. The relationship between invertebrate abundance (total, Chironomidae,
Oligochaeta, minor taxa) and conductance, dissolved oxygen, Secchi, chlorophyll, sediment organic content, lake age, and sampling depth or bank slope was determined by forward stepwise regression. In both littoral and profundal zones, conductance accounted for a great proportion (40-80%) of variation of total, Chironomidae, Oligochaeta, and minor taxa abundance (P<0.001). In the littoral zone, an additional 4-14% was explained by sediment organic matter (P<0.02). Some littoral taxa richness (36%, P=0.002) and Chironomidae relative abundance (23%, P=0.02) variation was explained by dissolved oxygen. No other relationships were statistically significant. Community composition, total abundance and taxa richness displayed minimal or no change versus lake age. Lack of succession was attributed to sustained productivity fostered by phosphate release from the geologic substrate.

Mitrovic, S. M., University of Technology, Sydney, Australia, simon.mitrovic@uts.edu.au
Westhorpe, D. P., University of Technology, Sydney, Australia
Kobayashi, T., Department of Environment and Climate Change, Sydney, Australia
POTENTIAL FOOD WEB CHANGES WITH TERRRESTRIAL DOC DELIVERY TO A RIVER WITH HIGHLY MODIFIED FLOWS
The Namoi River, Australia, is a floodplain inland river that has greatly reduced flows from natural due to the effects of regulation and abstraction. Environmental flows have been allocated to the river as a strategy to increase wetting of terrestrial areas and deliver increased amounts of dissolved organic carbon to the river. To test the response of the planktonic foodweb to increased DOC delivery, mesocosm experiments were performed. Mesocosms were 70 l bins filled with river water. DOC was added as glucose or leachates of common riparian plant both alone and with nitrogen and phosphorus, and this was compared to controls. DOC addition with and without nutrients was found to increase heterotrophic respiration. In these treatments, zooplankton concentrations were found to increase relative to controls, with diversity also increased. This study supports the contention that environmental flows that increase DOC delivery within the river will stimulate heterotrophic bacterioplankton and may alter the food web.

Moorey, E. A., Massachusetts Institute of Technology, Cambridge, USA, emoberg@mit.edu
Sosik, H. M., Woods Hole Oceanographic Institution, Woods Hole, USA, hsosik@whoi.edu
AUTOMATED CALCULATION OF CELL VOLUME FROM 2D IMAGES OF PHYTOPLANKTON WITH COMPLEX SHAPES
Automated plankton imaging systems generate more data than can be feasibly analyzed with manual intervention. For phytoplankton, cell volume estimates are an important feature to extract, but existing automated approaches are acceptable only for relatively simple cell shapes. We have developed and evaluated a new algorithm that uses a distance map to automatically calculate a plankton biovolume from a two-dimensional boundary. The approach is well suited for a range of cell shapes (including chains of cells) with convex perimeters that deviate from simple geometric shapes and whose volumes are not well represented by a solid of revolution around a single axis. This distance map method can be applied to the rapid analysis of large numbers of images without any human interaction. Furthermore, the algorithm can be modified to use both shape and taxonomic information (either automated or user-input) to refine the volume estimates. We demonstrate the application of this new method to time series observations from Imaging FlowCytobot, an automated submersible imaging-in-flow cytometer, deployed for several years at the Martha’s Vineyard Coastal Observatory.

Modenutti, B., Lab. Limnología. INIBIOMA, UNComahue, Bariloche, Argentina, bnodeunetti@conicet.gob.ar
Bastidas Navarro, M., Lab. Limnología. INIBIOMA, UNComahue, Bariloche, Argentina, mbastidas@uncomahue-conicet.gob.ar
Balseiro, E., Lab. Limnología. INIBIOMA, UNComahue, Bariloche, Argentina, e.balseiro@uncomahue-conicet.gob.ar
DEEP CHLOROPHYLL MAXIMA IN NORTH PATAGONIAN ANDEAN LAKES: STRATEGIES IN A STRONG LIGHT GRADIENT
North Patagonian Andean lakes from Argentina are high light/low nutrient environments, in which mixotrophy appears as a suitable and very common strategy for exploiting the extended euphotic zone of the water column. During summer stratification these lakes exhibit the development of a Deep Chlorophyll Maxima (DCM) at the metalimnetic layers, near 1% of surface PAR irradiance. Here, we combined data from field surveys and laboratory experiments in order to analyze how organisms cope with a strong physical gradient of light. Picocyanobacteria, mixotrophic ciliates and flagellates are the main components of most DCM found in Andean-Patagonian lakes. The vertical distribution of phototrophic species is driven by a trade-off between light availability and damage by UV. In particular, the mixotrophic ciliate Ophydium naumannii exhibited high photosynthetic efficiency at low light intensities and further experiments showed that there is a positive correlation between light intensity and ingestion rates. Therefore, in environments where light is not limiting, an increase in light availability should increase particle uptake because phagotrophy provides essential substances for growth. These results may also indicate that changes in carbon/nutrient uptake may have important consequences for elemental (carbon:nitrogen:phosphorus) ratios.

Moellendorf, S. M., GSI Water Solutions Inc, Corvallis, Oregon, USA, smoellenufl@gmail.com
Crisman, T. L., University of South Florida, Tampa, Florida, USA, tcrtisman@usf.edu
ECOHYDROLOGY OF SEASONAL AND CANAL INFLUENCED PERENNIAL STREAMS OF GUANACASTE, COSTA RICA
Irrigation canals have been expanded in western Costa Rica in the past three decades to facilitate rice agriculture in former wetlands. Canal Oeste delivers water from the central highlands and crosses several seasonal, headwater streams through viaducts. In unlined canal sections, sufficient water leaks to change these streams into perennial systems. Seasonal streams either dry completely during the dry season or are reduced to a series of isolated pools. Macroinvertebrates and fish were sampled in both stream types from the dry-wet season transition and throughout the wet season to the wet-dry transition. Macroinvertebrates rapidly colonized seasonal streams upon rewetting, presumably from pool refugia, and species composition became markedly similar to perennial streams by the end of the wet season. Rapid colonization was noted for Diptera (chironomids), oligochaetes and nematodes. The fish fauna was depauperate in both stream types with six species in common, and recolonization of seasonal streams was very rapid after flow returned. This study provides a baseline for stream ecohydrological studies in dry tropical forests of Central America.

Mohn, W., Leibniz Institute for Marine Sciences (IFM-GEOMAR), Kiel, Germany, wmohn@ifm-geomar.de
Großkopf, T., Leibniz Institute for Marine Sciences (IFM-GEOMAR), Kiel, Germany, tgrosskopf@ifm-geomar.de
Wallace, D., Leibniz Institute for Marine Sciences (IFM-GEOMAR), Kiel, Germany, dwallace@ifm-geomar.de
LaRoche, J., Leibniz Institute for Marine Sciences (IFM-GEOMAR), Kiel, Germany, jlaroche@ifm-geomar.de
METHODOLOGICAL UNDERESTIMATION OF OCEANIC NITROGEN FIXATION RATES
Dinitrogen (N$_2$) fixation is the largest source of new nitrogen to the open ocean. The addition of the gaseous stable isotope tracer ^15$N$_2$ is commonly used to measure rates of N$_2$ fixation. Mörh et al. (2010) recently highlighted that N$_2$ fixation rates may be significantly and variably underestimated when the gaseous tracer is added as a bubble due to a time-dependent equilibration between gas and liquid phase. In contrast, the addition of the tracer as $^{15}$N$_2$-enriched seawater generates an instantaneous, constant isotopic enrichment at the expected value. The addition of $^{15}$N$_2$-enriched seawater is proposed for the measurement of N$_2$ fixation rates in culture and field experiments. Preliminary field comparisons carried out within the SOPRAN project show variable underestimation. The application of the improved protocol will likely result in N$_2$ fixation rates which are on average higher than those previously measured and may contribute to closing the apparent oceanic nitrogen deficit.

Moisander, P. H., University of Massachusetts Dartmouth, North Dartmouth, MA, USA, pmoisander@uml.edu
Bench, S., University of California Santa Cruz, Santa Cruz, CA, USA, sbench@ucsc.edu
Ochiai, M., Ehime University, Matsuyama, Japan, mari.ochiai@gmail.com
Carter, B. J., University of California Santa Cruz, Santa Cruz, CA, USA, bjcarter@ucsc.edu
Bernick, D., University of California Santa Cruz, Santa Cruz, CA, USA, dbernick@soe.ucsc.edu
Zeh, J. P., University of California Santa Cruz, Santa Cruz, USA, jzehn@gmail.com
DRAFT GENOME SEQUENCE OF A NON-TOXIC MICROCYSTIS AERUGINOSA STRAIN FROM THE KLAMATH RIVER, CALIFORNIA
Microcystis aeruginosa is a colony-forming coccid cyanobacterium that commonly forms blooms in nutrient-rich freshwaters and estuaries. It produces potent hepatotoxins...
toxins microcystins, cyclic pentapeptides that are assembled by large non-ribosomal peptide synthetase complexes. We established a culture isolate of Microcystis that doesn't appear to produce microcystins from the northern California Klamath River. To compare the genome of the non-toxic isolate to toxic Microcystis genomes, we conducted a 454 sequencing run, followed by a long mate pair SoLiD sequencing run. Pyrosequencing resulted in a total of 660,000 reads that assembled into approximately 500 long reads. The draft genome had a high similarity with the genomes previously published for two toxic Microcystis aeruginosa strains (NIES834 and PCC7806). Draft genome annotation by MG-RAST revealed the presence of major pathways, but major genes belonging to the peptide synthetase pathway were not found. We identified six CRISPRs (clustered regularly interspaced palindromic repeats) that are thought to confer resistance to phage infection. The differences in genomes of the toxic and non-toxic Microcystis may elucidate reasons for cyanobacterial toxin production.

Mokiao-Lee, A. U., University of Hawaii at Hilo, Hilo, USA, ambyrmlee@gmail.com
Wiegner, T. N., University of Hawaii at Hilo, Hilo, USA, wiegner@hawaii.edu
Johnson, E., University of Hawaii at Hilo, Hilo, USA, erike@hawaii.edu
IDENTIFYING NITROGEN SOURCES TO THERMALLY-HEATED CORAL REEF TIDE POOLS ON HAWAII ISLAND USING A MULTI-STABLE ISOTOPE APPROACH
Eutrophication of coral reefs is a worldwide problem. In Hawaii, it is a concern because of increasing development, agriculture, and wide-spread use of cesspools. Therefore, determining nitrogen (N) sources to coral reefs is important for their management and sustainability. The objective of our study was to identify N sources entering thermally-heated, coral reef tide pools in Kapaohi, Hawaii, and determine their relative importance, as it is a Marine Life Conservation District affected by farms and cesspools. Possible N sources to the tide pools include fertilizer, soil, sewage, and ocean water, and each had unique values for 815N and 818O in NO3- and 818O. Areas of groundwater input to the tide pools that were identified by high-resolution spatial water quality mapping were warm and had high nutrient concentrations. Preliminary water and macroalgal tissue samples collected in these areas suggest that sewage and fertilizer N are present in the tide pools, but that macroalgae are enriched with fertilizers. Further sampling and analysis will determine the spatial extent of the pollution and the relative contributions of the N sources to tide pools.

Molina, M., U.S. EPA, Athens, USA, molina.marizosa@epa.gov
Hunter, S., U.S EPA Contractor, Athens, USA, hunter.shayla@epa.gov
White, E., USA, emilywhitewhite.phb@gmail.com
Cyterski, M., US EPA, Athens, USA, cytterski.mike@epa.gov
Zepp, R., US EPA, Athens, USA, zepp.richard@epa.gov
IMPACT OF NON-POINT SOURCES ON THE ENTEROCOCCI QPCR AND CULTURABLE SIGNALS
This study focused on the impact of runoff from non-point sources and environmental parameters on the culturable and qPCR signals of enterococci and other alternative fecal indicators in recreational beaches associated with the swimming area, were processed for enterococci densities (EPA Method 1600), enterococci qPCR analysis and selected microbial source tracking markers. Automated equipment collected hydrogeomorphological and biogeochemical variables on a 24-hour basis. Culturable enterococci and qPCR signals highly correlated (R2=0.7) during the onset of the rainy period. Multilinear regressions (MLR) indicated that wind parallel to shore, humidity, absorbance, salinity, and strong tides explained most of the variability in the bacterial concentrations (adjusted R2 = 0.41) and qPCR signals (adjusted R2=0.56). Both MLR outputs and the enterococci DNA to culturable ratios indicated that the main source of fecal contamination was a creek located to the east of the beach. Correlation analysis indicated that the DNA signal observed at the source streams was mostly attributable to culturable enterococci.

Molinero, J. C., Leibniz Institute of Marine Sciences, Kiel, Germany, jmolinero@ifm-geomar.de
Hidalgo, M., University of Oslo, Oslo, Croatia, j.m.h.roland@bio.uio.no
Morovic, M., Institute of Oceanography and Fisheries, Split, Norway, morovic@izor.hr
Coll, M., Dalhousie University, Halifax, Canada, mcoll@gcm.cis.ces.es
NON-STATIONARY EFFECTS OF CLIMATE AND FISHING ON NORTHERN MEDITERRANEAN SMALL PELAGIC FISH
Small pelagic fish are closely linked to the bottom of pelagic food web and therefore might integrate climate-related environmental changes. In addition, they are highly exploited in the Mediterranean Sea and account for ca. half of the total fish landings. Here we examine the effects of decadal changes of climate and fishing on small pelagic fish in the northern Mediterranean Sea. We quantified the hydroclimate events driven the pelagic environment throughout the last decades. Climate forcing enhanced during the early 1980s and shifted the hydroclimate conditions toward warmer and more stable waters. Concurrent with this, the fishing pressure increased in the last decades and exacerbated the climate effects on small pelagic fish. We found that both bottom-up and top-down controls on fish have been discontinuous through time and led to varying correlation functions at different time scales. We quantified such evolving relationship between climate-fishing forces and Mediterranean small pelagic fish and showed that the link is modulated over several time scales. These results draw attention on the non-stationary effects of the synergies of climate and fishing on exploited fish.

Montoya-Herrera, E., University of South Florida, College of Marine Science, St Petersburg, Venezuela, emontesh@mail.usf.edu
Muller-Karger, F. E., University of South Florida, College of Marine Science, St Petersburg, Venezuela, carib@marine.usf.edu
Thunell, R., University of South Carolina, Department of Geological Sciences, Columbia, Venezuela, thunell@geol.sc.edu
Tappa, E., University of South Carolina, Department of Geological Sciences, Columbia, Venezuela, tappa@geol.sc.edu
Trocilo, L., Universidad de Oriente, Porlamar - Nva. Esparta, Venezuela, lucas.trocilo@gmail.com
Lorenzoni, L., University of South Florida, College of Marine Science, St Petersburg, Venezuela, laural@marine.usf.edu
Astor, Y., Fundación La Salle de Ciencias Naturales, Estación de Investigaciones Marinas de Margarita, Porlamar - Nva. Esparta, Venezuela, yastor@edimar.org
Varela, R., Fundación La Salle de Ciencias Naturales, Estación de Investigaciones Marinas de Margarita, Porlamar - Nva. Esparta, Venezuela, rvara@edimar.org
ENVIRONMENTAL CONTROLS ON THE NITROGEN ISOTOPE SIGNAL OF SINKING PARTICLES IN THE CARIACO BASIN, VENEZUELA
The isotopic composition of particulate nitrogen (815N-PN) of marine sediments has become an important paleoclimatic proxy because of its potential for providing information about past changes in the nitrogen budget of the global ocean. We report here a decade of 815N from sinking particles in the Cariaco Basin, an anoxic depression off Venezuela that preserves an exceptional climate record in the sediments. We found that the 815N-PN responds to the seasonal upwelling cycle of the basin and to interannual climate variability over larger spatial scales. Particles produced during the spring upwelling period carry a nitrogen fixation isotopic signal imported from the Sub-tropical North Atlantic, while the 815N-PN during relaxed upwelling (September to November) seems to respond to local nitrogen fixation. The spring bloom 815N-PN is also strongly coupled to interannual changes in sea surface temperature, which is a proxy of upwelling strength. These findings indicate that the 815N-PN in the sediments of the Cariaco Basin need to be interpreted cautiously in the context of the role of climate change on sea level variations and the nutrient budget of the basin.

Montoya, J. P., Georgia Institute of Technology, Atlanta, USA, montoya@gatech.edu
Subramaniam, A., LEDO, Columbia University, New York, USA, aji@ledo.columbia.edu
Asper, V., University of Southern Mississippi, Stennis Space Center, USA, vernon.asper@usm.edu
Diercks, A., NIES, University of Southern Mississippi, Abbeville, USA, arne.diercks@usm.edu
Passow, U., UC Santa Barbara, Santa Barbara, USA, passow@lifesci.ucsb.edu
Crespo-Medina, M., University of Georgia, Athens, USA, mcrespo1@uga.edu
Joye, S. B., University of Georgia, Athens, USA, mjoye@uga.edu
Muller-Karger, F. E., University of South Florida, College of Marine Science, St Petersburg, USA, emontesh@mail.usf.edu
Bracco, A., Georgia Institute of Technology, Atlanta, USA, abracco@gatech.edu
Villareal, T. A., UT Marine Science Institute, Port Aransas, USA, tvillareal@gmail.utexas.edu
SUBSURFACE TURBID LAYERS IN THE GULF OF MEXICO: GHOSTS OF THE DEEPWATER HORIZON OIL SPILL?
During a recent cruise to the northern Gulf of Mexico (21 Aug - 16 Sep 2010), we encountered multiple subsurface features characterized by low beam transmittance,
distinct spectral fluorescence signatures, and high concentrations of particles. These features appeared to form coherent layers below the mixed layer at depths ranging between roughly 150 and 1400 m and extending in all directions around the Deepwater Horizon wellbore. We documented high particle concentrations in these layers using both imaging (Snow-Cam) and filtration sampling approaches. Although these layers appear spatially linked to the Deepwater Horizon oil spill, they were not consistently associated with high concentrations of methane and other hydrocarbons associated with the spill. We will discuss the hydrographic context of these layers, their elemental and isotopic composition, and their potential biogeochemical impact in the Northern Gulf of Mexico.

Moore, J. K., University of California, Irvine, Irvine, USA, jkmoore@uci.edu

**CONTROLS ON NITROGEN FIXATION IN A GLOBAL OCEAN MODEL**

A number of factors impact nitrogen fixation in the oceans including the concentrations of key nutrients, stratification and light regime, and temperature. Other factors may also play a role including atmospheric deposition and riverine inputs of nutrients to the oceans, the rate and location of denitrification (which alters N/P ratios in the upper ocean), and the cycling of dissolved organic nitrogen and dissolved organic phosphorus. Atmospheric deposition can provide key nutrients to the diatomophytes (Fe, P) but also provides N to ocean surface waters, which can impact N fixation by modifying ambient nutrient N/P ratios. I will address how these various factors impact global rates and the spatial distributions of nitrogen fixation in the context of the ocean component of the Community Climate System Model (CCSM). The Biogeochemical Elemental Cycling (BEC) module runs within the CCSM, with multiple phytoplankton functional groups, including an explicit diatomophytes group.

Moore, T. S., University of New Hampshire, Durham, USA, timothy.moore@unh.edu

Dowell, M. D., Joint Research Centre, Ispra, Italy, mark.dowell@jrc.ec.europa.eu

Campbell, J. W., University of New Hampshire, Durham, USA, janet.campbell@unh.edu

**CAN PHYTOPLANKTON ECOLOGICAL Niches BE DETECTED FROM SATELLITE DATA?**

Ocean color satellites have provided important information about phytoplankton biomass distributions in the oceans, yet the composition of phytoplankton communities is still elusive. Direct phytoplankton species detection from ocean color is limited to just a few types, notably coccolithophores. When blooming, the spatial distribution of coccolithophores (E. hux) can be inferred by their conspicuous high scattering effects visible in ocean color imagery. The environmental niche that blooming coccolithophores occupy is one of high light and high stratification. In this work, we seek to bridge the observations of these blooms with an ecological niche defined by other environmental variables that are amenable to remote sensing (light, temperature, wind). The characteristics of the environmental niche can be quantified and used in a multivariate statistical model to detect this niche using space-borne sensors. The mapped niche space is a depiction of the fundamental niche of the organism. We use the blooming coccolithophorid as a test case in this exploration of the feasibility of phytoplankton niche detection from satellite data for a single species.

Moorthi, S. D., ICBM, University of Oldenburg, Wilhelmshaven, Germany, stefanie.moorthi@uni-oldenburg.de

Hillebrand, H. L., ICBM, University of Oldenburg, Wilhelmshaven, Germany, helmut.hillebrand@uni-oldenburg.de

**COMPETITION AND NUTRIENT DYNAMICS AMONG MIXOTROPHIC AND HETEROTROPHIC CILIATES**

Mixotrophic protists are relevant primary producers and consumers in planktonic food webs. So far, little is known about their stoichiometric requirements in terms of major nutrients, and whether these depend on their degree of mixotrophy. The present study investigated competition and nutrient dynamics in assemblages of purely heterotrophic and mixotrophic ciliates. Ciliates were grown on microalgae reared under different nitrogen- and phosphorus-concentrations and ratios to investigate stoichiometric requirements of mixotrophs compared to heterotrophs, effects of food-quality on their performance and competitive behavior, and finally dynamics of dissolved nutrients in heterotrophic and mixotrophic assemblages. Depending on their primary nutritional mode, mixotrophs showed differences in their stoichiometry and their effects on nutrient turnover, among each other and compared to heterotrophs. One of the mixotrophs substantially hampered nutrient regeneration and altered N/P ratios. Under nutrient depletion, its growth was enhanced by the presence of a heterotroph, presumably due to nutrient regeneration through heterotrophic feeding. This study provides first insights into the stoichiometric traits of mixotrophic microzooplankton and will advance our understanding of mixotrophy and nutrient dynamics in planktonic food webs.

Moore, P. C., Instituto Oceanografico/Universidade de Sao Paulo, Sao Paulo, Brazil, pamarin}@usp.br

Sumida, P. Y., Instituto Oceanografico/Universidade de Sao Paulo, Sao Paulo, Brazil, psumida@usp.br

Castillo, D. F., Instituto Oceanografico/Universidade de Sao Paulo, Sao Paulo, Brazil

Pellizari, V. H., Instituto Oceanografico/Universidade de Sao Paulo, Sao Paulo, Brazil, vivian@usp.br

**SEDIMENTARY MICROORGANISM RESPONSE TO ORGANIC MATTER INPUT: A LABORATORY STUDY**

Coastal sediments of Ubatuba-SP (SE Brazil) are characterized by the presence of plankton-derived organic matter. There are two main seasonal events that drive organic matter (OM) dynamics in the area: the increasing phytoplanktontic primary productivity (especially diatoms) related to the advection of the South Atlantic Central Water (SACW) accumulates OM in surface sediments; and sediment re-suspension caused by the passage of cold fronts erodes deposited OM away from the area. An experimental study was done in Nov/Dec 2010 to observe the microbial response to two different POM inputs in this coastal sedimentary community. A total of 57 cores, separated in two treatments (diatoms and nanoflagellates) and a control were maintained for a total of 30 days in constant temperature, circulation and oxygenation. At six times after the addition, samples was collected by microbial and biochemical analyses. The microbial community was counted by the Live/Dead technique, showed an increase in total number after the addition of microalgae. Sediment oxygen and carbon dioxide fluxes confirmed the increase of microbial metabolism. DGGE analysis showed differences between the control and the treatments and sample times.

Morales, A. M., Trent University, Peterborough, Canada, anamorales@trentu.ca

Williams, C. J., Trent University, Peterborough, Canada, claytonwilliams@trentu.ca

Xenopoulos, M. A., Trent University, Peterborough, Canada, mxenopoulos@trentu.ca

Frost, P. C., Trent University, Peterborough, Canada, paulfrost@trentu.ca

**ASSESSING THE ROLE OF DISSOLVED ORGANIC MATTER IN THE COMMUNITY STRUCTURE AND STOICHIOMETRY OF LAKE PICO AND NANOPLANKTON**

We examined fluorometric properties of dissolved organic matter (DOM) in eleven lakes of southern Ontario, Canada to better understand influences on the structure and stoichiometry of pico- and nanoplankton populations. Lakes were sampled once in August 2009 and monthly between March and August 2010. Total heterotrophic bacteria and three distinct phytoplankton populations (phycoerythrin-type cyanobacteria, phycocyanin-type cyanobacteria and a mixed eukaryotic algae community) were identified and counted using flow cytometry. We observed significant spatial and temporal differences in pico- and nanoplankton community structure, seston stoichiometry, and DOM properties. Results indicate higher seston C:N ratios were correlated with higher ratios of recently produced to degraded DOM, and negatively related to humic and aromatic DOM in months that phycocyanin-type cyanobacteria were dominant. These results suggest that the source, optical properties and internal processing of DOM can influence algal community structure and nutrient limitation.

Moran, S. B., University of Rhode Island/Graduate School of Oceanography, Narragansett, USA, moran@soo.uri.edu

Lomas, M. W., Bermuda Institute of Ocean Sciences, St. Georges, Bermuda, Michael.Lomas@bios.edu

**AGGREGATION AND EXPORT OF CYANOBACTERIA AND NANO-EUKARYOTES FROM THE SARGASSO SEA EUPHOTIC ZONE**

Size-distributions (10⁻²0 μm, 20–53 μm, ≥53 μm) of particulate organic carbon (OC) and 234Th in the Sargasso Sea indicate a convergence during the winter-spring bloom that is positively correlated to the depth-integrated abundance of autotrophic pico-eukaryotes and Synechococcus. Pigment concentrations in these size-fractionated particles reveal indicator pigments for Synechococcus, Prochlorococcus and nano-eukaryotes exist down to 500 m and are essentially constant across these size fractions. Based on the presence of chlorophyll precursor and degradation pigments, we suggest these pigments were redistributed to deeper waters on larger, more rapidly sinking aggregates. We estimate that Synechococcus, Prochlorococcus and nano-plankton derived aggregates represent 2-13% (5 ± 4%), 1-20% (5 ± 7%) and 6-43% (23 ± 14%) of the total sediment trap POC flux, respectively. Nano-eukaryotes contribute equally to POC export and autotrophic biomass, while export of cyanobacteria represents one-tenth of their contribution to autotrophic biomass. These field observations provide direct evidence that pico- and nano-plankton represent an important contribution to the total POC export in this sub-tropical gyre.
Morata, N., University of Tromsø, Tromsø, Norway, nathalie.morata@gmail.com
Manno, C., University of Tromsø, Tromsø, Norway, clara.manno@uit.no

IMPACT OF OCEAN ACIDIFICATION ON THE METABOLISM OF ARCTIC CALCIFYING MEROPLOANKTONIC ORGANISMS
Atmospheric pCO₂ is predicted to double by the end of the century, leading to global warming and ocean acidification, both being enhanced in polar oceans. In the Arctic, calcifying organisms are particularly important as food sources and for carbon fluxes, and will likely be affected as their shells dissolve with lower pH. Marine calcifying organisms include some strictly planktonic and benthic organisms, as well as meroplankton, which are benthic larvae spending only part of their life in the water column. In order to understand the effect of decreasing pH on the overall metabolism of meroplankton, perturbation experiments were performed, and respiration was measured at regular pH (8.1) and lower pH (7.7) predicted for the next 100 years. While gastropods and clams (both starting calcification at larval stage) showed an increase of respiration at lower pH, barnacles (starting calcification after settlement) respiration did not change. This suggests that barnets starting calcification at planktonic larval stage, might be more affected by pH changes, and that ocean acidification is likely to lead to changes in food web structure, carbon fluxes and benthic communities.

Morata, N., University of Tromsø, Tromsø, Norway, nathalie.morata@gmail.com
Laclau, J. P., DIAPH, France

THE CLASS CORE / LA CAROTTE DE CLASSE
This project was born from the collaboration of an elementary school teacher, Jean Pierre Laclau and his students (9-10 years old), with Nathalie Morata, a young doctoral student working on Arctic research. Nathalie came to the class and spent various times to sensitize the children to her polar interests, research, and life as scientist. She also kept in touch with the children by email during her field work onboard a Canadian icebreaker, the Amundsen, sharing with them her experiences and answering their questions. Curious and constantly seeking knowledge, the students enjoyed letting Nathalie bring them onboard albeit virtually, and worked on class on various questions linked to polar regions, including global warming, ocean preservation, biodiversity, inuit communities and much more. This book relates the adventures of Nathalie through the children eyes, combining scientific facts and children imagination. It has been translated in various languages and is enriched with working suggestions. The bilingual French-English version is, in particular, a powerful tool for supporting teaching at various levels. Moreover the website lacarottedeclasse.com contains additional educational information for teachers.

Morrell, J. M., University of Puerto Rico, Mayaguez, Puerto Rico, julio.morrell@upr.edu

ESTIMATION OF NUTRIENT VECTORS INTO CARIBBEAN SURFACE WATERS: THE ROLE OF REMOTELY SENSED SEA SURFACE SALINITY
We will present two examples of the potential impact of remotely sensed surface salinity data on our understanding of Eastern Caribbean biogeochemistry: The upper thermocline of Eastern Caribbean waters is dominated by the Subtropical Underwater (SUW), a high salinity mass formed in the WT Atlantic. The SUW carries into the thermocline of Eastern Caribbean waters is dominated by the Subtropical Underwater (SUW), a high salinity mass formed in the WT Atlantic. The SUW carries into the Thermocline. We will use this information to develop models for evaluating surface oil spill trajectory forecast models using surface oil maps produced from Synthetic Aperture Radar (SAR) satellite imagery. The methods are applied to evaluate model performance at different forecast time horizons, and also to evaluate the time-composited solution. This latter technique allows us to understand model errors and stochasticity, and to describe the life history of the oil spill event. Applications of the techniques to the Deepwater Horizon oil spill incident are presented.

Andersen, D., UPM Arktis, Tromsø, Norway, dave.andersen@upm.no

HIGH-PRESSURE, LOW-TEMPERATURE INCUBATIONS OF THE FLAGELLATE CAFETERIA ROENBERGENSIS (CHROMISTA, BICOSOECALES)
Eukaryotic microbes from the surface ocean are continuously transported into deeper layers either by advection or by colonizing sinking particles, and are thus exposed to extreme pressures and low temperatures. Little is known about whether these extreme conditions affect the distribution and activity of organisms in this environment. Cultures of the cosmopolitan marine flagellate C. roenbergensis (surface pressure) were incubated in titanium chambers for approximately a week to simulate the low-temperature (2°C) and high-pressure conditions (5000m) of the deep sea. Samples were taken daily without pressure loss. Although cell counts declined in both the high pressure chambers and low pressure controls, the decline was steeper under high pressure with an average of 1.7% of the initial count after seven days versus 6.6% in control chambers. In two control incubations, the population increased toward the end of incubation. Some viable cells always survived in these extreme conditions. This experiment showed that while C. roenbergensis were able to persist over time in deep-sea conditions, high pressure inhibited population growth and caused increased mortality compared to low pressure.

Morris, E. P., University of Cadiz, Puerto Real, Spain, edward.morris@uca.es

THE ROLE OF BIO-HYDRODYNAMICS INTERACTIONS IN DETERMINING THE FUNCTIONING OF SHALLOW, BENTHIC ECOSYSTEMS
Epi-benthic organisms play a strong role in controlling pelagic-benthic mass transfer rates by directly modifying concentration gradients (i.e., production, or removal of material) and by indirectly modifying near-bed hydrodynamics. Focusing on these
bio-hydrodynamic interactions, we will demonstrate how the physical structure of different assemblages, via their interaction with currents and waves, results in spatio-temporal variation in transfer rates at a range of scales. Examples will be used to highlight the, sometimes complex, interactions between organism/population properties (i.e., height, area, volume, flexibility, density and distribution) and near-bed hydrodynamics. Innovative approaches for examining transfer rates under natural hydrodynamic conditions will demonstrate how these interactions can determine the transfer (and retention) of nutrients and particles between the water column and benthos, creating intra-specific micro-niches (or zones) with different physiochemical properties (potentially influencing biodiversity). Finally, inter-specific differences in bio-hydrodynamic effects will be discussed in relation to benthic processes (such as the burial of organic matter, i.e., the "blue carbon hypothesis") and suggestions will be made about the potential consequences of changes in benthic habitat distribution for the functioning of shallow, benthic ecosystems.

Morris, P. J., University of South Carolina, Georgetown, USA, pjmorris@belle.baruch.sc.edu

Kimes, N. E., University of South Carolina, Georgetown, USA, kimes@musc.edu

Johnson, W. R., Medical University of South Carolina, Charleston, USA, wesman72@gmail.com

Vizcaino, M. I., Medical University of South Carolina, Charleston, USA, vizcain@musc.edu

Williams, K., Medical University of South Carolina, Charleston, USA, willking@musc.edu

VIBRIO CORALLILYITICUS AND TEMPERATURE-DEPENDENT VIRULENCE
In coral reef ecosystems, unprecedented degradation has occurred over the past three decades due in part to temperature-related diseases. V. corallilyticus, a globally-distributed pathogen of scleractinian corals and their endosymbionts, exhibits temperature-dependent pathogenicity, switching from the avirulent to the pathogenic state between 24–27 degrees C. To study this temperature effect, we utilized whole genome sequencing and proteomic analysis of V. corallilyticus ATCC ATCC RAA-450, the type strain isolated from diseased Pocillopora damicornis. We identified over 400 virulence factors of human pathogens in the genome, including elements for integration and conjugation, stress response, secretion, host colonization and degradation, chemotaxis, motility, antibiotic resistance, and quorum sensing. V. corallilyticus grown at the pathogenic temperature (27 degrees C) exhibited up-regulation of many of these virulence factors, as well as increased antimicrobial resistance. Our proteomic and antimicrobial analysis supports the hypothesis that temperature plays a direct role in V. corallilyticus pathogenesis, and we propose that this coral pathogen serve as a model Gram-negative bacterium to study temperature-dependent mechanisms of virulence in Vibriob-related diseases in the marine environment.

Morris, R. M., University of Washington, Seattle, USA, morrisrm@u.washington.edu

Frazar, C. A., University of Washington, Seattle, USA, cfrazar@u.washington.edu

Carlson, C. A., University of California, Santa Barbara, USA, carlson@lifesci.ucsb.edu

UNIQUE MICROBIAL COMMUNITIES IN THE SOUTH ATLANTIC
Marine microbial communities shift along physical and chemical gradients in the oceans and in response to episodic perturbations to a system. Here we report shifts in the abundance and distribution of marine bacteria along physical and chemical gradients in the South Atlantic gyre and in response to upwelling in the Benguela system. SAR11 subclusters Ib and II dominated heterotrophic surface communities in the southwestern gyre and SAR11 subcluster la dominated surface communities in the southeastern gyre. Differences in the relative abundance of SAR11 ecotypes are attributed to increases in SAR11 subcluster la, which occurred along a basin-scale gradient in nutrient, chlorophyll and dissolved organic matter concentrations. Members of the marine Actinobacteria OM1 clade were identified throughout the South Atlantic and were most abundant at the deep chlorophyll maximum, where they reached 10% of the community. These data suggest that SAR11 ecotypes respond differently to variable conditions in oceanic gyres and that members of the marine Actinobacteria OM1 clade are tightly coupled to phytoplankton communities in the South Atlantic.

Morrison, C. L., USGS-BRD Leetown Science Center, Kearneyville, WV, USA, cmorrison@usgs.gov

GENETIC CONNECTIVITY AMONG LOPHELLA PERTUSA REEFS IN THE NORTHERN GULF OF MEXICO WITH ESTIMATES OF SENSITIVITY TO DISTURBANCE
In the Gulf of Mexico, the cold-water coral Lophelia pertusa forms extensive reefs at relict cold seep sites where authigenic carbonates serve as a substrate for larval settlement. Given the ties between hydrocarbon seeps and oil reserves, L. pertusa reefs are especially vulnerable to oil industry activities in the Gulf. Knowledge of the degree to which populations are connected through larval dispersal is imperative to effective management and mitigation efforts, yet little is known about larval dispersal ability or population connectivity in L. pertusa. Using twelve microsatellite DNA markers, we assessed the spatial scale and pattern of genetic connectivity across six L. pertusa reef localities that span the northern Gulf of Mexico, as well as colonies inhabiting two shipwrecks. Dispersal between L. pertusa populations in the Gulf of Mexico and the western North Atlantic Ocean appears restricted. Results will be discussed in terms of oceanographic conditions that may influence connectivity and resilience of these unique and fragile ecosystems.

Morrison, J. R., NERACOOS, Rye, USA, Ru.Morrison@neracoos.org

Napoli, N., MOS, Boston, USA, napoli@massceanpartnership.org

Shyka, T., GMRI, Portland, USA, tshyka@gmri.org

Martin, D., NOAA CSC, Charleston, USA, Daniel.Martin@noaa.gov

Greene, J., TNC, Boston, USA, jgreene@tnc.org

Howlett, E., ASA, State Kingstown, USA, ehowlett@asascience.com

A REGIONAL OCEAN DATA PORTAL SUPPORTING COASTAL AND MARINE SPATIAL PLANNING FOR THE NORTHEAST UNITED STATES
The Northeast Data Portal Working Group was established early in 2010 to support regional coastal and marine spatial planning (CSPM) coordinated with the Northeast Regional Ocean Council (NROC). The goals of the group are to implement the portal (with associated viewer and data warehouse), to integrate data and data products, and to coordinate data management, linked to the national information management system, with regional data providers. Map/data viewer design considered technical, operational, and maintenance issues and builds on and integrates with previous efforts including state viewers and the Multipurpose Marine Cadastre. Data priorities, integration profiles, and inventory were developed with extensive consultation with federal and state managers and literature review. Although an initial base capacity and design have been achieved, significant challenges remain to fully support CSPM in the northeast United States.

Mortimer, R. J., School of Earth and Environment, University of Leeds, Leeds, United Kingdom, r.j.mortimer@leeds.ac.uk

Palmer-Felgate, E. J., Centre for Ecology and Hydrology, Wallingford, United Kingdom

Jarvie, H. P., Centre for Ecology and Hydrology, Wallingford, United Kingdom

Clerici, S., School of Earth and Environment, University of Leeds, Leeds, United Kingdom

Krom, M. D., School of Earth and Environment, University of Leeds, Leeds, United Kingdom

UNDERSTANDING THE ROLE OF BED SEDIMENTS IN PHOSPHOROUS AND NITROGEN CYCLING IN RIVERS AND FRESHWATER WETLANDS: NEW INSIGHTS FROM DET
Eutrophication of lowland rivers due to nutrient enrichment (nitrogen and phosphorus) is of global concern, particularly in areas of intensive agriculture and/or high population density. The role of bed sediments in buffering different types of nutrient input is not well understood, both in the river channels themselves and in artificial wetlands constructed to treat point sources. Much of the work to date has been based on laboratory experiments and mesocosm studies. Diffusive Equilibrium in Thin films (DET) allows in-situ measurement of pore-water profiles, enabling detailed process understanding of the role of sediments in nutrient cycling. Here we present results of DET deployments in bed sediments of streams impacted by agriculture and/or sewage inputs, as well as in lagoon sediments of a wetland treatment system. These studies highlight the pivotal role of sediments in buffering nutrients in such freshwater systems, and in particular how variations in flow regime and redox can cause them to switch from being a sink of nutrients to a source. Such improved process understanding can be used to implement more effective environmental and land management strategies.

Mosby, A. F., University of Rhode Island, Narragansett, USA, afmosby@gmail.com

Lawrence, C., University of Rhode Island, Narragansett, USA, caitlynl@gso.uri.edu

Menden-Deuer, S., University of Rhode Island, Narragansett, USA, smenden@gso.uri.edu

EFFECTS OF COPEPOD GRAZING AND NUTRIENT AVAILABILITY ON MEASUREMENTS OF HETEROPTROPHIC PROTIST GRAZING RATES IN NARRAGANSETT BAY, RHODE ISLAND, USA
The quantitative effects of grazing by copepods and nutrient limitation on phytoplankton growth were investigated using whole plankton community samples in
Narragansett Bay, RI, USA. Dilution experiments to measure heterotrophic protist grazing rates were amended with 10 μM nitrate and 2 μM phosphate. In parallel dilution experiments, *Acartia tonsa* were added to determine the effect of competition and carnivory on measurements of grazing rates. For all samples, phytoplankton biomass was determined through cell sizing. Nutrient addition significantly increased growth rate 3-fold, showing that phytoplankton growth was nutrient limited. Grazing rate increased with nutrient addition from an average grazing rate of 1.27 d⁻¹ to 2.77 d⁻¹. Copepod addition had no measurable effect on growth or grazing rates. Cell size measurements showed that size of the dominant *Skeletocentrum spp.* varied significantly over time. Winter/spring cells were on average 30% larger than summer/fall cells. Thus, comparing cell numbers seasonally may be misrepresenting actual biomass. Despite high nutrient concentrations in the summer, phytoplankton were still nutrient limited and heterotrophic protists had a relatively greater impact on phytoplankton mortality than the copepod species investigated.

**Moss, A. G.,** Auburn University, Auburn, USA, mossant@auburn.edu

Madin, L., Woods Hole Oceanographic Institution, Woods Hole, USA, lmadin@whoi.edu

CILIARY ORGANIZATION OF THE SALP FOOD WEB APPARATUS: Salps directly crop algal production; capture is carried out on an orthogonally ar- ranged fine mucus static array, revealed for the first time in living animals by Rakow (thesis, MIT/WHOI joint program) by fluorescent staining. Organization of medial adult ciliary structures that regulate the formation of the food web are presented here, along with a model of the mechanism of the formation of the orthogonal array of mucus strands. Preparation for SEM was carried out according to a modified method of Tamrn and Tamrn, 1981. Samples were collected from *Pogopea confinata*. An alternating ciliary apparatus located in the pharyngeal apparatus appears to be responsible for the orthogonally-organized web, which is used for collection of algal cells. Collection of the web clearly occurs on the ciliated gill bars appears to be responsible for the orderly collection of the web, folding and compressing it so that it fits tightly into the gut. We thank Kelly Rakow for collection of samples critical to this analysis. Funding: NSF 0348327, Alabama EPSCoR, and a grant from the Office of the Vice President for Research, Auburn University.

**Moss, A. G.,** Auburn University, Auburn, USA, mossant@auburn.edu

Wadisawara, S., Auburn University, Auburn, USA

Welch, C., Auburn University, Auburn, USA

Smith, K., Auburn University, Auburn, USA

Dodson, M., Auburn University, Auburn, USA

Donovan, E., Auburn University, Auburn USA

Tatum, T., Auburn University, Auburn USA

Joiner, D., Auburn University, Auburn USA

**SILLY CILIA: A WIGGLING OUTREACH MODEL FOR THE UNDERSTAND-
FIGA OF CILIA AND FLAGELLA-DRIVEN FLUID FLOW IN MARINE AND AQUATIC SYSTEMS**

Silly Cilia demonstrates the importance of eukaryotic cilia in marine and freshwater protists and invertebrates. After a brief introduction to the importance of cilia and flagella in antipredator behavior, left-right asymmetry, and reproduction, the in-structor and students explore how cilia work by using a simple ‘interfiber sliding’ model. We then turn to living animals: *Geukensia demissa* gill cilia to demonstrate mucociliary transport, mutants of *Chlamydomonas* to indicate the importance of genes in the normal functioning of cilia (and as a model of genetic disease) through the examination of normal swimming, phototaxis and photokinesis. We also present the ctenophore mal functioning of cilia (and as a model of genetic disease) through the examination transport, mutants of...
from 1895 – 2009 show initial increases in pH and calcification, but sharp declines in records (\(\delta^{13}C\)) past ocean acidification. In this study we present new multiple geochemical proxy records from Puerto Rico and their relationship to anthropogenic ocean acidification. In this study we present new multiple geochemical proxy records from Puerto Rico and their relationship to anthropogenic ocean acidification.

PUERTO RICO AND THEIR RELATIONSHIP TO ANTHROPOGENIC OCEAN ACIDIFICATION

A 114-YEAR RECORD OF CORAL GEOCHEMISTRY AND GROWTH IN PUERTO RICO AND THEIR RELATIONSHIP TO ANTHROPOGENIC OCEAN ACIDIFICATION

Much biomonitoring uses indices based on the structure of communities; less attention has been given to functional parameters (ecosystem processes like decomposition, primary production, nutrient cycling, etc.). The breakdown of leaf material in streams provides a system in which an aspect of ecosystem functioning (decomposition) can be measured along with the community structure of the fauna associated with the leaves. We measured rate of leaf processing and the associated macroinvertebrates in streams of the urban forest Parque Estadual da Pedra Branca above and below urban impact (untreated sewerage, loss of riparian vegetation, impermeable surfaces) and in pristine streams of Ilha Grande. We separated the effects of macroconsumers, macroinvertebrates and microbes using bags with different mesh-size. Leaf processing was fastest in the least impacted streams and parts of streams. Macroconsumers but not macroinvertebrates increased the rate of leaf processing, but were not the principal cause of the decreased leaf processing in impacted sites. The macroinvertebrate community changed with impact but taxon diversity was not different among impacts. We suggest that leaf processing can be a cheap and indicative parameter for biomonitoring.

A CASE FOR USING LEAF PROCESSING AND ASSOCIATED FAUNA FOR THE ASSESSMENT OF ENVIRONMENTAL IMPACT IN URBAN STREAMS OF RIO DE JANEIRO, BRAZIL

Moulton, T. P., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, moulton@uerj.br
Magalhães-Fraga, S. A., FIOCRUZ, Rio de Janeiro, Brazil, sandram@farc.focruz.br
Brito, E. F., Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, fuentesbrito@uol.com.br
Silva-Junior, E. F., Universidade Federal de São João del Rei, São João del Rei, Brazil, eduardohibwindventure@gmail.com

MOWER, C. B., University of Wisconsin-Madison, Madison, USA, colleen.mower@wisc.edu
McKinley, G. A., University of Wisconsin-Madison, Madison, USA, gmckinley@wisc.edu
Chen, H., University of Wisconsin-Madison, Madison, USA, hchen224@wisc.edu

EVALUATION AND OPTIMIZATION OF BIO-OPTICAL INVERSION ALGORITHMS FOR REMOTE SENSING OF LAKE SUPERIOR'S OPTICAL AND BIOGEOCHEMICAL PROPERTIES

Basic understanding of Lake Superior's carbon budget and temporal/spatial variability of optical and biogeochemical parameters is lacking. The elusive knowledge persists due to the scarcity of observations. Remote sensing offers an excellent platform to observe the entire lake. However, remote sensing products of the lake have been slow to develop due to the independency of optical constituents (case 2 waters), domination of colored dissolved organic matter, and complex atmosphere of the region. We have analyzed the limited optical observations of the lake and compared their variability to NASA's NOMAD optical dataset from the global ocean. Existing inversion algorithms have been evaluated on the Lake Superior optical data and tuned for optimal performance. The tuned inversion algorithms were applied to SeaWIFS and MODIS imagery and spatial/temporal trends were analyzed in the context of the physical dynamics of the lake.

MOWER, R. P., United States Geological Survey, Saint Petersburg, FL, USA, rmower@usgs.gov
Helmle, K. P., National Oceanic and Atmospheric Administration, Miami, FL, USA
Hönisch, B., Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY, USA

A 114-YEAR RECORD OF CORAL GEOCHEMISTRY AND GROWTH IN PUERTO RICO AND THEIR RELATIONSHIP TO ANTHROPOGENIC OCEAN ACIDIFICATION

Recent increases in a combination of anthropogenic and climatic stresses have resulted in degradation and decline of many coral reef communities worldwide. Ocean acidification is one such stressor that may already be impacting corals and coral reefs, and stands to be a prominent stressor to reefs over the next few decades. Corals are excellent recorders of changes in seawater chemistry because they can grow for several centuries by depositing calcium carbonate skeletons in chronological layers of density bands. Such historical context provides critical understanding of how coral growth has been affected by changes in surface ocean chemistry, including past ocean acidification. In this study we present new multiple geochemical proxy records (\(8^{18}O\), \(8^{13}C\), and \(8^{14}C\)) and coral extension, density, and calcification data from a Montastraea faveolata coral from Puerto Rico. Preliminary \(8^{18}O\) and calcification data from 1895 – 2009 show initial increases in pH and calcification, but sharp declines in both parameters after 1950. \(8^{14}C\) data will also be compared to other published coral records, and \(8^{13}O\) and \(8^{14}C\) will be presented and compared to trends and variability in coral growth.

Muller-Karger, F. E., University of South Florida, College of Marine Science, St. Petersburg, USA, carib@marine.usf.edu
Varela, R., Fundación La Salle de Ciencias Naturales, Estación de Investigaciones Marinas de Margarita, Punta de Piedras, Venezuela, varelaallegue@hotmail.com
Thunell, R., Department of Geological Sciences, University of South Carolina, Columbia, USA, Thunell@geol.sc.edu
Astor, Y., Fundación La Salle de Ciencias Naturales, Estación de Investigaciones Marinas de Margarita, Punta de Piedras, Venezuela, yastor@edimar.org
Scranton, M., Marine Sciences Research Center, Stony Brook University, Stony Brook, USA, msctrannton@notes.cc.sunysb.edu
Taylor, G., Marine Sciences Research Center, Stony Brook University, Stony Brook, gtaylor@notes.cc.sunysb.edu
Lorenzoni, L., University of South Florida, College of Marine Science, St. Petersburg, USA, laural@marine.usf.edu
Rueda, D., University of South Florida, College of Marine Science, St. Petersburg, USA, druedaro@mail.usf.edu
Montes, E., University of South Florida, College of Marine Science, St. Petersburg, USA, emontesh@mail.usf.edu
Fanning, K., University of South Florida, College of Marine Science, St. Petersburg, USA, kaf@marine.usf.edu

THE CARIACO OCEAN TIME-SERIES PROGRAM

The CARIACO program has conducted monthly oceanographic cruises to the Cariaco Basin (10°30’N, 64°40’W, SE Caribbean Sea) since November 1995. One mooring with five sediment traps is in place, with each collecting samples over two-week periods. This basin is openly connected with the Caribbean Sea in the upper 140 m and is well ventilated above this sill depth, but waters below about 250 m are anoxic. The objective of the series is to understand the relationship between hydrography, community composition, primary production, microbial activity, terrigenous inputs, sediment fluxes, and element cycling in the water column, and how changes in these processes are preserved in seafloor sediments. These sediments are one of the most important paleoclimate records available, and the series is designed to link knowledge about modern physical and biogeochemical processes with ancient regional oceanography. We discuss marked changes in the hydrography, nutrient availability, and phytoplankton community observed over the short life of the time series that have resulted in ecosystem shifts. These are reflected in the chemistry, amount of sinking particles, and other processes that seem to have affected even the important regional sardine fisheries.
Muller-Karger, F., University of South Florida; College of Marine Science, St. Petersburg, USA, carib@marine.usf.edu
Ryan, J., University of South Florida, Department of Geology, Tampa, USA, ryan@usf.edu
Feldman, A., University of South Florida, Department of Secondary Education, Tampa, USA, afeldman@usf.edu
Gilbes, F., University of Puerto Rico, Department of Geology, Mayaguez, USA, fernando.gilbes@upr.edu

THE CACCE CLIMATE EDUCATION PARTNERSHIP FOR THE SOUTHEAST US AND CARIBBEAN SEA

The Coastal Area Climate Change Education (CACCE) Partnership, funded by the National Science Foundation, seeks to develop new ways to educate citizens about global climate change. The core theme is sea level and impacts of climate change in the southeastern United States and the Caribbean Sea. We describe an innovative educational and research model, namely Multiple Outcome Interdisciplinary Research and Learning (MOIRL), in which stakeholders engage in varied research and learning activities leading to multiple outcomes. In the CACCE Partnership the stakeholders include: students (K-16 and graduate); teachers and education researchers; informal science educators; scientists and engineers; business and industry; policy makers; and community members. CACCE combines interdisciplinary research with action research and community-based participatory research in a way that is best described as “transdisciplinary”. Learning occurs in all spheres of interactions among stakeholders as they engage in scientific, educational, community and business activities through their legitimate participation in research communities of practice. We will describe the process of seeking and building partnerships, and call for a dialogue with groups pursuing climate and climate change education.

Mullins, R. L., Texas A&M University, College Station, USA, rmullins@ocean.tamu.edu
DiMarco, S. F., Texas A&M University, College Station, USA, sdimarco@tamu.edu

LAND-LOCKED? NO PROBLEM! EFFECTIVE EXAMPLES OF BRINGING OCEANS INTO THE LOCAL COMMUNITY

Effective and continuing education and outreach is a new, emergent priority in the TAMU Mechanisms Controlling Hypoxia project. We have implemented a variety of outreach programs in local middle schools and with the general community to promote geosciences as a future career and the importance of coastal ocean research. Programs include an â€“Oceanographer-in-Trainingâ€“ program and websites providing real-time resources for teachers to integrate project data into their classrooms. Partnerships with a TAMU NSF GK-12 program provide opportunities to expand classroom involvement to developing curriculum and hands-on activities, and experiments for teachers to use in their classrooms to improve upon available geosciences resources. Recent funding from Texas Sea Grant has resulted in a partnership to develop an outreach program linking middle schools in College Station, Galveston, and Corpus Christi Texas. The program is designed as a technological pen-pal program, allowing students to teach each other about their community focius primarily on the roles of the coastal ocean environment, current research projects, and promoting environmental sustainability within their communities. This presentation will elaborate on formation and success of the programs and future education outreach directions.

Mullins, R. L., Texas A&M University, College Station, USA, rmullins@ocean.tamu.edu
DiMarco, S. F., Texas A&M University, College Station, USA, sdimarco@tamu.edu
Guinasso, N., Texas A&M University, College Station, USA, guinasso@gerg.tamu.edu

UNRAVELING FRESHWATER SOURCES RESPONSIBLE FOR HYPOXIA FORMATION ALONG THE TEXAS COAST

Hypoxia is a common environmental hazard in the northern Gulf of Mexico and recent studies have shown hypoxic areas forming along the Texas coast independent from Louisiana Dead Zone. Events in Texas (TX) have been routinely observed since 1985 and are not necessarily attributed to anthropogenic riverine nutrient inputs. In 2009, a real-time mooring provided conclusive results that events along Texas shelf form rapidly, last 18 – 36 hours, and possibly exhibit different oxygen dynamics than LA shelf. As part of the NOAA-funded study to determine areal extent of GOM hypoxia, survey cruises were conducted in summer 2010 along the Louisiana-Texas shelf. An innovative towed instrument, Sea Sciences Inc. Acrobot, collected high temporal and spatial resolution datasets of dissolved oxygen, salinity, temperature, and productivity. Results from the two cruises and regional ocean observing system in the GOM will be presented in an effort to understand the formation and duration coastal ocean processes responsible for these independent TX hypoxic events.

Results will focus specifically on the role and detection of freshwater sources to the TX shelf and the role of stratification on TX hypoxia formation.

Munday, P. L., ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Australia, p.munday@jcu.edu.au
NEW DISCOVERIES IN OCEAN ACIDIFICATION RESEARCH ON CORAL REEFS

Although coral reefs are one of the ecosystems most threatened by ocean acidification, the full impacts of increased CO2 and reduced pH on reef assemblages are still not well understood. In this seminar I will first review the predicted effects of ocean acidification on scleractinian corals and other calcifying species that build and maintain reef structure. I will then describe recent laboratory and field-based experiments designed to test the effects of ocean acidification on reef fishes. Elevated CO2 and reduced pH did not have a negative effect on growth, development and survival of larvae and juveniles of two common reef species. Similarly, skeletal and otolith development were unaffected. In contrast, dramatic changes were observed in the behaviour of larvae. Larval fish exposed to elevated CO2 had impaired olfactory abilities, were more active, and exhibited riskier behavior in their natural coral-reef habitat. As a result, they had markedly higher mortality from predation. The discovery that elevated PCO2 and reduced pH can affect larval behaviour has important implications for predicting the impacts of ocean acidification on marine ecosystems.

Munday, P. L., James Cook University, Townsville, Australia, philip.munday@jcu.edu.au
Donelson, J. M.
McCormick, M. I.
Gardiner, N.
Nilsson, G.

PROSPECTS FOR ADAPTATION OF REEF FISHES TO RAPID CLIMATE CHANGE

In water-breathing animals the capacity of the ventilatory system to maintain oxygen supply at elevated temperatures is thought to underlie thermal tolerance. Acclimation and adaptation potential of coral reef fishes to increased water temperature was tested by examining thermal reaction norms of metabolic function (resting metabolic rate, active metabolic rate, aerobic scope) in two different populations of reefs fishes separated by over 100km on the Great Barrier Reef, Australia, and by multi-generational rearing of one species (Acanthochromis polyacanthus) in the laboratory. A counter gradient pattern of thermal reaction norms was observed, whereby fish from the high latitude population performed better at elevated temperatures than did fish from the low latitude population, possibly because they are adapted greater thermal variation. No capacity for reversible thermal acclimation was observed in adults. In contrast, developmental acclimation was detected in populations reared from birth at elevated temperature and further acclimation capacity was detected between generations. Acclimation did not fully compensate for the effect of increased temperature on metabolic function and appeared to incur a cost because acclimated fish were smaller and in poorer condition.

Munson, K. M., MIT/WHOI Joint Program in Chemical Oceanography, Woods Hole, USA, kmunson@whoi.edu
Lamborg, C. H., Woods Hole Oceanographic Institution, Woods Hole, USA, clamborg@whoi.edu
Mindeque, T. J., Woods Hole Oceanographic Institution, Woods Hole, USA, tmincere@whoi.edu

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Munday, P. L., ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Australia, p.munday@jcu.edu.au
be identified using this method. Our screen, along with measurements of mercury species throughout the water column, will provide insights into the role of biological demethylation in mercury cycling.

Murphy, M. E., Savannah State University, Savannah, USA, dmonet.murphy@gmail.com
Hoskins, D., NOAA Fisheries/Savannah State University, Savannah, USA, hoskins@savannahstate.edu
Hall, J. M., Savannah State University, Savannah, USA, kingjmch@yahoo.com

UNLOCKING THE HISTORY OF AFRICAN AMERICANS IN GEORGIA COASTAL FISHERIES

African American participation in marine-related careers predates the programming efforts funded by federal agencies in recent decades. A rich body of knowledge about community fishing history and the African American culture is disappearing. Capturing the stories and experiences of local fishermen and women is especially important in coastal states like Georgia which historically have depended on the marine environment for their economic and cultural base. Coastal cities like Savannah and African-American enclaves like Thunderbolt, Georgia (USA) were centers of fishing and shellfish processing. African American fishermen are now scarce in these coastal industries and the decline has been attributed to the increase in fishing costs and their inability to make a living (Blount, 2007). The purpose of this study was to characterize the fishery-related occupations of African Americans, specifically in Thunderbolt, Georgia, and to obtain information for future work that may determine the relationships between their decreased involvement and changes in regional fish populations and the fishing industry.

Murray, L., UMCES, Cambridge, USA, murray@umces.edu
Gibson, D., Hampton University, Hampton, USA, deidre.gibson@hamptonu.edu
Carruthers, T., UMES, Cambridge, USA, tcarruth@umces.edu
Gurgiuz, C., UMES, Cambridge, USA, cghrigbs@umces.edu
Werener, J., UMES, Cambridge, USA, jwerener@umces.edu

DEVELOPING ONLINE EDUCATIONAL RESOURCES THROUGH SCIENCE-EDUCATOR PARTNERSHIPS

The Center for Ocean Science Education Excellence (COSEE) Coastal Trends has developed a Scientist-Educator Partnership Program, which creates partnerships among scientists, educators and students to help advance teacher understanding of science concepts, to improve scientist communication skills, and to develop online classroom and field applications that build on the research experiences. The SEP team consists of a research scientist, graduate student, teacher, and underrepresented college student. This four member team works together for six weeks during the summer to improve scientist communication/pedagogy skills, help scientists meet education and outreach requirements for research proposals, help advance teacher/student understanding of ocean science research, and assemble an online education module that communicates the scientists’ ocean science research to formal and informal audiences. Module development thus becomes a mechanism for team work, collaboration, and focus for the Science-Educator Partnership, and also becomes part of what the scientist can use to meet the “Broader Impact” for proposals. Evaluation data indicates that each team member benefits from participating in the Scientist-Educator Partnership program.

Mydlarz, L. D., University of Texas at Arlington, Arlington, USA, mydlarz@uta.edu

TEMPERATURE STRESS AND PATHOGEN PRESSURE SYNERGISTICALLY AFFECT CORAL AND ZOOXANTHELLAE HEALTH

Climate change has been hypothesized as a driver of recent increases in the prevalence and impacts of coral diseases. Some diseases like Caribbean Yellow Band Disease (YBD) have strong temperature correlates and seem to affect both the coral host and the symbiotic dinoflagellate known as zoanthellae. Using a comparative approach we investigated the combined effects of experimental temperature stress and pathogen exposure on seven types of cultured zoanthellae and the intact coral-symbiont association. In zoanthellae, pathogens elicitors prepared from YBD isolates inhibited growth of several types of zoanthellae, and this effect was magnified with additional temperature stress. In coral, exposure to elevated temperature and subsequent bacterial LPS as a pathogen mimic had a different effect on the disease resistant Porites astreoides and the disease prevalent Montastrea faveolata. Post stress, P. astreoides upregulated LPS as a pathogen mimic had a different effect on the disease resistant Porites astreoides.

Mydlarz, L. D., University of Texas at Arlington, Arlington, USA, mydlarz@uta.edu

THE USE OF SERVICE-LEARNING PEDAGOGY TO FACILITATE K-12 OUT-REACH AND TO FOSTER SCIENTIFIC INQUIRY IN UNIVERSITY STUDENTS

In efforts to develop an outreach program to educate Junior High School students about current marine biology, ecology and climate change issues as well as my own research on coral reefs, I applied applying service-learning pedagogy in my Marine Biology course. The students enrolled in my class at The University of Texas at Arlington take part in a project that combines the course academic outcomes with outreach and culminates in a 45 minute interactive presentation at local district schools on current marine issues that also coincides with the Junior High curriculum on ecosystems and the environment. The lesson plans are therefore academically relevant to both groups of students. University student learning was assessed using a series of formative evaluations, reflections and oral presentations. Initially the project was met with hesitation but ultimately students were empowered as teachers and, by getting out into the community, they saw firsthand the need to increase scientific literacy and education. This project was successful in promoting interactions and mentoring between University and Junior High students while disseminating important information on the future of our marine ecosystems.

NAGAHAMA, Y., Tohoku University, Sendai, Japan, nagahama@eco.civil.tohoku.ac.jp
NOMURA, M., Tohoku University, Sendai, Japan
FUJIBAYASHI, M., Tohoku University, Sendai, Japan
SHIN, W. S., Tohoku University, Sendai, Japan
NISHIMURA, O., Tohoku University, Sendai, Japan

IMPORTANCE OF ZOSTERA JAPONICA AS A FOOD SOURCE FOR BENTHIC ANIMALS IN INTERTIDAL ZONE

Zostera japonica, a kind of seagrass, forms patch-like meadows in intertidal zone. Some researches showed that benthic fauna of seagrass area was different from that of adjacent sand area, however, the mechanism of the difference between them was not clarified. The objective of this research is to clarify the role of Z. japonica as a food source for benthos. We focused on Batillaria cumingii and Umbonium sp. which inhabited both seagrass and sand area in intertidal zone. The population of B. cumingii was higher than Umbonium sp. in seagrass area, though opposite result was obtained in sand area. Using stable isotope and fatty acid analysis it was revealed that B. cumingii assimilated Zostera-derived organic matter more efficiently than Umbonium sp. which mainly assimilated diatoms. The sediment of seagrass area contained higher amounts of Zostera-derived organic matter in comparison with the sediment of sand area. These results suggested patch-like meadow created variety of food sources availability and caused species richness in intertidal zone.

Nakamura, M., Okinawa Institute of Science and Technology, Okinawa, Japan, masako.nakamura@oist.jp
Morita, M., University of Tsukuba, Shizuoka, Japan, morita@kyofune.shimoda.tsukuba.ac.jp
Kuribara, H., University of the Ryukyus, Okinawa, Japan, harukoku@lab.u-ryukyu.ac.jp
Mitarai, S., Okinawa Institute of Science and Technology, Okinawa, Japan, satoshi@oist.jp

GENE EXPRESSION OF HSP IN CORAL LARVAE UNDER ACIDIFIED CONDITIONS

Ocean acidification (OA) due to uptake of anthropogenic CO2 is expected to have deleterious impacts on many marine calcifiers and non-calcifiers across life stages. Particularly the early life stages, strongly related to population maintenance through recruitment, appear to be vulnerable to acidified seawater. However, there is a significant gap in our knowledge regarding biological response to OA at molecular levels. In this study, we investigated the stress response of the coral Acropora digitifera with respect to the expression of two heat shock proteins (hsp70 and hsp90) and heat shock protein transcription factor (hsf1) with quantitative PCR. We maintained coral larvae under ambient and elevated CO2 conditions, expected within next 100 years, and then examined the expressions of hsp70 and hsf1. The expression levels significantly differed among target genes; expression of hsp90 was much higher than other genes. However, it did not change significantly between CO2 conditions and there was no consistent pattern in the expression over observed days between CO2 conditions. These results suggest that coral larvae may enable to cope with environmental pH decrease.

Mydlarz, L. D., University of Texas at Arlington, Arlington, USA, mydlarz@uta.edu

ASLO
USE OF FERRY BOATS TO STUDY THE SPATIO-TEMPORAL EVOLUTION OF PHYTOPLANKTON DYNAMIC AND PHOTOSYNTHETIC PARAMETERS IN THE ENGLISH CHANNEL

Primary production data in the English Channel, mainly present on coastal areas, are restricted in time and space. In order to estimate the spatio-temporal variability of phytoplankton dynamic and production in the English Channel, sampling cruises on ferry boats between Ouistreham and Portsmouth have been carried out for a year. Physico-chemical characteristics strongly influence phytoplankton biomass and photosynthetic parameters. ACP analyses allowed us to divide the transect into 3 areas: 1- French coastal area (FCA); 2- North of the Baie de Seine (NBS); 3- Oceanic area (OA). High nutrient inputs from rivers in the FCA lead to a high biomass, high maximal photosynthetic capacity ($P_{\text{max}}$) and satisfactory photoacclimation. In the OA, low nutrient concentrations lead to low $P_{\text{max}}$ and poor photoacclimation. In that area, the correlation between the quantum yield efficiency of the PSII (Fv/Fm) and nutrient concentrations reveals a control of the nutrients. Furthermore, the NBS is an intermediate area controlled by nutrient inputs from rivers and oceanic waters. By using remote sensing and model, those data will enable us to estimate the primary production throughout the English Channel.

Narvaez, D. A., Old Dominion University, Norfolk, USA, diego@ccpo.odu.edu
Klinek, J., Old Dominion University, Norfolk, USA, klineck@ccpo.odu.edu
Powell, E., Rutgers University, Port Norris, USA, eric@bof.rutgers.edu
Hofmann, E., Old Dominion University, Norfolk, USA, hofmann@ccpo.odu.edu
Wilkin, J., Rutgers University, New Brunswick, USA, wilkin@marine.rutgers.edu
Haidvogel, D., Rutgers University, New Brunswick, USA, dale@marine.rutgers.edu
Hedgerock, D., University of Southern California, Los Angeles, USA, dehedge@usd.edu

EFFECTS OF LARVAL DISPERSION ON THE MOVEMENT OF DISEASE RESISTANT GENES BETWEEN OYSTER POPULATIONS

In oyster populations, the exchange of individuals, and therefore genetic material, occurs during the larval phase where biophysical processes determine the fate of the larva. An hydrodynamic model developed for Delaware Bay coupled with a larval model are used to represent these processes and estimate exchange rates between low and high disease-resistant populations. This information is used in an individual-based genetics model in which each individual oyster has 10 chromosome pairs with 4 genes per chromosome. An initial population with a random genetic structure was established and a varying number of individuals (estimated from the larval-hydraulics model) with a neutral marker gene were added to the population. Simulations are run for 100 generations and the frequency of the marker allele determined. For low resistant populations that receive immigrants from high resistant populations, the disease-resistant gene will become common in 4 to 12 years and dominant in about 10 to 30 years. Depending on the exchange rates and the size of the populations, the gene transfer might take more than 100 years. For immigrants going from low to high resistant populations, the gene transfer occurs between 20 and 40 years. These simulations are illuminating for fisheries management decisions and oyster restoration efforts.

Neal, B. P., Scripps Intuition of Oceanography, University of California San Diego, La Jolla, USA, bNeal@ucsd.edu
Beijbom, O., Department of Computer Science and Engineering, University of California San Diego, La Jolla, USA, oskarbeijbom@gmail.com
Kline, D. L., Coral Reef Ecosystems Lab, Global Change Institute, University of Queensland, Queensland, USA, dkl010@gmail.com
Trebitz, T., Department of Computer Science and Engineering, University of California San Diego, La Jolla, USA, tali@cse.ucsd.edu
Kriegman, D., Department of Computer Science and Engineering, University of California San Diego, La Jolla, USA, Kriegman@cs.ucsd.edu
Belongie, D., Department of Computer Science and Engineering, University of California San Diego, La Jolla, USA, sbel@cs.ucsd.edu
Cumming, L., Scripps Intuition of Oceanography, University of California San Diego, La Jolla, USA, laurac@stanford.edu
Lin, T. H., Department of Computer Science and Engineering, University of California San Diego, La Jolla, USA
Winters, R., Scripps Intuition of Oceanography, University of California San Diego, La Jolla, USA, rivah.winter@gmail.com
Mitchell, B. G., Scripps Intuition of Oceanography, University of California San Diego, La Jolla, USA, gmitchell@ucsd.edu

Semi-Automated Processing of Coral Reef Photographs from Time Series Observations at Bocas del Toro Panama

This project presents the development and use of a semi-automated graphical tool for segmenting and processing digital images from coral environments, and details the use of this tool in processing coral images from a coral reef monitoring project to the Smithsonian Tropical Research Institute (STRI) in Bocas del Toro, Panama. The specific goal of this field project is the long term observation of three hundred tagged individual coral colonies, first tagged during the 2005 Caribbean mass bleaching event and re-photographed annually. Digital photographs of reefs like these are routinely used to monitor substrate cover, biodiversity, colony growth, bleaching or disease, and changes in these characteristics over time. However, the processing of these images by experts is laborious and resource intensive. One of the primary aims of this work is to create and apply tools that will aid in the rapid and accurate segmentation and classification of coral community images. Development of these software tools as well as recommended protocols for acquiring digital images for computer vision applications will be presented.

Neale, P. J., Smithsonian Environmental Res Ctr, Edgewater, USA, nealep@si.edu
Pritchard, A. L., Smithsonian Environmental Res Ctr, Edgewater, USA, pritchard@si.edu

UV Inhibition of Photosynthesis in Synechococcus sp: Biological Weighting Functions and Exposure Response Curve

The photosynthetic response to solar UV of picoplanktonic cyanobacteria such as *Synechococcus* sp. has received little attention despite their contribution to global primary production and predominance in relatively UV transparent central ocean surface layers. Our study focuses on the spectral dependency (biological weighting function or BWF) for UV inhibition of photosynthesis, a critical component for modeling UV effects in the ocean under present conditions and for climate-change affected scenarios. Photosynthetic carbon incorporation over a range of irradiiances was measured under 12 spectral treatments obtained by filtering xenon lamp irradiance through different combinations of Schott glass filters and films, enabling estimates of BWFs with high spectral resolution and well-defined exposure-response curve. The study considers multiple strains of *Synechococcus* cultured under a range of temperature and irradiance conditions. Strains WH8102 and WH7803 show high sensitivity to UV inhibition of photosynthesis, with growth temperature an important factor affecting response, particularly in the UVA (320-400 nm) range. Short-term photoacclimation significantly influences the BWF (see presentation by Fragoso et al.). The exposure response curve is consistent with repair rates increasing with inhibition at low exposure and reaching a maximum at moderate to high exposure.

Neistgaard, J. C., Skidaway Institute of Oceanography, 10 Ocean Science Circle, Savannah 31411, USA, jens.neistgaard@skio.usg.edu
Frischer, M. E., Skidaway Institute of Oceanography, 10 Ocean Science Circle, Savannah 31411, USA, marc.frischer@skio.usg.edu
Troedsson, C., Uni Research, Tromøhlensgate 49, Bergen 5006, Norway, christofer.troedsson@uni.no
Simonelli, P., Department of Biology, University of Bergen, P.O.Box 7800, Bergen, Norway
Anderson, J. T., Booz Allen Hamilton Inc., 46950 Bradley Boulevard, Lexington Park, USA
Zarbel, M. J., College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, USA
Verity, P. G., Skidaway Institute of Oceanography, 10 Ocean Science Circle, Savannah 31411, USA, Diseased
The Quest to Define Who is Doing What in Plankton Communities – Zooplankton

In order to predict and mitigate the human impacts on our environment we must have an accurate and quantitative understanding of the key interactions that compose the complex ecosystems we are a part of. By challenging traditional conventions Peter Verity was a relentless advocate for better approaches to understand...
Building upon advances in technology, input from the user community, and of the study and monitoring of microorganisms in both fresh and marine systems.

Over 150 FlowCAMs in 30+ countries have been put to use for the purpose of Ocean Sciences in 1999. Built and installed the first FlowCAM, an imaging system for the study of plankton. The evolution of the FlowCAM—15 years in the making.

Species habitat modeling techniques can be used to extract ecological functional responses or niches for species and biogeochemical functional groups from large observational datasets. We applied the species habitat model Maxent on the phytoplankton data from the Continuous Plankton Recorder time series from the North Atlantic, along with World Ocean Atlas and satellite remote-sensing climatologies of environmental conditions. A small proportion of the species recorded by the CPR time-series are characterized by well-defined niches showing preferences for particular temperatures, salinities, and nutrient environments, while other species were either too widespread or infrequently observed to be adequately characterized. The best environmental predictors for both diatoms and dinoflagellate species are sea surface temperature, salinity, and remote-sensed chlorophyll. Although the presence of both groups are best predicted by the same environmental predictors their functional responses are inversely related, signaling niche differentiation and competition between these two groups.

We used stable isotope probing to characterize the composition of Sargasso Sea mesopelagic and euphotic bacterioplankton communities that do and do not incorporate different source pools of dissolved organic matter. We harvested DNA from 48 hour dilution-enrichment cultures and characterized the community structure of 13C-enriched and unenriched fractions using 16S amplicon pyrosequencing. Our results define and differentiate the bacterioplankton assemblages incorporating dissolved organic carbon derived from diatom and cyanobacterial exudates and lysates as well as the model compounds glucose and gluconic acid. We show how the taxa metabolizing these compounds vary depending on season and depth, contrasting the composition and growth characteristics of communities depending on substrate type. We also discuss the design, analysis and interpretation of stable isotope probing experiments, including the contextual value of dilution-enrichment cultures and the potential relevance of examining the response of unlabeled communities. Our conclusions have ramifications for understanding the role of rare taxa in diverse communities, the concept of lable and recalcitrant organic compounds, and the future application of stable isotope probing in understanding the roles of heterotrophic microbes in aquatic carbon cycling.

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the management programs and territorial arrangement in another dependencies of the Environmental Ministry in Vargas State. This study points out the importance of integrating field studies with management programs. The coordination between these two departments together with the Committee of Coastal Zone, which is also well represented in this state, is part of the clue to achieve a successful management in the coastal zone.

Neuberger-Cywik, L., Universidad Nacional Experimental Maritima, Caracas, Venezuela, lyanneuberger@gmail.com

THE SUSTAINABLE DEVELOPMENT EDUCATION AT POSTGRADUATE MARITIME TRANSPORT AND SEA-CAPTAIN STUDIES AT THE UNIVERSIDAD MARITIMA DEL CARIBE (VENUEZUELA)

Following the Venezuelan Constitution (1999) (articles 128 –environment-, 310 –social-economic government functions- and 326- national security-), and international guidelines (UNESCO – Education for Sustainable Development-), among others) courses in postgraduate programs at the Universidad Maritima del Caribe were introduced. These courses are directed to decision making personnel giving them an integrated vision in principles, values and practices on sustainable development so they can cope with social, economic, cultural and environmental problems in the 21st century, particularly in developing countries, where the goals are different from other societies. Mercantile Marine in its undergraduate program for “Captain or Chief Engineer” take a course on “Environmental problems and Guidelines for its Management”. In the Postgraduate program in Maritime Transport a course on “Sustainable Development, Environmental and Management” is given. In this study are presented programs, didactic strategies and implementation experiences of these courses. In some cases, adult education in sustainable development in coastal zone is not an easy task caused by the students’ rejection. The importance of education strategies to trigger environmental awareness, obtaining change in individuals’ attitude and behavior are crucial in these issues.

Neuer, S., Arizona State University, Tempe, USA, susanne.neuer@asu.edu Hansen, A. M., Arizona State University, Tempe, USA, ahsaneny@asu.edu Freibott, A., Arizona State University, Tempe, USA, Alexandra.Freibott@asu.edu Lomas, M. W., Bermuda Institute of Ocean Sciences, St. George’s, Bermuda, michael.lomas@bios.edu

PROTIST AND CYANOBACTERIAL COMMUNITY RESPONSE TO THE INTENSE WINTER STORMS IN THE SARGASSO SEA IN 2010

The Sargasso Sea is a region that exhibits strong hydrographic seasonality; with mixing by winter storms stimulating a yearly phytoplankton bloom. Here we present an analysis of the protist and cyanobacterial community from the Bermuda Atlantic Time-series Study (BATS) collected monthly from May 2008 to April 2010 using epifluorescence and inverted microscopy aided by DNA-based molecular identification, as well as flow cytometry. We will focus on the comparison of the communities between the late winter-spring blooms of 2009 and 2010. The latter was characterized by a greater frequency of winter storms, likely a consequence of a negative North Atlantic Oscillation index, resulting in more episodic mixing and a deeper seasonal reversal of N fluxes from the sediments.

Newell, S. E., University of Washington, Seattle, USA, newton@apl.washington.edu Mayorga, E., University of Washington, Seattle, USA, mayorga@apl.washington.edu Hall, C., Oregon Department of Geology and Mineral Industries, Newport, USA, jonathan.allan@dogami.state.or.us Runnill, S., Oregon Dept of State Lands & South Slough NERRS, Coos Bay, USA, steve.runnill@state.or.us Lanier, A., Oregon Dept. of Land Conservation and Development, Salem, USA, Andy.Lanier@state.or.us Bernthal, C., NOAA Olympic Coast National Marine Sanctuary, Port Angeles, USA Galasso, G., NOAA Olympic Coast National Marine Sanctuary, Port Angeles, USA Bowley, E., NOAA Olympic Coast National Marine Sanctuary, Port Angeles, USA Hennessey, J., Washington Department of Ecology, Olympia, USA

IOOS’ ROLE IN CONTRIBUTING TO NATIONAL AND REGIONAL CAPABILITY FOR COASTAL MARINE SPATIAL PLANNING: A VIEW FROM THE NANOOS REGIONAL ASSOCIATION

Coastal and Marine Spatial Planning (COSP) has emerged as a compelling approach for using science to facilitate decision making regarding coastal and marine resource management, ecosystem health, and economic well being. NANOOS (the Northwest Association of Networked Ocean Observing Systems) and the IOOS community are poised to make critical contributions to the new COSP frameworks, policies and plans being developed in Washington and Oregon as well as future regional planning efforts, including those established under the new national COSP framework. While NANOOS’ priority areas are already directly relevant to COSP concerns, we are engaged with regional COSP efforts by supporting needs assessments and helping to coordinate discussions to identify objectives and tasks that take advantage of NANOOS’ specific strengths to complement those of other COSP partners. We will describe our experience in the development of this partnership and using CMSP as a framework for focusing and integrating NANOOS activities. We will also present progress on the delineation and execution of short-term products that have been identified to be of high value to the Pacific NW COSP community.

Ng, S. M., The University of Western Australia/ Centre fro Water Research, Crawley, Australia, ng@cwruwa.edu.au

Antenucci, J. P., The University of Western Australia/ Centre fro Water Research, Crawley, Australia, antenucci@cwruwa.edu.au

Hipsey, M. R., The University of Western Australia/ School of Earth and Environment, Crawley, Australia, matt.hipsey@uwa.edu.au

Tibor, G., Israel Oceanographic and Limnological Research, Haifa, Israel, tiborg@ocean.org.il

Zohary, T., Israel Oceanographic and Limnological Research, Migdal, Israel, tamara@ocean.org.il

PROCESSES CONTROLLING PHYTOPLANKTON SPATIAL DISTRIBUTION IN A LARGE LAKE

A comprehensive study to investigate the processes controlling phytoplankton spatial patchiness in Lake Kinneret was carried out using a combination of satellite images, numerical modeling, and geo-statistical methods. Geo-statistical methods applied to satellite images of chlorophyll allowed for the quantification of dominant length scales, which was used to design numerical experiments to elucidate the underlying processes. Findings showed that while phytoplankton growth is responsible for initiation of patches, its influence on the transport and fine-scale structure was minimal. Vertical migration behaviour, rather than differential growth, of phytoplankton was found to be the dominant process producing fine-scale features in the spatial distribution. Physical processes, such as internal waves and wind, were important in determining the larger scale features of phytoplankton patches. The study also demonstrated an intimate relationship between the time scales embodied in governing processes and the spatial scales in the manifested phytoplankton spatial distribution, and that the consideration of the issues of modelling complexity is essential when addressing ecological questions of specific inherent time scales.
are caught in fisheries throughout the Arctic, but spawning populations are poorly documented. Physical and biological conditions play critical roles in establishment of Arctic salmon. While broad-scale predictive climate models exist for marine and freshwater Arctic habitats, we have little to judge the temporal and spatial scales of change and adaptations available to salmon that affect Arctic colonization and impact local biota and food webs in Arctic waters. We describe potential barriers to colonization based on current conditions and explore what we know and do not know about patterns of climate change in the Arctic potentially affecting sustainability in salmon as part of the Arctic food web.

Nielsen, S. L., Roskilde University, Roskilde, Denmark, nielsen@ruc.dk

Nielsen, H. D., Napier University, Edinburgh, United Kingdom

THE EFFECTS OF TEMPERATURE AND HEAVY METALS AS JOINT STRESSORS ON ADULT INDIVIDUALS AND GERMIGNGS OF FUCUS SERRATUS

Fucoid brown algae form extensive populations that dominate the vegetation on temperate rocky shores. The persistence of populations of fucoid brown algae depends on their reproductive ability and the survival and growth of germings that are more susceptible to stressors than adults. The interaction between temperature changes and anthropogenic pollution as joint stressors on populations of brown macroalgae warrant further investigation, especially with the prospects of temperature changes in many coastal marine areas, already strongly influenced by human activities. In this study, the effect of temperature and heavy metal (copper) pollution as joint stressors was studied on both germings and adult individuals of the brown alga Fucus serratus. We studied the effects on growth, photosynthesis and on germing survival. The results clearly show that the germings are more susceptible to environmental stress than adults. We conclude that to fully assess the survival and fitness of brown macroalgae populations, the effect of stressors on germings have to be included, studies only focusing on adult individuals may be misleading.

Nielsen, M. E., University of Maryland Center for Environmental Sciences, Solomons, USA, Niesen@cbl.umces.edu

Harris, L. A., University of Maryland Center for Environmental Sciences, Solomons, USA, Harris@cbl.umces.edu

DISSOLVED ORGANIC NITROGEN TRACER DEVELOPMENT IN SUPPORT OF A CAMPAIGN TO IMPROVE WATER QUALITY PREDICTIONS FOR THE POTOMAC ESTUARY, USA

Estuaries are typically more susceptible to human impacts than other marine ecosystems, responding with changes in water quality. Eutrophication caused by increased nitrogen loads sustain phytoplankton blooms and high rates of microbial respiration during decomposition and result in low dissolved oxygen levels, hypoxia, or anoxia; a frequent and detrimental seasonal feature in the Potomac. The DC Water Blue Plains Treatment Plant is the largest point source of nitrogen to the Chesapeake Bay and discharges into the tidal freshwater region of the Potomac. Projected upgrades to biological denitrification capacity at Blue Plains will likely change the ratio of DIN:DON, with organic nitrogen dominating the remaining total nitrogen discharged. Here I describe methods developed to create an effluent specific isotopic tracer of del15N for Blue Plains DON. Laboratory scale batch reactors are spiked with a labeled N source, incubated, and then processed to isolate the resulting labeled DON. Bioassays that will use this DON tracer, created during biological nitrogen reduction processes that mimic treatment plant biogeochemistry, are also described. Current organic nitrogen bioavailability analysis might be improved by using this approach.

Nielsen, J. L., USGS Alaska Science Center, Anchorage, USA, jnielesen@usgs.gov

Ruggerone, G. T., Natural Resources Consultants, Inc., Seattle, USA, gruggerone@nrccomp.com

Zimmerman, C. E., USGS Alaska Science Center, Anchorage, USA

SUSTAINABLE STRATEGIES IN A WARMING CLIMATE: SALMON IN THE ARCTIC?

In the warming Arctic, aquatic habitats are in flux and salmonids are exploring their options. Post-glacial Atlantic and Pacific salmon have colonized hundreds of rivers throughout the Arctic. Colonization barrier exist where low freshwater temperatures prevent development of juvenile salmon. Small populations of Pacific chum and pink salmon survive because these species are less dependent on freshwater habitats and grow rapidly at sea. However, adult sockeye, coho, Chinook, pink and chum salmon...
from the autumn through the winter until early spring. This pattern, with high colour to carbon and fluorescence to absorbance ratios increasing during 2 years. Dissolved organic carbon (DOC) concentrations (normalized to 1 rural, urban and marine environments of this area was monitored on a daily basis during phytoplankton blooms. The organic and inorganic nutrient content of rain water in contrasting surface layer of the Ría de Vigo during the spring and autumn phytoplankton

ORGANIC AND INORGANIC NUTRIENTS OF RAIN WATER IN A TEMPERATE COASTAL EMBAYMENT (RÍA DE VIGO, NW SPAIN)

Copious rainfall is a significant source of organic and inorganic nutrients to the surface layer of the Ría de Vigo during the spring and autumn phytoplankton blooms. The organic and inorganic nutrient content of rain water in contrasting rural, urban and marine environments of this area was monitored on a daily basis during 2 years. Dissolved organic carbon (DOC) concentrations (normalized to 1 mmol C m⁻² d⁻¹ precipitation rate) ranged from 8 to 14 mmol C m⁻², being significantly lower in the marine compared with the urban and rural sites. Rainwater DOC revealed to be coloured due to the presence of aromatic protein materials (dominant in the marine site) and humic materials (dominant in the urban and rural sites). It displays seasonal pattern, with high colour to carbon and fluorescence to absorbance ratios increasing from the autumn through the winter until early spring. In vitro rainwater addition experiments to natural seawater of the Ría de Vigo (salinity 35) during the spring have shown the capacity of organic and inorganic nutrients in rainwater to induce bloom conditions in the microbial food web, resulting in a 3-fold increase of both primary and bacterial production.

Niiranen, S., Baltic Nest Institute, Stockholm University, Stockholm, Sweden, susa.niiranen@stockholmresilience.su.se
Tomczak, M. T., Baltic Nest Institute, Stockholm University, Stockholm, Sweden, mt@aquat.dtu.dk
Hjerne, O., Systems Ecology, Stockholm University, Stockholm, Sweden, olle@system.ecology.su.se
Blenckner, T., Baltic Nest Institute, Stockholm University, Stockholm, Sweden, thorsten.blenckner@stockholmresilience.su.se

LACK OF SPATIAL CONNECTIVITY AS A CONTRIBUTOR TO THE LATE 1980S CENTRAL BALTIC SEA REGIME SHIFT?

Several of hysteresis displaying marine ecosystem regime shifts have been observed in environments of enclosed nature such as the Baltic, Black Sea and Chesapeake Bay. This suggests spatial ecosystem connectivity as a factor in determining the nature and persistence of abrupt ecosystem changes. The importance of species-level spatial connectivity is studied in the context of the late 1980s Central Baltic Sea ecosystem regime shift using an EcoPath with Ecosim food web model (1974-2006). The shift is characterized by a drastic decline of the commercially important cod (Gadus morhua), a simultaneous increase of the planktivore sprat (Sprattus sprattus) and changes in the zooplankton composition. Migration of key functional groups was altered to test how the lack of spatial connectivity contributed to the shift. Increased migration of cod and sprat decreased the magnitude and persistence of change, eventually repressing it. The biomass thresholds for migration differed by group and increased migration of cod and sprat decreased the magnitude and persistence of change, whereas cod and sprat showed limited spatial connectivity in increasing number of marine ecosystems.

Nilsson, P. A., Lund University, Lund, Sweden, anders.nilsson@limno.lu.se

VISIBILITY AND PISCIVORE-PREY INTERACTIONS AND BEHAVIOURS

The optical properties of water can determine the success of visually oriented organisms. Most fish depend substantially on vision to obtain foraging opportunity and avoid predators, and degraded visibility conditions can hereby affect predator-prey interactions. Investigations on piscivorous pike (Esox lucius) and prey roach (Rutilus rutilus) and Eurasian perch (Perca fluviatilis) reveal that increased turbidity induces altered spatio-temporal behavioural patterns in both predators and prey, and these behaviours suggest that pike predation rates can be sustained or even increased in high turbidity, in spite of severely decreased visual ranges. However, as pike density-dependent intraspecific interference is maintained at high turbidity and limits per capita foraging rates, pike predation is unlikely to induce top-down trophic cascades to initiate shifts from phytoplankton- to macrophyte-dominated ecosystem states in lakes.

Noble, A. E., Woods Hole Oceanographic Institution, Woods Hole, USA, anoble@whoi.edu
Saito, M. A., Woods Hole Oceanographic Institution, Woods Hole, USA, msaito@whoi.edu
Goepfert, T. J., Woods Hole Oceanographic Institution, Woods Hole, USA, tgoepfert@whoi.edu
Lamborg, C. H., Woods Hole Oceanographic Institution, Woods Hole, USA, clamborg@whoi.edu

DISSOLVED COBALT DISTRIBUTIONS IN A FULL-DEPTH OCEAN SECTION ACROSS THE SOUTH ATLANTIC OCEAN

We present full-depth zonal sections of dissolved cobalt from from the CoFeMUG (Co, Fe, and Microorganisms from the Upwelling to the Gyre) cruise across the South Atlantic Ocean along 11S. A plume containing high cobalt concentrations in the oxygen minimum zone of the eastern boundary extends far into the South Atlantic Subtropical Gyre. Elevated cobalt concentrations decay linearly with decreasing dissolved oxygen and increasing distance from the coast, with an apparent coastal sedimentary source. Because scavenging, biological utilization, and export constantly deplete oceanic cobalt inventories, point sources of the scale observed here serve as vital drivers of the oceanic cobalt cycle. Cobalt and phosphorus coupling is discussed in the context of a hybrid-type metal to phosphorus conceptual scheme. The recent evidence that oxygen minimum zones may be expanding suggests that increases in sources and advective dispersion of hybrid-type trace metals is likely occurring, and thereby increasing their oceanic inventories. Comparisons will be made with the US GEOTRACES North Atlantic zonal cobalt section as results are available.

Noble, R. T., UNC Chapel Hill Institute of Marine Sciences, Morehead City, USA, rmnoble@email.unc.edu
Blackwood, A. D., UNC Chapel Hill Institute of Marine Sciences, Morehead City, USA, ad@med.unc.edu
Conn, K. E., UNC Chapel Hill Institute of Marine Sciences, Morehead City, USA, keconn@email.unc.edu
Characklis, G. W., UNC Chapel Hill Department of Environmental Sciences and Engineering, Chapel Hill, USA, charack@email.unc.edu
Helmy, T., UNC Chapel Hill Institute of Marine Sciences, Morehead City, USA, helmy@unc.edu
Luettich, R. A., UNC Chapel Hill Institute of Marine Sciences, Morehead City, USA, rick_luettich@unc.edu
Neve, R., UNC Chapel Hill Institute of Marine Sciences, Morehead City, USA, neve@email.unc.edu
Paepl, H. W., UNC Chapel Hill Institute of Marine Sciences, Morehead City, USA, hpaerl@email.unc.edu
Whipple, A. C., UNC Chapel Hill Institute of Marine Sciences, Morehead City, USA, whipple@email.unc.edu

THE ECOLOGY OF AUTOCHTHONOUS AND ALLOCHTHONOUS PATHOGENS DURING EXTREME EVENTS

This project has been designed to examine humans as both stressors and members of intricate estuarine ecosystems. The Neuse River Estuary (NRE) in eastern North Carolina has been studied over an eight-year period to understand links among storms, the fate and transport of bacterial pathogens, and human health. The two bacterial groups are allochthonous (E. coli and Enterococcus sp.) and autochthonous (Vibrio spp.). A state-of-the-art automated sampling system has been designed for sample collection during hurricanes and tropical storms, providing vital data for predictive and mechanistic model development. Multiple regression analyses during a recent tropical depression indicates roughly equal roles of salinity and temperature in predicting total Vibrio concentrations (explaining 77% of the variability). Partitioning of virulent ecotypes will permit further assessment of public health risk associated with pathogenic forms. Hurricanes and tropical storms also have defined
periods of surge, resuspension and runoff, to which *E. coli* and *Enterococcus* sp. can be attributed. The outcomes of the study have reinforced the importance of high-frequency sampling, attention to linkage across scales, and novel approaches for elucidating complex mechanisms of estuarine dynamics.

**Noffke, A.**, Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany, anoffke@ifm-geomar.de

**Hensen, C.**, Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany

**Sommer, S.**, Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany

**Croog, P.**, Plymouth Marine Laboratory, Plymouth, United Kingdom

**Scholz, F.**, Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany

**Wallmann, K.**, Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany

**THE BENTHIC PHOSPHORUS AND IRON SOURCE ACROSS THE PERUVIAN OXYGEN MINIMUM ZONE**

Oxygen minimum zones (OMZs) are key regions with respect to carbon and nutrient cycling as well as biological productivity of the global ocean. The OMZ off Peru impinges on the continental margin at water depths between ~50 and 750 m where oxygen concentrations in the near-surface water column become typically below ~200 μM. Benthic processes and cycling of redox-sensitive elements are strongly influenced by this feature. In the Peru upwelling system, water temperatures, resource loads and disturbance regimes vary across seasons, which can ultimately lead to decreases in coarse BOM (> 1 mm size) standing stocks. Food resource quality and quantity within the OMZ are determined by the net production of primary producers such as *Prochlorococcus*, *Synechococcus*, and *Coccolithus*.

**Norf, H.**, Korea Ocean Reserch and Development Institute, Ansan, Republic Of Korea

**Choi, D. H.**, Korea Ocean Reserch and Development Institute, Ansan, Republic Of Korea

**Lee, C. M.**, Korea Ocean Reserch and Development Institute, Ansan, Republic Of Korea

**DYNAMIC SEASONAL AND SPATIAL CHANGES OF SYNECHOCoccus LIN- EAGES IN MARGINAL SEAS OF THE NORTH-WESTERN PACIFIC OCEAN**

To understand seasonal distribution of pico-cyanobacteria and to elucidate factors regulating their distribution, abundances and diversity of environmental and biological variability were investigated for the East China Sea and the East Sea. *Synechococcus* were found to be abundant in the East Sea, whereas in the West Sea, they were not detected. *Prochlorococcus* were found to be more dominant in the East Sea, whereas in the West Sea, they were not detected. The results suggest that the environment in the East Sea is more suitable for the growth of *Synechococcus* than in the West Sea.

**Novak, M. G.**, NASA Goddard Space Flight Center, Greenbelt, USA, michael.novak@nasa.gov

**Mannino, A.**

**MODELING THE DISTRIBUTION OF POC AND DOC FROM DISCRETE AND ATONOMOUS UNDERWAY MEASUREMENTS COLLECTED SEASONALLY IN THE NORTHEASTERN US CONTINENTAL MARGIN**

In order to refine Ocean Color measurements in the coastal region, extensive spatial and seasonal in situ data are required. However, it is expensive and time consuming to collect and process sufficient numbers of discrete samples during a research cruise. One way to extend the data set is to make underway measurements using a multi-sensor seawater system. Seasonal research cruises in 2009 and 2010 were carried out to study climate variability in the U.S. east coast (CICE). Fluorometric CDOM, fluorometric chlorophyll, and beam attenuation at 650nm were measured in flow-through and discrete samples collected on stations. To help refine and quality control the flow-through data, every 50 minutes a valve automatically diverted the flow into a 0.2 micron capsule filter. These filters provided baseline absorption measurements to account for fouling or instrumental background noise that was later subtracted from the attenuation measurements. Seasonal and spatial relationships identified between: POC and CDOM, and DOC distributions throughout the region. These results were compared to satellite derived products.

**Novoveská, L.**, Dauphin Island Sea Lab and University of South Alabama, Dauphin Island, USA, lnovoveska@daslab.org

**Smith, W. L.**, Alabama Department of Public Health, Mobile, USA, billandelinor72@yahoo.com

**Dorsey, C. P.**, Alabama Department of Public Health, Mobile, USA, carol.dorsey@adph.state.al.us

**MacIntyre, H. L.**, Dalhousie University, Halifax, Canada, hugh.macintyre@dal.ca

**SEASONAL AND INTER-ANNUAL CHANGES IN DINOFLAGELLATE COMPOSITION IN NEAR-SHORE ALABAMA WATERS**

Alabama coastal waters have experienced significant blooms of potentially-toxic and toxic diatoms, raphidophytes and dinoflagellates. Our goal was to describe the temporal and spatial variability in community composition and to relate it to environmental changes. Here we evaluated the dinoflagellate community composition over a period of 10 years. Dinoflagellate species abundances from 11 sites in the near-shore Gulf of Mexico have been monitored weekly to bi-weekly since 1999.
compositions were grouped and averaged by season and year and analyzed using PRIMER to determine species interactions, trends and patterns. There was a clear shift in dinoflagellate community composition between seasons and between years. There were major blooms (10^{10} – 10^{12} cells/l) of Karenia brevis in the coastal Gulf of Mexico in October 2005 and of Heterocapsa triquetra and Prorocentrum minimum in February 2006 and 2007. Some of these were associated with fish-kills. We tested relationships between phytoplankton composition and environmental parameters that were available for the period 1999–2008, which included river discharge (USGS), salinity and temperature, as well as 6 climate indices describing coupled ocean-atmosphere phenomena.

Nunez, E., Universidad Autónoma del Carmen, Ciudad del Carmen, Mexico, quique_nunezlar@hotmail.com
Laffon, S., Universidad Autónoma del Carmen, Ciudad del Carmen, Mexico, slafon@hotmail.com
Aldere, A., Universidad Autónoma del Carmen, Ciudad del Carmen, Mexico,

**STATISTICAL APPROACH**

Scavia, D., University of Michigan, Ann Arbor, USA, scavia@umich.edu

Using a hierarchical multi-scale survey design, we tested an ecological model concerning anthropogenic pressure possibly driving community structure. Canonical redundancy analysis was used as a form of multivariate analysis of variance (MANOVA) to assess for differences in reef fish community composition at two spatial scales: broad (105 m) and intermediate (104 m). Surveys were conducted on the east coast of the Yucatan Peninsula (Mexican Caribbean fringing reef), including regions and reefs which differed in degree of human effect. Line transects were distributed among 12 reef localities belonging to different regions established a priori. Transects covered four types of reef habitat. Tests of significance were based on permutation procedures by using Redundancy Analysis and Multivariate ANOVA. Significant differences were found only in the reef lagoon consistent with the anthropogenic model, which may indicate an effect of coastal human activities. Significant differences among reefs within regions were observed, which could be associated with local environmental gradients. Canonical nested MANOVA was an appropriate method for testing ecological hypotheses about the functioning of complex biological systems and to model human influence on them.

Obelcz, J., University of Texas Marine Science Institute, Port Aransas, USA, jbobelcz@coastal.edu
Shank, C., University of Texas Marine Science Institute, Port Aransas, USA

**DISSOLVED ORGANIC CARBON (DOC) AND CHROMOPHORIC DISSOLVED ORGANIC MATTER (CDOM) CYCLING WITHIN THE NUECES MARSH, CORPUS CHRISTI, TX**

The Nueces Marsh is an area of great primary productivity, which makes studying the distribution of carbon in the marsh important. Water samples were collected from March through July 2010 and analyzed for DOC and CDOM content. There were distinct differences in the CDOM/DOC ratios among sites, ranging from 2:1 to 4:1. Absorbance data strongly correlated seasonality and CDOM magnitude. EEM (excitation emissions matrix) data indicate that the majority of Nueces Marsh CDOM is derived from terrestrial vegetation. Since the Nueces Marsh is shallow and often turbid, the role of suspended particles as a source of DOC and CDOM was investigated. Sediment resuspension experiments showed that simulated solar irradiation greatly enhanced the release of CDOM and DOC from particles. In irradiated conditions, CDOM exhibited an initial increase followed by a drop to levels lower than the T0 sample. DOC experienced a net increase of up to 0.6 mg C L−1 under irradiation. Dark incubations exhibited little DOC or CDOM production, highlighting the influence of solar radiation on the release of organic substances from suspended particles in marsh waters.

Obenour, D., University of Michigan, Ann Arbor, USA, obenour@umich.edu
Michalak, A. M., University of Michigan, Ann Arbor, amichal@umich.edu
Scavia, D., University of Michigan, Ann Arbor, USA, scavia@umich.edu
Zhou, Y., University of Michigan, Ann Arbor, USA, yr2zhou@umich.edu

**UNDERSTANDING THE CAUSES OF GULF OF MEXICO HYPOXIA: A GEO-STATISTICAL APPROACH**

A geostatistical regression model has been developed to determine how various factors contribute to the formation of hypoxia in the northern Gulf of Mexico. The model incorporates station-specific data collected from shelf-wide cruises over a multi-year study period. The bottom water dissolved oxygen (BWDO) concentra-

**PREDATION ON THE TROPICAL FRESHWATER SHRIMP XIPHOCARIS ELONGATA: ANTIPREDATOR RESPONSES AND CASCADE EFFECTS**

My dissertation is focused on the effects of natural barriers and the presence of predatory fishes on the behavior, morphology, abundance, and survival of the amphipromous shrimp Xiphocaris elongata, including the possible trophic cascade effects. These shrimp exhibit a phenotypic polymorphism that has been correlated to the presence/absence of predators. They possess a short rostrum in headwater streams where catadromous predatory fishes cannot access, but have a long rostrum in stream reaches below waterfalls (Covich et al. 2009). These shrimp may avoid fish predation by migrating above waterfalls and by altering their morphology where predatory fishes are present (Hein 2009). The objectives of my dissertation are to test whether long rostrum is an effective defense mechanism against catadromous predatory fishes, to determine if the growth of the rostrum is inducible by chemical cues from catadromous predatory fishes, to examine whether long rostrum is costly or beneficial in terms of upstream migration, survival, and abundance, and to determine if catadromous predatory fishes create cascade effects. Preliminary results suggest that fish prefer to feed on short rostrum shrimp versus long rostrum shrimp.

O’Connell, C. A., Stony Brook University, Stony Brook, USA, cciamo@ic.sunysb.edu
Swanson, R. L., Stony Brook University, Stony Brook, USA, lswanson@notes.cc.sunysb.edu
Cuomo, C., University of New Haven, New Haven, USA, ccuomo@newhaven.edu

**IDENTIFYING SOCIAL PERSPECTIVES, VALUES, AND USE-CONFLICTS AS THE BASIS FOR COASTAL AND MARINE SPATIAL PLANNING (CMSP) FOR LONG ISLAND SOUND**

Existing piecemeal marine policy efforts (largely reactionary) are not sustainable for Long Island Sound (LIS), especially as it continues to face increasing coastal development pressure and new interest in commercial exploitation of local marine resources (Swanson and Conover, 2006). Integrated CMSP is a useful tool to assess tradeoffs between various human uses and services in marine systems. Countless examples exist supporting the involvement of stakeholders early on in the CMSP process (Arkema et al., 2006; Oracion et al., 2005; Salz and Loomis, 2004; Christie et al., 2005; Ami et al., 2005; Carter, 2003). In addition, identifying current social and ecological conflicts and compatibilities, and where and what conflicts exist among the various human uses, are some of the first steps in creating a CMSP (Douvre and Ehler, 2009). There are many active stakeholder groups, associations, and agencies working in LIS. We developed a targeted stakeholder survey to document perceived conflicts in LIS and relative values of ecosystem uses and services by these various user groups. Survey analysis also allowed us to document opinions on, and priorities for, the management of LIS; views regarding CMSP; and feedback and concerns specific to different stakeholders. We also discuss potential issues with an integrated CMSP and suggest possible solutions.

Ogburn, M. B., Savannah State University, Savannah, USA, ogburnm@savannahstate.edu
Forward, Jr., R. B., Duke University, Beaufort, USA, rforward@duke.edu

**FRESHWATER INFLOW AFFECTS RECRUITMENT SUCCESS OF THE BLUE CRAB CALLINECTES SAPIDUS**

Freshwater inflow influences estuarine ecosystems through complex interactions between organisms and their environment. In developing a recruit-stock relationship for blue crabs in North Carolina, USA, we found salinity to be a primary factor affecting recruitment success. Blue crab megalopae were collected during fall in 11 years from 1993-2006. Fishery landings, stream flow and salinity data were obtained
from the NC Department of Environment and Natural Resources. A split recruit-stock relationship was developed by comparing an index of megalopa settlement between high inflow/low salinity and low inflow/high salinity

relationships. In high inflow years, the best-fit recruit-stock relationship was an exponential relationship was split between high inflow/low salinity and low inflow/high salinity

stock relationship was developed by comparing an index of megalopa settlement from the NC Department of Environment and Natural Resources. A split recruit-relationship between megalopa abundance and catch per unit effort ($r^2 = 0.01$). In low inflow years, fishery landings remained low despite a positive linear relationship between megalopa abundance and catch per unit effort ($r^2 = 0.98, p = 0.002$). These results suggest that inter-annual variability in freshwater inflow is an important determinant of year-class success of blue crab populations.

Ojala, A. K., University of Helsinki, Lahti, Finland, anne.ojala@helsinki.fi
Lopez Bellido, J., University of Helsinki, Lahti, Finland, jessica.lopezbellido@helsinki.fi
Tulonen, T., University of Helsinki, Lammi, Finland, tiina.tulonen@helsinki.fi
Kankaala, P., University of Eastern Finland, Joensuu, Finland, paula.kankaala@uef.fi
Huotari, J., University of Helsinki, Lammi, Finland, jussi.huotari@helsinki.fi

GAS FLUXES FROM A BROWN-WATER AND A CLEAR-WATER LAKE DURING A SUMMER WITH EXTREME RAIN EVENTS
We studied CO2 and CH4 fluxes from two boreal lakes with differing trophic status and water color throughout an open-water period when precipitation doubled using both chambers and concentration gradients. Chamber fluxes were higher, but irrespective of the method, both lakes were heterotrophic and annually atmospheric sources of C gases. With the CO2 flux of 6.85 (chambers) or 5.43 mol m$^2$ a$^{-1}$ (gradients), the humic lake had higher emissions than the clear-water lake with the fluxes of 3.97 and 3.38 mol m$^2$ a$^{-1}$, respectively. The annual CH4 flux from the clear-water lake was 28.5 (chambers) or 20.5 mmol m$^2$ a$^{-1}$ (gradients) and from the humic lake 20.7 or 16.2 mmol m$^2$ a$^{-1}$, respectively. There were interlake differences in seasonal patterns, but the most obvious changes occurred during or just after the rains. In the humic lake the resulting peak in CO2 and CH4 flux was responsible for 46% and 48% of the annual flux, respectively. In the humic lake, biological mineralization explained the majority of the fluxes, whereas in the clear-water lake the association between the biology and fluxes was less pronounced.

O' Mullan, G. D., Queens College, City University of New York, Flushing, USA, gomullan@qc.cuny.edu
Mellendorf, M., University of Natural Resources and Applied Life Sciences, Vienna, Austria
Juhl, A., Lamont-Doherty Earth Observatory of Columbia University, Palisades, USA
Young, S., Queens College, City University of New York, Flushing, USA

CHARACTERIZATION OF PARTICLE-ASSOCIATED MICROBIAL COMMUNITIES IN URBAN ESTUARIES OF NEW YORK
Water quality sampling in Flushing Bay and the Hudson River Estuary quantified the occurrence and frequency of sewage contamination using the fecal indicator bacteria, Enterococcus. Predictable patterns of spatial, temporal and cross-channel variability in Enterococci counts were identified, including elevated levels following rainfall, in nearshore environments, and in proximity to sewage point sources. Predictable patterns of microbial particle association were also found. Compared to the total bacterial community, a higher proportion of Enterococci were associated with particles (>3 µm). The number of particle-associated Enterococci also increased with total suspended solids. Settling rates of free-living bacteria and Enterococci were lower than particle-associated cells, especially following precipitation. Bacterial community composition of particle-associated and free-living fractions were characterized by sequencing of 16S rRNA genes from samples with differing levels of sewage loading. Particle attachment and settling rates have implications for the transport and persistence of sewage-associated microbial communities within the water column of these urban estuaries.

O'Reilly, C. M., Bard College, Annandale, USA, oreilly@bard.edu
Cunningham, M. A., Vassar College, Poughkeepsie, USA, macunningham@vassar.edu
Menking, K. L., Vassar College, Poughkeepsie, USA, kimenking@vassar.edu
Gillikin, D. P., Union College, USA, gillikin@union.edu
Belli, S. L., Vassar College, Poughkeepsie, USA, bellis@aol.com

THE SUBURBAN STREAM SYNDROME: THE EFFECTS OF LOW-DENSITY URBAN EXPANSION ON STREAM WATER CHEMISTRY
Urban development is known to impair stream water quality. Most work has focused on urban streams, where watersheds have high percentages of impervious surface associated with high-density development. To extend our understanding of the impacts of watershed development, we examined five suburban headwater streams in Duchess County, New York whose watersheds contained between 47% and 34% impervious surface cover. We measured Cl and nitrate concentrations in water samples taken at four to six sites on each stream in winter and summer for 3 years. Even at low levels of population and impervious cover, concentrations of both Cl and NO$_3$ exceeded reference levels found in cleaner streams in the region and this pattern was consistent in both seasons. Agricultural inputs were not sufficient to explain observed trends in NO$_3$, and we interpret inputs to result chiefly from low-density development, through the use of road salt and septic systems.

Orellana, M. V., Instituto de Sistemas Biology, Seattle, USA, morellana@systemsbiology.org
Matrai, P. A., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA, pnmatrai@bigelow.org
Leck, C., Department of Meteorology, Stockholm University, Stockholm, Sweden
Rauschenberg, C. D., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA
Lee, A. M., Institute for Systems Biology, Seattle, USA
Cox, E., CEMAT, Department of Environment, Madrid, Spain

MARINE MICROGELS AND CLOUD FORMATION IN THE HIGH ARCTIC
Clouds remain a major weakness in our understanding of the climate system and consequently in developing accurate climate projections. This is mainly true for Arctic low-level clouds in their key role of regulating surface energy fluxes which affect the freezing and melting of sea ice. The radiative properties of clouds are strongly dependent on the number concentration of airborne water-soluble particles, known as cloud condensation nuclei (CCN). In the Arctic, the aerosol-cloud-radiation relationship is more complex than elsewhere and the clouds constitute a warming factor for climate, rather than cooling, most of the year. This is due to the semi-permanent ice cover, which raises the albedo of the surface, and the clean Arctic air, which decreases the albedo of the clouds. The Arctic CCN originate in the open leads in the pack ice and are formed mostly by aggregates of organic material, apparently of marine origin. In this work, we identify and characterize the source of CCN in Arctic clouds during a summer season (August 2008). We demonstrate that marine microgels, which are important in regulating ocean-basin-scale biogeochemical dynamics, also have an increased and relevant role in cloud formation processes and bio-radiative coupling and establish a strong and fundamental link between the biology at the ocean surface, clouds and climate over the Arctic. Funded by NSF OPP ANS, ARC-070755S and ARC-0707513.

Orinzel, D. M., University of Alberta, Edmonton, Canada, orinzel@ualberta.ca
Vinebrooke, R. D., University of Alberta,
Wilson, L., University of Alberta,
Schindler, D. W., University of Alberta,

DOES IRON AVAILABILITY DETERMINE THE TROPHIC STATE OF FRESH-WATER LAKES?
Eutrophication of freshwaters is generally attributed to excessive nutrient inputs, but sulfur pollution may be exacerbating this global problem by stimulating internal phosphorus loading in lakes. Because sulfur forms insoluble complexes with iron, sulfur may render lakes deficient in the element that sequesters phosphorus in sediments. However, the role of iron in controlling the trophic state of freshwaters is poorly elucidated due to its antagonistic effects on primary productivity. Iron is an essential micronutrient that stimulates algal growth, if other nutrients are in adequate supply. In contrast, iron increases the phosphorus-hindering capacity of sediments which may inhibit algal growth, if phosphorus is in short supply. We tested these competing hypotheses by adding different amounts of iron to fifteen meso-gels, which are important in regulating ocean-basin-scale biogeochemical processes, including phytoplankton growth. Increasing iron concentrations increased algal biomass in the presence of excess nutrients, but reduced algal biomass in nutrient-poor environments. Increasing iron concentrations also reduced the abundance of iron-staining bacteria and the number of bacterial cells associated with iron oxide particles. These results suggest that iron availability may be a major factor in controlling the trophic state of freshwaters.

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PROKARYOTIC HETEROTROPHIC ACTIVITY AND DIVERSITY IN THE WESTERN ARCTIC OCEAN: PATTERNS AND CONTROLLING FACTORS
Unravelling the patterns and drivers of heterotrophic activity and diversity in the Arctic Ocean is crucial in view of marked climate change observations in this region. We described prokaryotic heterotrophic production (PHP) and bacterial community structure in contrasting (river-influenced vs. ice-influenced) areas of the Western Arctic Ocean, sampled during cruises in the Beaufort (BS) and Chukchi (CS) Seas. Average PHP was substantially lower in the BS (20.2 ± 14.5 µg C m⁻² d⁻¹) than in the CS (30.8 ± 29.2 µg C m⁻² d⁻¹). The BS, spatial patterns of PHP appeared to be influenced by temperature and organic matter supplied by inputs from the Mackenzie River. In contrast, PHP in the CS was not correlated to temperature but appeared to be related to chlorophyll a. Nutrient addition experiments showed that PHP was limited by inorganic nitrogen in surface waters, although minor changes in community structure suggested that most of the species were responsive to the added nutrients. This result evidences for the first time that carbon is not the only limiting nutrient of PHP in Arctic waters.

Ortiz, V., Georgia Institute of Technology REU, Atlanta, USA, vickym@hawaii.edu
Sieg, R. D., Georgia Institute of Technology, Atlanta, USA
Kubanek, J., Georgia Institute of Technology, Atlanta, USA

CHEMICAL DEFENSES OF SALT MARSH PLANTS AGAINST GRAZERS AND FUNGAL INFECTION
Salt marshes are among the most productive ecosystems in the U.S., fulfilling roles as nurseries for commercially important fish and shellfish, buffers that lessen coastal flooding, and nutrient sinks that prevent eutrophication of coastal waters and algal blooms. Snail grazing on marsh plants leads to subsequent ecological problems, because the scars left by snail grazing can promote fungal infection. Increased grazing and fungal infection coupled with drought can turn healthy marshes to barren mudflats in a few months. Previous studies demonstrated that many salt marsh plants are chemically defended against grazers or fungi, but no specific compounds have been indentified to date. We focused on identifying compounds in salt marsh plants that deter snail grazing or fungal infection. Crude extracts of two marsh plants were significantly deterrent to snail grazing. Separations suggested that these deterrent compounds are relatively non-polar. In addition, extracts of two plants (including at least one chloroform-soluble compound) deterred growth of marsh fungi. Discoveries of compounds are relatively non-polar. In addition, extracts of two plants (including at least one chloroform-soluble compound) deterred growth of marsh fungi. Discoveries of chemical defenses against grazers and fungi are important to allow future studies in salt marsh ecosystems including an understanding of grazing and pathogen relationships.

Ortiz-Carrión, B., University of Puerto Rico, Río Piedras, Puerto Rico, ortizbetsaida@gmail.com
Ortiz-Zayas, J., University of Puerto Rico, Río Piedras, Puerto Rico, jorgeortiz.ires@gmail.com
Rodríguez, J. M., US Geological Survey, Guaynabo, Puerto Rico, jmrod@usgs.gov

THE AGRICULTURAL DILEMMA OF LAND USE CHANGE IN THE SANTA ISABEL/COAMO AREA, SOUTHERN PUERTO RICO
A research project is being conducted to study the relationship between land use and the hydrology of the Southern Aquifer in the area between Santo Isabel and Coamo, Puerto Rico. Land use change in the area is being studied from 1936 to present. As part of this investigation, the water cycle will be carefully studied in areas of different land use in the Santa Isabel area: forest, urban, and active cropland. The proposed research will build on the existing hydrological knowledge generated by the United States Geological Survey. Because socio-economical factors typically drive water and land use decisions, a socio-ecological approach will be applied to assess community perceptions on natural resources valuation. Excessive water extraction and an increased of urban areas have contributed to the hydrological alteration of the Southern Aquifer (Rodríguez, et.al., 2009). The high and constant water extractions are linked to observed aquifer saline intrusion and to the deterioration of water quality in the aquifer which has historically met the water demands of the local communities near the Santa Isabel area. Groundwater saline intrusion has also led to the shutting down of some agricultural wells in this area.

Ortiz-Rosa, S., University of Puerto Rico, Department of Marine Sciences, Mayaguez, Puerto Rico, suheyortiz.upr.edu
Corredor, J. E., University of Puerto Rico, Department of Marine Sciences, Mayaguez, Puerto Rico, jorge.corredor@upr.edu

OPTICAL PROPERTIES AND PHOTOCHMICAL RESPONSE OF COLORED DISSOLVED ORGANIC MATTER (CDOM) AT JOBOS BAY NATIONAL ESTUARINE RESEARCH RESERVE (JOBANERR)

Kubanek, J., Georgia Institute of Technology, Atlanta, USA, usa.kubanek@gmail.com

Representative species of the Heterotrophic Bacteria (HOB) community were isolated and identified by molecular techniques. The phylogenetic analyses identify new clades at multiple levels of taxonomic hierarchy, revealing increased ecological and geographic distributions. Several clades were detected only in anoxic samples, suggestive of habitat specialization. This is supported by multivariate analyses and parametric richness estimations showing a division between communities present in different geochemical layers of the water column. We also obtained in situ fixed samples to enumerate protists from different biogeochemical habitats using fluorescent in situ hybridization and scanning electron microscopy, and show that 90% of cells in deep anoxic layers of the Cariaco Basin, but not its oxygenated waters, do not hybridize with a universal probe. This suggests divergence in one of the most conserved regions of the 18S gene, and thus substantial novelty. These findings make this habitat exceptionally promising for microbial discovery.

Otegui-Rutueta, E., Laboratoire d’Océanographie Microbienne, CNRS UMR7621, Banyuls/Mer, France, ortega@obs-banyuls.fr
Joux, F., Laboratoire d’Océanographie Microbienne, CNRS UMR7621, Banyuls/Mer, France, f.joux@obs-banyuls.fr
Jeffrey, W. H., Center for Environmental Diagnostics and Bioremediation, University of West Florida, Pensacola FL, USA, wjeffrey@uwf.edu
Ghilgione, J. F., Laboratoire d’Océanographie Microbienne, CNRS UMR7621, Banyuls/Mer, France, ghilgione@obs-banyuls.fr

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Ortiz-Carrón, B., University of Puerto Rico, Río Piedras, Puerto Rico, ortizbetsaida@gmail.com

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Otegui-Rutueta, E., Laboratoire d’Océanographie Microbienne, CNRS UMR7621, Banyuls/Mer, France, ortega@obs-banyuls.fr
Joux, F., Laboratoire d’Océanographie Microbienne, CNRS UMR7621, Banyuls/Mer, France, f.joux@obs-banyuls.fr
Jeffrey, W. H., Center for Environmental Diagnostics and Bioremediation, University of West Florida, Pensacola FL, USA, wjeffrey@uwf.edu
Ghilgione, J. F., Laboratoire d’Océanographie Microbienne, CNRS UMR7621, Banyuls/Mer, France, ghilgione@obs-banyuls.fr
We evaluate the optical properties and dynamics of CDOM in JOBANERR. CDOM absorption coefficient spectrum ($a_{\text{CDOM}}$), Slope (S), excitation emission matrix (EEM) fluorescence and Parallel Factor Analysis (PARAFAC) analyses were used to characterize sources of CDOM. S values varied from 0.014-0.034 nm$^{-1}$ and $a_{\text{CDOM}}$ ranged from 0.11-11 m$^{-1}$. Mar Negro presented a strong terrestrial source of CDOM. Mar Blanco is a transitional area that combines terrestrial and marine CDOM sources. Barca presented CDOM presented a low correlation (R$^2$). Fluorophores (C, M, A, H) were related to salinity, chlorophyll, and UV dose. DOC and CDOM presented a low correlation (R$^2$ = 0.16). UV dose correlated with $a_{\text{CDOM}}$ (R$^2$ = 0.98) in an exponential decay. Chlorophyll correlated with $a_{\text{CDOM}}$ (R$^2$ = 0.53). PARAFAC identified seven components in samples exposed to sunlight. Two principal processes transform CDOM: dilution and photodegradation. The high variability of CDOM signatures in Jobos waters can be explained by chemical transformations of CDOM.

**Ortmann, A. C.** University of South Alabama, Dauphin Island Sea Lab, Mobile, USA, aortmann@usouthal.edu

**Metzger, R. C.** University of South Alabama, Dauphin Island Sea Lab, Mobile, USA, cmetzger@www.disl.org

**Liefer, J.** University of South Alabama, Dauphin Island Sea Lab, Mobile, USA, jliefer@disl.org

**DIFFERENT MEMBERS OF MICROBIAL COMMUNITIES EXPERIENCE DIFFERENT RELATIVE RATES OF GRAZING AND VIRAL LYSIS ALONG A SHALLOW ESTUARY**

The flow of energy through the plankton organisms in an estuarine system is complicated by the interactions of the grazing food web and the microbial loop including the viral shunt. To quantify the processes controlling food availability within the Mobile Bay estuary, modified dilution experiments were carried out in July and January along a transect from within the bay to the shelf. For prokaryotes, grazing rates ranged from undetectable to 0.186 d$^{-1}$ and were positively correlated with growth rates. Viral lysis rates ranged from undetectable in four experiments to 0.073 d$^{-1}$. In only one experiment were grazing and viral lysis both significant, with viral lysis almost twice as high as grazing. Analyses of chl a and zeaxanthin, a proxy for cyanobacteria, suggest that different components of the phytoplankton communities experienced different growth rates as well as different rates of grazing and virus infection. Grazing was detected in two experiments based on zeaxanthin and two different experiments based on chl a. Viral lysis was never detected using chl a, but was detected based on zeaxanthin in one experiment.

**Otten, P. B.** University of Miami, RSMAS, Miami, USA, portner@rsmas.miami.edu

**Boyer, J. N.** Florida International University, Miami, USA, boyer@fiu.edu

**Mitchell, C. L.** Everglades National Park, Homestead, USA, carol.mitchell@nps.gov

**Nuttle, W.** Edo-Hydrology, Ottawa, Ontario, Canada, wnutte@eco-hydrology.com

**Gayanilo, F.** University of Miami, RSMAS, Miami, USA, FGayanilo@med.miami.edu

**A SYSTEMATIC PROCESS OF CONSENSUS BUILDING AND GOAL SETTING: THE MARES PROJECT**

The overall goal of the Marine and Estuarine Goal Setting for South Florida (MARES) is to reach across social, political and intellectual boundaries to formulate a consensus about the defining characteristics and fundamental regulating processes of a coastal marine ecosystem that is both sustainable and capable of providing the diverse ecological services upon which our society depends. MARES bridges these by: collaborating between academics, federal and state agencies and NGO scientists as well as agency managers, private industry and the public; explicitly incorporating both natural and human dimension's science; and following a formalized process. MARES has adapted the DPSIR framework in developing its integrated conceptual ecosystem models (ICEMs). Examples are provided with respect to two very different MARES subregions: The Dry Tortugas/Florida Keys and the Southwest Florida Shelf. The ICEMs and a deliberate series of public meetings and agency briefings are then used to develop indicators that will be integrated into an ecosystem report card. The MARES process is currently being encapsulated into a semantically-enabled, web-based, software application to enable others to efficiently align scientific understanding with management needs.

**Orvain, F.** University of Caen, Caen, France, francis.orvain@unicaen.fr

**De Crignis, M.** University of Caen, Caen, France, mdecrignis@univ-lr.fr

**Guizien, K.** CNRS, FRE3350, LECOB, Banyuls sur mer, France, katell.guizien@obs-banyuls.fr

Lefebvre, S., University of Lille, Wimeux, France, sebastien.lefebvre@univ-lille1.fr

Dupuy, C., University of La Rochelle, La Rochelle, France, christine.dupuy@univ-lr.fr

**RELEVANCE OF EXOPOLYSMER SECRETION TO UNDERSTAND THE DYNAMIC BEHAVIOR OF ERODIBILITY IN RELATION TO MICROPHYTOBENTHOSES, BACTERIA AND MACROFAUNA ACTIVITIES**

Interactions between sediment parameters and bed erodability were studied during 15 days on intertidal mudflats of the Marennes-Oléron bay in summer 2008. The microphytobenthic and bacteria biomasses were positively correlated in the sediment and they remained very low reflecting the top-down regulation due to high densities of the gastropod Hydraea ulvae. The secretion of bound exopolymeric substances (EPS) reflected the constitution of a biofilm rich in glycoproteins coinciding with significant migratory activities of diatoms across the sediment profile. There was also an impact of desiccation on the secretion of colloidal exopolysaccharides that contributed to maintain moieties in the surrounding microenvironment of diatoms in relation to osmotic processes. This substrate provided favorable conditions for bacteria development. The biofilm development fully explained the variations of sediment erodability. During the precocious fluff layer erosion phase, there were positive effects of bacteria colonization and colloidal exopolysaccharides on erosion fluxes of a material rich in chl-a. When examining the subsequent bed erosion, results clearly reflect the stabilising influences of desiccation and bound EPS on bed properties but also the destabilising effects caused by Hydrobia bioturbation.

Otero-Morales, E., University of Puerto Rico, Mayaguez, Puerto Rico, ernesto. otero3@upr.edu

Carbery, K. K., Washington University Shool of Medicine, St. Louis, USA, KELLY. CARBERY@MONSANTO.COM

**FURTHER RESULTS OF IRGAROL 1051 CONCENTRATION IN COASTAL WATERS OF PUERTO RICO AND US VIRGIN ISLANDS**

Irgarol 1051 is a known herbicide used in anti fouling paints for recreational vessels. A previous effort established levels of Irgarol in water of PR and USVI and hotspots were identified with intermediate to high concentrations (20-1000 ng/L). This work reports results of follow up visits to assess the spatial distribution of Irgarol and its temporal pattern in a selected area to evaluate the persistence of the contaminant at those hot spot sites. Samples collected in Red Hook, USVI, showed values of 2-49 ng/L, while those of Benner Bay were 19-668 ng/L, similar to the previous survey. Estimates for Boqueron, PR (-1-92 ng/L), also encompassed values reported previously. These results confirm the persistence of Irgarol contamination at these sites suggesting the possibility for chronic effects on the extant biota and the necessity of further monitoring of this and other organic pollutants in Caribbean coastal waters.

Otten, T. G., University of North Carolina at Chapel Hill, Chapel Hill, USA, otten-tim@email.unc.edu

Paerl, H. W., University of North Carolina at Chapel Hill, Chapel Hill, USA, hpaerl@email.unc.edu

**BLOOM DYNAMICS AND CONTROLLING FACTORS OF PERENNIAL TOXIN-PRODUCING MICROCYSTIS BLOOMS IN CHINAS LAKE TAIHU**

The frequency and severity of cyanobacterial harmful algal blooms (CHABs) are increasing worldwide. A case study can be made of the on-going crisis affecting China’s Lake Taihu, the third largest lake in China and provider of drinking water to over 10 million residents. The lake itself is shallow, well mixed and highly eutrophic. For several months each year the water is rendered undrinkable due to a massive, toxic bloom of Microcystis spp. During the 2009 and 2010 blooms samples were collected from all across the lake. The samples, along with physicochemical data, were used to characterize the blooms and elucidate the environmental factors most likely to promote toxin-producing bloom-forming strains in this system. The microbial community from each sample was examined both macroscopically and by whole cell PCR allowing for 16S rRNA fingerprinting and verification of microcystin (mcy) genes. ELISA was used for direct measurements of microcystin (MC-LR).The results of this work showed that the blooms are dynamic, varying over time and space and composed of a variety of Microcystis morphologies possessing distinct genotypes and varying degrees of toxicity.
Oxborough, K., new approach for characterizing marine microbial communities. More recently, the ESP was deployed for a five-day mission on a drift-over the course of the day, suggesting that distinct water masses and communities instrumentation showed changes in nutrient concentrations and physical conditions of sequences belonging to dominant taxa varied between samples, and on-board HTCC2255 and a Polaribacter-like flavobacterium. However, the relative abundances... phytoplankton and proteorhodopsin heterotrophs such as Rhodobacterales sp.

metatranscriptomic analysis of these samples revealed broadly similar communities dominated by eukaryotic microorganisms. Using the Environmental Sample Processor (ESP), we have developed a protocol for automated collection and preservation of marine bacterioplankton for metatranscriptomic analysis. In the initial field test in Monterey Bay, four samples were collected from a moored platform over the course of a single day. Metatranscriptomic analysis of these samples should reveal trends in microbial gene expression within a single water mass. To summarize, autonomous collection and preservation of samples for transcriptomic analysis is a promising new approach for characterizing marine microbial communities.

Oxborough, K., CTG Ltd, West Molesey, United Kingdom, koxborough@chelsea.co.uk Moore, C. M., NOC, Southampton, United Kingdom, c.moore@noc.soton.ac.uk Suggs, D., University of Essex, Colchester, United Kingdom, dsuggs@essex.ac.uk Lawson, T., University of Essex, Colchester, United Kingdom, lawson@essex.ac.uk Geider, R., University of Essex, Colchester, United Kingdom, geider@essex.ac.uk USING MULTI-WAVELENGTH FRR FLUOROMETRY TO IMPROVE THE ACCURACY OF PRIMARY PRODUCTIVITY MEASUREMENTS WITHIN DIVERSE NATURAL PHYTOPLANKTON COMMUNITIES

Traditional approaches to the assessment of primary production have depended on laboratory-based measurements from incubated samples, which seriously limits the temporal and spatial scales over which such measurements can be made. Although Fast Repetition Rate fluorometry (FRRf) provides an in situ method for quantification of primary production, through estimation of Photosynthetic Electron Transport Rates (PETR), the single excitation wavelength of existing systems (typically, 470 nm central wavelength with 40 nm bandwidth) frequently is poorly matched with the ambient spectral conditions and absorption spectra of the dominant phytoplankton groups, within a given environmental setting. This can result in very significant errors (usually an underestimation) of the true rate of primary production. Although corrections for these effects can be applied, they require measurements from discrete water samples, which effectively negates the main advantage of the FRRf technique. In this study, we are using multiple FRRf sensors, configured with different excitation wavelengths (450, 470, 530 and 624 nm), to test the viability of using multi-wavelength FRRf to greatly improve in situ assessment of primary production.

Packard, T. T., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, tdpackard@hiof.ulpgc.es Gómez, M. M., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, mgomez@hiof.ulpgc.es THE METABOLIC THEORY OF ECOLOGY WORKS BECAUSE BIOMASS PACKAGES THE RESPIRATORY ELECTRON TRANSPORT CHAIN

Respiratory O2 consumption is the invivo activity of cytochrome oxidase, controlled by complex I of the electron transport chain (ETC). The ETC has been known since David Keilin’s research in the 1920s, but details of the redox activity of its cytochromes, their couple to oxidative phosphorylation through Peter Mitchell’s proton pumping, was not explained until the 1960s. In spite of our biochemical understanding of respiration, we persist in linking respiration to organism biomass and size through allometric equations. This was justified in the 1880s respiration-size research of Max Rubner, and perhaps in the mid 20th century respiration-biomass research of Max Kleiber, but not in the 2000s metabolic theory of ecology (MTE). It should be clear now from existing research from all fields that the reason that Kleiber’s law and the MTE hold over many orders of magnitude is simply that biomass packages the ETC. Here, following evidence that the ETC is the basic unit of respiration, we will show how in a microorganism a respiration model based on the ETC predicts respiration better than the MTE.

Packman, A. I., Northwestern University, Evanston, USA, a-packman@northwestern.edu Aubaneau, A. F., Northwestern University, Evanston, USA Schumner, R., Desert Research Institute, Reno, USA Drummond, J. D., Northwestern University, Evanston, USA CONCEPTUALIZING AND SIMULATING THE TRANSPORT OF CONSERVATIVE AND REACTIVE SOLUTES IN RIVERS

Recently it has become recognized that connectivity between streams and pore waters greatly influences river hydrodynamics, solute transport, and a wide variety of biogeochemical processes. Over the last 10 years, numerous approaches have been used to observe and model these processes. Here we review the mechanics of flow crossing along the sediment-water interface and into the hyporheic zone, present a stochastic framework for incorporating this information into downstream transport models, and illustrate the resulting in-stream transport of conservative and reactive solutes. Solute storage in the stream and subsurface can be simulated either by representing storage in a continuous-time random walk model or by considering the anomalous pre-asymptotic dispersion behavior. The first approach is flexible but somewhat artificially subdivides the flow continuum into mobile and immobile regions. The second approach is more general but requires specification of the velocity distribution not only in the river but also in the subsurface. We believe that this framework provides the proper conceptual model for solute transport in rivers. The generality of this approach will be illustrated by comparison against alternative, more limited modeling frameworks. In addition, we will discuss the significance of the results for interpretation of reactive transport and surface/subsurface (e.g., benthic and hyporheic) biological uptake rates.

Padilla-Gamino, J. L., University of Hawaii, Honolulu, USA, gamino@hawaii.edu Gates, R. D., Hawaii Institute of Marine Biology, Kaneohe, USA, rgates@hawai.edu SEDIMENTATION EFFECTS ON THE ECOPHYSIOLOGY OF PORITES RUS IN MOOREA, FRENCH POLYNESIA

Sedimentation, which results from both natural processes and human activities, can be one of the main drivers of reef degradation. The accumulation of sediment on corals is known to reduce metabolic and tissue growth rates of coral, increasing the probability of bleaching and coral death. This study seeks to understand how coral physiology is affected by sedimentation in Moorea, French Polynesia. Portites rus was chosen for this study because it is very widespread in a variety of reef environments (lagoon, fringing, barrier and fore reefs) and inhabits both sedimented and non-sedimented areas. This species can form large clusters that can measure up to ~2.3 meters. P. rus clusters are formed by smaller colonies that measure between 800 and 1000 cm2. To examine the role of sedimentation in P. rus, we measured several physiological characteristics including growth, tissue thickness, isotope signature, chlorophyll, Symbiodinium density and type. Our results show that there is a difference in P. rus physiological characteristics between sedimented and non-sedimented areas, suggesting that P. rus acclimatization capabilities facilitate its persistence under different environmental conditions.

Paeng, J., Florida State University/EOAS Oceanography, Tallahassee, USA, j.p06f@fsu.edu Dittmar, T., Max Planck Research Group for Marine Geochemistry, Oldenburg, Germany, tdittmar@mpi-bremen.de Cooper, W., Florida State University/Department of Chemistry, Tallahassee, USA, cooperw@chem.fsu.edu Chanton, J., Florida State University/EOAS Oceanography, Tallahassee, USA, jchanton@fsu.edu Rezende, C., Universidade Estadual do Norte Fluminense, Campos dos Goytacazes, Brazil Salomao, M., Universidade Estadual do Norte Fluminense, Campos dos Goytacazes, Brazil Bernardes, M., Universidade Federal Fluminense, Niterói, Brazil
THE SOURCES AND CYCLING OF PYROGENIC DISSOLVED ORGANIC MATTER IN THE ESTUARIES OF THE SUGAR CANE AREA OF SOUTHEASTERN BRAZIL

Pyrogenic organic carbon (BC) is derived from biomass burning and might act as a long-term global carbon sink due to its high recalcitrance. In southeastern Brazil pre-harvest burning of sugarcane is a major source of BC. We hypothesize that BC is mobilized from soils and released to the ocean mainly as dissolved organic matter (DOM). To address this hypothesis, DOM samples were collected in rivers, estuaries, and coastal areas in Southeastern Brazil in 2008 and 2010. BC was determined after nitric acid oxidation of DOM using a benzene-polycarboxylic acids (BPCA) by high performance liquid chromatography (HPLC). We found that BC accounts for 3-10% of dissolved organic carbon (DOC). Highest concentrations were found in the estuaries and small ponds that receive direct runoff from the sugarcane plantations. The concentration of BC decreased towards the open ocean mainly due to dilution, indicating conservative behavior of BC in the coastal ocean.

Paerl, H. W., Univ. of North Carolina at Chapel Hill, Institute of Marine Sciences, Morehead City, USA, hpaerl@email.unc.edu

Peierls, B. L., Univ. of North Carolina at Chapel Hill, Institute of Marine Sciences, Morehead City, USA, peierls@email.unc.edu

CONTROLLING EUTROPHICATION ALONG THE FRESHWATER-MARINE CONTINUUM: WHY IS IT ESSENTIAL TO REDUCE BOTH NITROGEN AND PHOSPHORUS INPUTS?

Coastal watersheds contain approximately 75% of the world’s human population and support unprecedented population growth. Accelerating anthropogenic nutrient (nitrogen and phosphorus) discharge along the freshwater to marine continuum of coastal watersheds has promoted eutrophication, harmful algal blooms, hypoxia and habitat destruction. Phosphorus input reduction has been the traditional approach to stemming upstream freshwater eutrophication, based on the fact that many freshwater systems are phosphorus limited and the assumption that nitrogen fixation can relieve nitrogen limitation. Recent studies have shown nitrogen limitation and nitrogen and phosphorus co-limitation are common in freshwater systems, and that nitrogen fixation generally does not meet ecosystem nitrogen demands, leading to persistent nitrogen limitation, especially in downstream coastal waters. Nutrient over-enrichment has caused imbalances in nitrogen and phosphorus loading, and nutrient-saturated conditions, complicating simple interpretations of nutrient limitation. Also, upstream nutrient reductions can impact downstream nutrient limitation. Physical factors, including water residence time, circulation, light availability, and biological interactions, including grazing, and microbial internal nutrient cycling further complicate single nutrient reduction approaches to stemming eutrophication. Increasingly, dual nutrient reductions are needed for controlling eutrophication along the continuum.

Paerl, R. W., University of California at Santa Cruz, Santa Cruz, USA, rpaerl@ucsc.edu

Tozzoli, S., University of California at Santa Cruz, Santa Cruz, USA, stozzi@ucsc.edu

Kolber, Z., University of California at Santa Cruz, Santa Cruz, USA, zkolber@gmail.com

Zehr, J. P., University of California at Santa Cruz, Santa Cruz, USA, zehrj@ucsc.edu

CHANGES IN NARB GENE EXPRESSION RELATIVE TO NITRATE ASSIMILATION, LIGHT AND NUTRIENTS IN EXPERIMENTS WITH COASTAL SYNECHOCOCUS ISOLATE CC9311.

A large diversity of marine Synechococcus, small (typically <2µm in cell diameter) unicellular cyanobacteria, exists in the marine environment, yet their roles in N cycling are not well characterized. The abundances of several narB-possessing Synechococcus (those capable of nitrate assimilation) appear to vary based on nitrate and co-varying environmental factors. Populations actively assimilating nitrate may be identifiable in the environment by examining narB gene expression. However first, narB gene expression was examined in laboratory experiments with Synechococcus sp. CC9311 under diel light fluctuations. narB transcript levels were (>10x) higher in cells grown on nitrate or N-deprived versus ammonium. In nitrate grown cells, nitrate assimilation was high (>0.014 hr^-1) throughout the light phase while narB expression was strongly down regulated (7.5 fold) 4–8 hrs after the early light period transcript maximum. In nitrate-grown CC9311 cultures, a two fold increase in irradiance during the light phase caused up-regulation of narB expression relative to when irradiance was unchanged. These experiments emphasize that timing of day, irradiance and cell growth should be considered when interpreting environmental Synechococcus narB expression.

Pal, S., University of South Carolina, Columbia, USA, muniapal@gmail.com

Benitez-Nelson, C., University of South Carolina, Columbia, USA, cbnelson@geol.sc.edu

CARBON AND PHOSPHORUS DYNAMICS IN THE CHUKCHI SEA

Some of the highest rates of primary production in the world ocean have been measured in the Chukchi Sea, which suggest that this region may have far-reaching biogeochemical importance as a sink for atmospheric CO2 as a source of fixed carbon to the Arctic Ocean. In June 2010, we participated in the NASA ICESCAPE (Impact of Climate change on the Eco-Systems and Chemistry of the Arctic Pacific Environment) mission in the Chukchi Sea to study: (a) particle using 234Th / 238U disequilibrium, and (b) phosphorus dynamics. Twenty one stations were sampled for total 234Th with sinking particles collected using an in situ pump. Surface sediment and ice core samples were also collected to determine 234Th mass balance. Nutrient measurements include dissolved inorganic and organic phosphorus, particulate phosphorus, carbon, nitrogen and biogenic silica, and total suspended particulate matter (120 stations). In combination with other optical and biological measurements, we will present a synoptic view of the biogeochemical cycling of carbon and phosphorus within the Chukchi Sea.

Paleček, B., University of California, San Diego, SIO, La Jolla, USA, bpalecuk@ucsd.edu

Brahamska, B., University of California, San Diego, SIO, La Jolla, USA, bbrahamsha@sdsu.edu

Daniei, E. F., University of California, San Diego, SIO, La Jolla, USA, edaniel@ucsd.edu

WHEN IS A UNICELLULAR CYANOBACTERIUM NOT UNICELLULAR?

Marine Synechococcus is comprised of diverse clades/species that are subject to strong grazing pressure by ciliates and small heterotrophic nanoflagellates. Using coastal
**ASLO Aquatic Sciences Meeting**

**Lewes, USA, luther@udel.edu**

**Parker, A. E., Romberg Tiburon Center, San Francisco State University, Tiburon, USA, aeparker@sfsu.edu**

**Kress, E., Romberg Tiburon Center, San Francisco State University, Tiburon, USA, ericakress@yahoo.com**

**Wilkersen, F. P., Romberg Tiburon Center, San Francisco State University, Tiburon, USA, fwilkers@sfsu.edu**

**Cercozoan. Co-culturing of these nanoflagellates with small heterotrophic nanoflagellates from coastal California seawater including a novel**

**Parker, C., operations. This “natural experiment” provides a means for comparing phytoplankton**

**FluoroProbe. The experimental design took advantage of a contrast in inorganic**

**Joaquin Rivers, which flow into the SFE, to characterize phytoplankton communities**

**Estuary (SFE), from diatoms to flagellates may contribute to food limitation in**

**Long-term changes in phytoplankton community composition in the San Francisco**

**as heterotrophic planktonic prokaryotes.**

**Parker, A. E.**

**UCSFO**

**Garay-Tinoco, J. A., Instituto de Investigaciones Marinas y Costeras, Santa Marta,**

**Colombia, jgaray@invemar.org.co**

**Lespinosa, J. M., Universidad de los Andes, medellin, Colombia, jlespinosa@invemar.org.co**

**River muds) before flowing into the water column.**

**transported throughout the water column, whereas pyrite in the Broadkill River and**

**at the oxic-anoxic interface (the maximum pyrite value in the profiles), and was then**

**of total iron from 1.2 to 92.2%. The nanoparticulate pyrite in Torquay Canal formed**

**Fe(III) was usually undetectable (0.010µM DL). Fe(II) was consistently present, but**

**measure Fe(II), hydroxylamine to reduce Fe(III), and nitric acid to decompose pyrite.**

**Torquay Canal, Delaware. The speciation was studied with the ferrozine method to**

**sediments. Three locations were studied: creeks of Great Marsh, Broadkill River, and**

**anoxic inland bay and for release or transport of nanoparticulate pyrite from marsh**

**Three locations were studied: creeks of Great Marsh, Broadkill River, and Torquay Canal, Delaware. The speciation was studied with the ferrozine method to**

**measure Fe(II), hydroxyamine to reduce Fe(III), and nitric acid to decompose pyrite.**

**Fe(III) was usually undetectable (0.010µM DL). Fe(II) was consistently present, but**

**at higher concentration [up to 2.5µM] in anoxic waters. Nanoparticulate pyrite was in**

**all but one of the 25 samples, ranging from 0.05µM to 0.25µM, and in percentage of**

**total iron from 1.2 to 92.2%. The nanoparticulate pyrite in Torquay Canal formed at**

**the oxic-anoxic interface (the maximum pyrite value in the profiles), and was then**

**transported throughout the water column, whereas pyrite in the Broadkill River and**

**Great Marsh creeks likely formed in anoxic sediment in Great Marsh (or the creek/ river muds) before flowing into the water column.**

**Parra-Lozano, J. P., Instituto de Investigaciones Marinas y Costeras, Santa Marta,**

**Colombia, juanpablo@invemar.org.co**

**Esponosa-Diaz, L. F., Instituto de Investigaciones Marinas y Costeras, Santa Marta,**

**Colombia, lespinosa@invemar.org.co**

**Betancourt-Portela, J. M., Instituto de Investigaciones Marinas y Costeras, Santa Marta,**

**Colombia, jbetancourt@invemar.org.co**

**Garay-Tinoco, J. A., Instituto de Investigaciones Marinas y Costeras, Santa Marta,**

**Colombia, jgaray@invemar.org.co**

**Alonso-Hernández, C., Centro de Estudios Ambientales de Cienfuegos (CEAC), Cienfuegos, Cuba**

**Díaz-Asencio, M., Centro de Estudios Ambientales de Cienfuegos (CEAC), Cienfuegos, Cuba**

**Ruiz-Fernandez, A. C., Universidad Nacional Autónoma de México (UNAM),**

**Mazatlán, México**

**Sanchez-Cabeza, J. A., International Atomic Energy Agency (IAEA), Vienna, Austria**

**Gerardo-Abaya, J., International Atomic Energy Agency (IAEA), Vienna, Austria**

**HISTORICAL RECONSTRUCTION OF MERCURY CONTAMINATION IN**

**SEDIMENTS FROM CARTAGENA BAY, COLOMBIA**

**Estuaries are important reservoirs for contaminants because they act as sinks for**

**contaminant-reactive sediments. Historically, estuaries have acted as centers of**

**industrial and urban development. Analysis of dated sediment cores from these**

**areas can reconstruct historical trends in heavy metal input. In this study, we used**

**210Pb dating of sediment cores to reconstruct the mercury input in Cartagena Bay,**

**Colombia. High mercury concentrations (18.76 µg/g) were detected at depths of 55 to**

**65 cm which corresponds to the 1970s when a chlor-alkali plant was operating. At**

**depths above 55 cm, a rapid decrease in concentrations to 1.75 µg/g was observed,**

**corresponding to the 1980s when the plant closed its operations. In surface sedi-**

**ments (<10 cm depth) that correspond to the 2000s, concentrations stabilize around**

**0.40 µg/g. Our results suggest that mercury can be persistent in the sediments of**

**previously exposed ecosystems and although the values have decreased in surface**

**sediments, there remains a risk of contamination by removing bottom sediments.**

**This work was supported by the IAEA-Regional Project RL A 7012.**

**Parrish, C. C.**

**Memorial University of Newfoundland, St. John’s, Canada, cparrish@mun.ca**

**French, V. M., Memorial University of Newfoundland, St. John’s, Canada**

**FATTY ACID COMPOSITION OF HARPACTICOID AND CALANOID COPE-**

**PODS FED VARIOUS COMBINATIONS OF AUTOTROPHIC AND HETERO-**

**TROPHIC PROTISTS**

**Tisbe furcata, Nitotira lacunaria, Calanus finmarchicus and Calanus glacialis were reared for several months in the laboratory prior to feeding selected diets. Dielchysis**

**galbana, Tetraselmis sp., Dunaliella tertiolecta, Thalassiosira pseudonana, Rhe-**

**domonas sp., R. lens and Oxyrrhis marina were fed individually or in combination.**

**The lipid class and fatty acid composition of the copepods was determined and compared with each other, the diets and with wild C. finmarchicus. C. glacialis and**

**Pseudocalanus sp. O. marina, T. furcata, and N. lacunaria had greater proportions of**

**22:6n3 or 20:5n3 than in their diets suggesting synthesis or preferential retention.**

**Lower proportions of 18:3n3 than in their diets fed individually or in combination**

**suggests desaturation and elongation of 18:3n3. Stable isotope composition of heterotroph**

**samples and dietary sources for each revealed similar values for 18:3n3 in each**

**dietary pair and different ones for 22:6n3 and 20:5n3 supporting derivation from**

**precursors over trophic magnification. Principal components analysis of copepods**

**and their diets showed cultured Calanus spp. to have the most similar fatty acid**

**composition to their diet indicating little modification or sequestration of polyun-**

**aturated fatty acids.**

**Parveen, S., University of Maryland Eastern Shore, Princess Anne, USA, sparveen@umes.edu**

**Mudhol, M., University of Maryland Eastern Shore, Princess Anne, USA, formu-**

**doh@yahoo.com**

**Burgos, J. A.**

**University of Puerto Rico, Rio Piedras, San Juan, Puerto Rico, jbsot-**

**burgos@yahoo.com**

**THE EFFECTS OF STORAGE TEMPERATURE ON THE GROWTH OF TOTAL**

**AND PATHOGENIC VIBRIO PARAHAMALOTYRICUS IN THE CHESAPEAKE**

**BAY OYSTERS**

**Vibrio parahaemolyticus (Vp) is a naturally occurring halophilic bacterium in coastal**

**waters that can cause gastroenteritis in seafood consumers, usually associated with**

**the ingestion of contaminated oysters. This study evaluated the effect of storage**

**temperature on the growth and survival of total and pathogenic Vp in post-harvest**

**shell-stock oysters. Oysters harvested from the Chesapeake Bay summer 2008 were**

**stored at 5, 10, 15, 20, 25 and 30°C for selected time intervals. Two replicates of**

**six oysters each were analyzed. Total Vp levels were determined by direct plating/ DNA probe for species thermolabile hemolysin (tlh) gene. Pathogenic Vp levels were**

**determined by MPN-qPCR targeting thermostable direct hemolysin (tlh) and**

**thermostable-related hemolysin (trh) genes. The Baranyi-D and linear models were**

**fitted to estimate the maximum-growth rate (GR). GR estimates for total Vp were**

**>872220.0007, >872200.0018, 0.038, 0.058, 0.099 and 0.098 log CFU/l, respectively**

**and 0.08, 0.14, 0.22, > 0.27, 0.17, and 0.048, 0.17, 0.26, and > 0.25 0.27 log MPN/l for**
pathogenic Vp. No growth of pathogenic Vp was detected at 5°C, pathogenic Vp GR and multiplication significantly were greater than total Vp.

Passow, U., Marine Science Institute, University of California Santa Barbara, Santa Barbara, USA, passow@lifesci.ucsb.edu

OCEAN ACIDIFICATION AND THE BIOLOGICAL PUMP: ABIOTIC FORMATION OF TRANSPARENT EXOPOLYMER PARTICLES (TEP)
The efficiency of the biological pump is determined by all processes affecting primary production, food web structure and aggregation. Each of these processes may, in part or in their totality, be impacted by ocean acidification. The formation, size and stickiness of transparent exopolymer particles, TEP, are essential factors driving aggregation. Increased TEP formation and sedimentation under future CO2 regimes have been postulated from a mesocosm study. In contrast, laboratory experiments demonstrated that although abiotic TEP formation increased, aggregation decreased with decreasing pH, implying a weakening of the biological carbon pump under future CO2 scenarios. We present results of nine experiments addressing this controversy. In contrast to predictions abiotic TEP formation was not impacted by ocean acidification, but TEP concentration changed when only pH was altered. Results suggest that equilibrium conditions between TEP and their dissolved precursors are not particularly sensitive to ocean acidification. They provide one puzzle piece towards addressing the question if ocean acidification will strengthen or weaken the efficiency of the biological pump and emphasizes the importance of complete CO2 perturbation when future conditions are to be mimicked.

Passy, S. I., University of Texas at Arlington, Arlington, USA, sophia.passy@uta.edu

HABITAT NICHE DIMENSIONALITY CONSTRAINTS THE POWER LAWS OF DIATOM DENSITY WITH BODY SIZE AND CONTINENTAL DISTRIBUTION
The relationships of local population density (N) with body size (M) and distribution (D) have been subjects of numerous investigations but the theories developed so far have focused on explaining their existence rather than their variability. To describe the behavior of these relationships, I propose a hierarchical theory, invoking growth rate, stress tolerance, and resource distribution at a species level but habitat niche dimensionalality at a community level. I argue that species-level approaches can explain why the relationships N–M×b and N–D×d exist but predicting the scaling exponents b and d becomes possible only from a community perspective. These ideas were tested using the continental NAWQA dataset of stream chemistry and diatoms, employing local species richness (S) as a surrogate measure of habitat dimensionality, both increasing with resource supply. Richness constrained both exponents, allowing reformulation of the power laws as: N–M×(1/S) and N–D×(1/S), which indicates that as biodiversity increased (in nutrient-rich streams) so did the contributions of large and rare species to community biomass. Therefore, biodiversity loss in freshwaters will have the strongest negative impact on the most vulnerable community members.

Paterson, A. M., Ontario Ministry of the Environment, Dorset, Canada, andrew.paterson@ontario.ca

Ruhland, K. M., Queen’s University, Kingston, Canada, ruhlandk@queensu.ca

Hyatt, C. V., Queen’s University, Kingston, Canada, crystalhyatt@gmail.com

Michelutti, N., Queen’s University, Kingston, Canada, nm37@queensu.ca

Smol, J. P., Queen’s University, Kingston, Canada, smol@queensu.ca

ALGAL COMMUNITY AND BIOMASS RESPONSES TO RECENT WARMING IN THE LAKE OF THE WOODS, ONTARIO, CANADA
Although the nature and magnitude of climate-driven responses varies among freshwater systems, a warmer climate will affect important lake-water properties and biota in numerous and often surprising ways. We present data recorded over the last ca. 200 years from the Lake of the Woods, Ontario, Canada, that show long-term changes in diatom community composition and algal biomass (as chlorophyll a) that are consistent with recent warming. Trends in air temperature and lake ice cover are compared to overall patterns of diatom assemblage compositional changes, lacustrine primary production, and diatom-inferred total phosphorus concentrations, analysed from eight 210Pb-dated sediment cores. We observe a sharp increase in the relative abundances of planktonic Cyclotella taxa, and a concurrent decline in thickly-silicified Aulacoseira taxa starting ca. 1980 that are consistent with the warmest decades on record. At sites with high measured phosphorus concentrations, we also note strong, significant correlations between climatic measures and lacustrine chlorophyll a concentrations. Our research reveals that algal communities may respond rapidly to warming, and that these changes can occur with relatively small changes (~1.5 C) in mean annual air temperature.

Patoine, A., Université de Moncton, Shippagan, Canada, alain.patoine@unm.ca

Leavitt, P. R., University of Regina, Regina, Canada, peter.leavitt@uregina.ca

LANDSCAPE AND TEMPORAL REGULATION OF THE IMPORTANCE OF FIXED NITROGEN TO PHYTOPLANKTONIC NUTRIENT BUDGETS
We estimated nitrogen (N) fixation rates (supply, S) and N consumption rates by the phytoplankton community (demand, D) (1994–2006) in a chain of six freshwater and sub-saline lakes to estimate the proportion of ecosystem N uniquely derived from atmospheric sources. Seasonal fixation rates were estimated with the natural abundance method (NAM) which uses the nitrogen isotopic signature (d15N) and standing stocks of particulate organic matter (PON) as key parameters. Fixation rate estimates increased predictably from up- to downstream lakes, as did the supply-to-demand ratio. We also measured temporal and spatial variation in heterocyst density and used published physiological relationships to estimate N fixation rates in two downstream lakes 2000–2006. Taking heterocyst-derived values as a basis for comparison, Prairie lakes showed fixed rate corrections comparable to those of oligotrophic Boreal Shield lakes, despite heterocyst densities 10 to 100-times greater in the former. N consumption rates showed synchronous yearly fluctuations suggesting the influence of large-scale environmental factors. Overall, results suggest that N supply-to-demand ratios obey to spatial (landscape-scale) and temporal (annual climatic variations) interactions and are greatest in downstream systems during years of low demand.

Patten, B. C., University of Georgia, Athens, USA, bmpatten@earthlink.net

Whipple, S. J., University of Georgia, Athens, USA, whipplejs@gmail.com

Kazanci, C., University of Georgia, Athens, USA, caner@uga.edu

Food-web theory is dominated by qualitative (unweighted) digraph (directed graph) and corresponding adjacency-matrix approaches that do not lend themselves to existing methods for ecological Network Analysis (NEA). The reason is feeding flows are difficult to quantify, especially for large webs. As quantification is likely to remain elusive, there is need to attempt quantification of qualitative webs by other means. NEA decomposes quantified (weighted) flow and flow–storage networks into sub-networks (environ) driven by specific inputs. This paper develops a probability approach to formulating a quantitative structure-based methodology (SNEA) based solely on unweighted adjacency information. Matrices corresponding to those of standard NEA are derived, from which all key concepts and measures of the standard theory are accessible. NEA vs. SNEA results are compared and contrasted for a quantified food-web model vs. its unquantified structural (adjacency) counterpart.
Paul, C., Friedrich Schiller University Jena, Jena, Germany, carsten.paul@uni-jena.de
Pohnert, G., Friedrich Schiller University Jena, Jena, Germany, georg.pohnert@uni-jena.de
MÉNAGE A TROIS: INTERACTION OF MARINE ALGICIDAL BACTERIA WITH RESISTANT AND SUSCEPTIBLE DIATOMS
The success of diatoms can be limited by a variety of abiotic and biotic factors. Among the biotic limitations, the interactions with marine bacteria play an essential role. Here we describe how the algicidal marine bacterium Kordia algicida affects the growth of the planktonic diatoms Skeletonema costatum and Chaetoceros didymus and how these diatoms affect each other. K. algicida excretes a protease into the surrounding medium once the bacterial cell density reaches a defined threshold concentration. The protease is then responsible for growth inhibition of S. costatum. However, the diatom C. didymus is not affected by K. algicida. The reasons for this resistance will be discussed. We suggest that these findings help to further explain the complex population dynamics of phytoplankton communities.

Paul, J. H., University of South Florida, St Petersburg, USA, jpaullarine.usf.edu
McDaniel, L. D., University of South Florida, St Petersburg, USA, mcDaniel@marine.usf.edu
Hollandar, D., University of South Florida, St Petersburg, USA, dbhollandar@marine.usf.edu
Coble, P. G., University of South Florida, St Petersburg, USA, pcoble@marine.usf.edu
Murasko, S., Florida Fish and Wildlife Conservation Commission, St Petersburg, USA, Sue.murasko@myfwc.com
MICROBIAL TOXICITY AND MUTAGENICITY OF WATERS NEAR THE DEEPWATER HORIZON OIL SPILL
The Deepwater Horizon oil spill represents an environmental disaster of unprecedented dimension. We participated in two research cruises in the Gulf of Mexico to measure the toxicity of the oil-contaminated waters. The first cruise (July 2010) sampled stations on the West Florida Shelf while the second cruise sampled stations in the Northeastern Gulf of Mexico in August of 2010. Two assays of toxicity were employed, the Microtox assay and the QwikLite assay. The general mutagenicity test Microscreen/Inductest was also employed. No waters on the West Florida Shelf sampled during the July cruise were toxic or mutagenic. The Microtox assay detected microbial toxicity in the surface waters of 3 of 14 stations (21.4%) in subsurface waters (35-275 m deep). Strong mutagenicity was detected in 6 of 14 stations (42.9%) in surface and subsurface waters on the eastern/northeastern side of the Deepwater/Horizon blowout site. Even though surface waters were visibly clear of oil and tar balls were absent, toxicity and mutagenicity of roughly a third of the stations sampled persisted.

Pearson, G. A., Centre for Marine Sciences, University of the Algarve, Faro, Portugal, gppearson@ualg.pt
Canovas, F., Centre for Marine Sciences, University of the Algarve, Faro, Portugal, fcanovas@ualg.pt
Cox, C. J., Centre for Marine Sciences, University of the Algarve, Faro, Portugal, ccoy@cymon.org
Duarte, C. M., IMEDEA (CSIC-UIB), Instituto Mediterráneo de Estudios Avanzados, Esporles, Spain, susagusti@uib.es
Paytan, A., CUSC, Santa Cruz, USA, apaytan@ucsc.edu
McLaughlin, K., SCCWRP, Long Beach, USA, karenm@scwrp.org
Sohm, J., USC, Los Angeles, USA, sohm@usc.edu
Cutter, G., ODU, Norfolk, USA, gcutter@odu.edu
Lomas, M., BIOS, St. George's, Bermuda, michael.lomas@bios.io
PHOSPHATE CYCLING IN THE SARGASSO SEA: INVESTIGATION USING THE OXYGEN ISOOTPIC COMPOSITION OF PHOSPHATE, ENZYME LABELED FLUORESCENCE, AND TURNOVER TIMES*
Dissolved inorganic phosphorus (DIP) concentrations in oligotrophic systems are extremely low and phosphorus (P) is thought to limit or co-limit primary productivity in these regions. We utilized multiple techniques to investigate biogeochemical cycling of P in the Sargasso Sea, Atlantic Ocean. Results from these studies indicate that dissolved organic phosphorus (DOP) is utilized by phytoplankton and bacteria to supplement cellular requirements. Remineralization of the DOP pool is most extensive above the thermocline as indicated by expression of alkaline phosphatase, rapid P turnover (4-8 hours), and large d18Op deviations from equilibrium. These data suggest that DOP remineralization by extracellular enzymes is prevalent and can account for an average of 40% of P utilized. Below the thermocline, alkaline phosphatase expression is reduced, turnover times increase, and d18Op values approach equilibrium, indicative of intracellular phosphate cycling and slower turnover of the DOP pool. This study highlights the importance of DOP to primary productivity in oligotrophic systems. In the surface waters of the Sargasso Sea C fixation supported by regenerated DOP utilization may account for 4,000,000,000 moles P per year.

Paytan, A., UCSC, Santa Cruz, USA, apaytan@ucsc.edu
McLaughlin, K., SCCWRP, Long Beach, USA, karenm@scwrp.org
Sohm, J., USC, Los Angeles, USA, sohm@usc.edu
Cutter, G., ODU, Norfolk, USA, gcutter@odu.edu
Lomas, M., BIOS, St. George's, Bermuda, michael.lomas@bios.io
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Paytan, A., UCSC, Santa Cruz, USA, apaytan@ucsc.edu
McLaughlin, K., SCCWRP, Long Beach, USA, karenm@scwrp.org
Sohm, J., USC, Los Angeles, USA, sohm@usc.edu
Cutter, G., ODU, Norfolk, USA, gcutter@odu.edu
Lomas, M., BIOS, St. George's, Bermuda, michael.lomas@bios.io
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Pearson, G. A., Centre for Marine Sciences, University of the Algarve, Faro, Portugal, gppearson@ualg.pt
Canovas, F., Centre for Marine Sciences, University of the Algarve, Faro, Portugal, fcanovas@ualg.pt
Cox, C. J., Centre for Marine Sciences, University of the Algarve, Faro, Portugal, ccoy@cymon.org
Lago-Leston, A., Centre for Marine Sciences, University of the Algarve, Faro, Portugal, alago@ualg.pt
Agusti, S., IMEDEA (CSIC-UIB), Instituto Mediterráneo de Estudios Avanzados, Esporles, Spain, susagusti@uib.es
Duarte, C. M., IMEDEA (CSIC-UIB), Instituto Mediterráneo de Estudios Avanzados, Esporles, Spain, carlosduarte@imeida.uib-csic.es
Serrão, E. A., Centre for Marine Sciences, University of the Algarve, Faro, eserra@ualg.pt
METATRANSCRIPTOMICS OF DIATOM-DOMINATED ANTARCTIC COMMUNITIES: ESTABLISHING LINKS BETWEEN DIVERSITY AND FUNCTION
The routine generation of immense quantities of sequence data allows, in principle, metatranscriptomic analysis to describe the combined function-diversity relationships in natural communities. Here, the potential and drawbacks of metatranscriptomics are explored by comparing three diatom-dominated community samples collected in the austral summer of 2009 from the Antarctic Peninsula; the Bransfield Strait, Weddell Sea, and an ice community from a portion of collapsed Wilkins Ice Shelf. Samples collected by filtration were used to generate cDNA libraries by selective amplification of mRNA, resulting in >10^6 FLX Titanium sequence reads. The data analysis workflow is described, from sequence assembly to the databases containing diversity and functional assignments. The workflow does community
component in all three samples, with almost 20 x 10^9 (13.8 x 10^9 with functional annotations) and 78 x 10^9 reads. We present function-diversity results showing extensive variation between diatom communities from the three habitats, including amongst others, annotations for primary metabolism, nutrient acquisition, urea cycle, and antioxidant activity. For well-represented taxa in public databases, metatranscriptomics therefore offers exciting new possibilities for community analyses in both natural and experimental settings.

Pedersen, T. M., Roskilde University, Roskilde, Denmark, tmp@ruc.dk
Nielsen, S. L., Roskilde University, Roskilde, Denmark, nielssen@ruc.dk
Sand-Jensen, K., Copenhagen University, Hillerød, Denmark, ksandjensen@bio.ku.dk
Markager, S. S., Aarhus University, Roskilde, Denmark, sms@dmu.dk

HISTORICAL CHANGES IN OPTICAL PROPERTIES OF ROSKILDE FJORD, DURING A PERIOD OF DECREASING NUTRIENT LOAD

Loss of water clarity is a common consequence of coastal eutrophication. Efforts have been made to reduce the nutrient load of the inner Danish waters, hence increasing water column clarity. Measurements of Light attenuation, Particulate Organic Matter (POM) and Chlorophyll a (Chl a) concentrations from one of the major Danish estuarine systems have been conducted from April to September in 1985 and 2008. In an effort to assess the dynamics controlling light attenuation linear models are made of light attenuations as a function of Chl a and POM concentration. An average decrease in light attenuation of 34% is observed along with decreases in Chl a and POM concentrations of 71% and 84%, respectively. Analysis of simultaneous changes in light attenuation and secchi depth indicates that changes in scatter-to-absorption ratio accompanied the nutrient and Chl a reductions implying reduction in particulate detritus. Furthermore the managerial effort to increase water clarity seems to have a larger impact on the POM concentration than the Chl a concentration throughout the estuary, which helps to explain the decrease in scatter-to-absorption ratio.

Pedler, B. E., Scripps Institution of Oceanography, UCSD, La Jolla, USA, bpedler@ucsd.edu
Azam, F., Scripps Institution of Oceanography, UCSD, La Jolla, USA, fazam@ucsd.edu

SINGLE-CELL GROWTH DYNAMICS OF A MARINE BACTERIAL ISOLATE'S UTILIZATION OF AMBIENT DISSOLVED ORGANIC MATTER

Understanding the interaction between heterotrophic bacteria and dissolved organic matter (DOM) is essential for determining and ultimately predicting the biogeochemical state of the ocean. We developed a model system to study the single-cell growth dynamics of an Alteromonas species’ exclusive utilization of dissolved organic matter. Under ambient seawater conditions, the rate of growth, dissolved organic carbon (DOC) utilization, carbon production and respiration was measured through total organic carbon analysis, cell abundance, and cell morphometrics. Biovolume was calculated by measuring cell length, width and height using atomic force microscopy (AFM). Results from multiple experiments show that this isolate is capable of reaching cell abundances comparable to the carrying capacity of ambient microbial seawater assemblages, and exhibits a growth efficiency within the range of reported bulk measurements. A species-specific fluorescence in situ hybridization (FISH) probe has been developed and used to address whether this isolate is capable of growth performance and DOC drawdown comparable to that in seawater in isolation; or whether their physiological performance is affected by some ecosystem factors such as the presence of predators and competing heterotrophic bacteria.

Peltomaa, E. T., University of Helsinki, Lahti, Finland, elina.peltomaa@helsinki.fi
Ojala, A. K., University of Helsinki, Lahti, Finland, anne.ojala@helsinki.fi

ALGAL GROWTH ENHANCEMENT WITH ORGANIC SUBSTRATES

We studied the effects of additional organic substrates on growth rates as well as cellular yields, lipid concentrations and amount of chlorophyll a in four microalgal strains. The experiments were carried out in mixotrophic and heterotrophic conditions, i.e. with organic substrates in the presence of light or in total darkness, respectively. The organic substrates were acetate, glucose and glycerol, and the four strains the chlorophytes Brachiononas submarina and Chlorella pyrenoidosa, the euglenophyte Euglena gracilis, and the chrysophyte Ochromonas danica. We discovered that both the substrate and the light conditions had significant - but very strain-specific - effects: C. pyrenoidosa grew well in most treatments, whereas B. submarina grew only in the presence of light. O. danica preferred certain substrates, and grew often better when mixo- or heterotrophic than autotrophic. However, the lipid yields and chlorophyll a contents of these three strains were quite low compared to E. gracilis which grew smoothly regardless of the treatment and due to the large cell size attained high biomass.

Perez, K., Stony Brook University, Stony Brook, USA, kested.perez@gmail.com
Munch, S. B., Stony Brook University, Stony Brook, USA, smunch@notes.cc.sunysb.edu

PROLONGED COSTS OF EARLY GROWTH IN ATLANTIC SILVERSIDES

In many species, large body size is associated with increased survival and fecundity. Despite this, most species do not grow at their physiological maximum suggesting some cost to rapid growth. There are now many empirical examples of trade-offs with growth. However, the vast majority of these examples and virtually all life-history theory focus on instantaneous growth costs. Despite the ubiquity of physiological delays, few studies have evaluated whether delayed or prolonged growth-costs exist or evaluated their duration. To address this question, we measured swimming ability and lipid accumulation in growth-manipulated Atlantic silversides (Menidia menidia). Fish were grown fast (1.4mm/day) or slow (0.6mm/day) for 2 weeks. Following this, all fish were grown slowly for up to 45 days. Fast-grown fish had both significantly poorer swimming ability and less lipid mass than fish that had grown slowly early in life. Moreover, we found that it took 30 days for swimming performance and lipid levels to recover. These results indicate that the costs of growth are prolonged and a new life history theory that accounts for prolonged costs is needed.

Perez-Alegría, L. R., University of Puerto Rico, Mayaguez, Puerto Rico, luis.perez1@upr.edu
Sotomayor, D., University of Puerto Rico, Mayaguez, Puerto Rico, dsotomayor@upr.edu
Martínez, G., University of Puerto Rico, Mayaguez, Puerto Rico, tovomarti@hotmail.com
Villalta, C., Polytechnical University, San Juan, Puerto Rico, chirianvillalta@gmail.com
Suarez, G., Menar & Associates, Carolina, Puerto Rico, gsuarez@hotmail.com

MODELLING NUTRIENT AND SEDIMENT EXPORT FROM A TROPICAL WATERSHED TO MARINE ECOSYSTEMS IN THE CARIBBEAN

The status of management of terrestrial ecosystems is a predictor or the health of the surrounding marine ecosystems especially in isolated island settings where influence from continental masses are negligible or, in some instances, easily detectable. The present study reports findings of continuous hydrologic simulation modeling of the Rio Grande de Arecibo watershed, one of the largest watersheds in Puerto Rico (450 km²), looking specifically at quantifying its potential for exporting nutrients (total nitrogen and total phosphorous) and sediments to lake Dos Bocas, the largest potable water supply in the island. To understand the mechanisms for nutrient and sediments a HSFP continuous simulation model was assembled, calibrated and validated from Oct’95 to Sept’01. Extreme events were monitored at four sub-watersheds using automatic samplers-flow meters. Results from study suggest that although agriculture is a small percentage of landuse (6.9%) is responsible for nearly 48% of sediment yield (9.2 ton/ha-yr) and forest cover (67%, 6%) for 0.12 ton/ha-yr. Barren land, however, supplies 205 ton/ha-yr, two and three orders of magnitude over ag and forest lands. Similar findings for nutrients.

Pérez-Pérez, N. M., University of Puerto Rico at Humacao, Humacao, Puerto Rico, nivetite.perez@upr.edu
Franquí, R., University of Puerto Rico at Humacao, Humacao, Puerto Rico
Sánchez, J., University of Puerto Rico at Humacao, Humacao, Puerto Rico
Rodríguez, C. J., University of Puerto Rico at Humacao, Humacao, Puerto Rico
Santiago, S., University of Puerto Rico at Humacao, Humacao, Puerto Rico
Vázquez, E., University of Puerto Rico at Humacao, Humacao, Puerto Rico
García, C. I., University of Puerto Rico at Humacao, Humacao, Puerto Rico, cedarc.iu@gmail.com

MOLECULAR PHYLOGENY OF CHITONS (MOLLUSCA: POLYPLACOPHORA) OF THE GENUS CHITON IN THE CARIBBEAN

The evolutionary relationships among four Caribbean species representing the genus Chiton were examined using sequences of mitochondrial (mt) DNA from the cytochrome oxidase subunit I gene (CO1). Using morphological data the genus Chiton Linné, 1758 is divided (in the Caribbean) by two subgenera: Chiton Linné s.s. with C. tuberculatus and Dichelotiton Thiele, 1893 with C. squamosus, C. marmoratus and C. viridis. We want to test the traditional classification with the molecular data within this genus. Our preliminary results suggest that C. viridis and C. trade-offs can not be separated in different subgenera. We determine the variability of the CO1 gene between distant populations of C. tuberculatus in Puerto Rico, and the genetic
distance between samples of this species in other Caribbean countries. This data is important to establish the level of isolation of the populations in different islands in the Caribbean region. Many authors propose intraspecific COI divergence values around 1-2% and upper values to separate species. We found divergences greater than 5% between samples of C. tuberculosis from Puerto Rico and Bonaire.

Pérez-Rodriguez, J. M., Rutgers University, New Brunswick, USA, jipererez@eden.rutgers.edu
Ricci, J., Rutgers University, New Brunswick, USA
Bini, E., Rutgers University, New Brunswick, USA
Starovoytov, V., Rutgers University, New Brunswick, USA
Vetriani, C., Rutgers University, New Brunswick, USA, vetriani@ims.rutgers.edu

AI-2 MEDIATED QUORUM SENSING IN ANAEROBIC CHEMOSYNTHETIC EPSILONPROTEOBACTERIA FROM DEEP-SEA HYDROTHERMAL VENTS

In most environments, including deep-sea vents, bacteria form multi-species biofilms, suggesting that community living is critical for their ecology and evolution. Direct observation of vent microbial communities suggests that biofilm formation is necessary for colonization, controlling electrochemical microgradients and harnessing geochemical energy. Although no single mechanism is known for biofilm establishment, many species use quorum-sensing (QS) to regulate the expression of attachment, motility and EPS production genes. QS mechanisms rely on cell density and the production of extracellular signals for cell-cell communication. One such QS signal is the autoinducer-2, whose precursor is synthesized by LuxS. Since chemosynthetic Epsilonproteobacteria are one of the most represented groups at the vents, we are using C. mediterranei, as a model to investigate QS. We have identified and detected luxS transcripts in C. mediterranei during growth, and we have demonstrated that these luxS-expressing cultures induce bioluminescence, a QS response, in a Vibrio harveyi reporter strain. We have also detected luxS transcripts in situ, indicating that QS-mediated regulation is likely occurring in natural vent biofilms. Our data suggests that vent Epsilonproteobacteria use the luxS/AI-2 system for cell-cell communication.

Perga, M. E., INRA CARTEL, THONON, France, perga@thonon.inra.fr
Jacob, J., ISTO, Orleans, France
Jenny, J. P., Edytem, Le Bourget du Lac, France
Pignol, C., Edytem, Le Bourget du Lac, France
Reyss, J. L., LRM, Modane, France
Arnaud, F., Edytem, Le Bourget du Lac, France

CHANGES IN THE ORIGINS OF CARBON SUSTAINING THE PELAGIC FOOD CHAIN DURING A CENTURY OF HUMAN PERTURBATIONS ON TWO DEEP SUB-ALPINE LAKES

Any perturbation of aquatic ecosystems that affects the quantity and quality of the phytoplankton, and thus the food resource available for primary consumers, might drive subsequent changes in carbon cycling within the food webs. For instance, shifts in lake nutrient regimes (eutrophication and subsequent re-oligotrophication) have caused long-term responses of the abundance and taxonomic composition of lake primary producers. Such changes at the first level of the food chain are expected to result in modified contributions of the autochthonous- versus terrestrial-derived organic matter in sustaining the lake secondary production, although such an hypothesis cannot be straightforwardly investigated with current tools in stable isotope analyses over long time scales. Through a paleolimnological approach combining stable isotope analyses on sub-fossil zooplankton remains and specific lipids, this study attempts to document multi-decadal changes in the origins of C-fluxing the pelagic food web of two French sub-alpine lakes that have undergone eutrophication and partial re-oligotrophication over the last 100 years.

Peri, E., University of Massachusetts Boston, Boston, USA, francesco.peri@umb.edu
Jiang, M., University of Massachusetts Boston, Boston, USA, mingshun.jiang@umb.edu
Zhou, M., University of Massachusetts Boston, Boston, USA, meng.zhou@umb.edu
Chen, R. F., University of Massachusetts Boston, Boston, USA, bob.chen@umb.edu

A REAL-TIME SEA-LEVEL MONITORING NETWORK FOR MASSACHUSETTS BAY

A major threat to coastal populations is storm and wave damage which may be increasing with climate-change-induced sea-level rise. Therefore, the Center for Coastal Environmental Sensing Networks (CESN) has developed a new, inexpensive sea-level sensor, and is integrating it into a network of sea level gauges for Massachusetts Bay that leverages existing infrastructure, integrates new and old monitoring stations and provides real-time data through the use of Web 2.0 standards. CESN has partnered with NOAA National Weather Service and the Gulf of Maine Ocean Observation System (GoMOOS) in this effort. The installation of new tide gauges directly benefits local communities by providing stakeholders with real-time measurement of sea-level to accurately assess and groundtruth predictive models of sea-level. In addition, the real-time sea-level data can be integrated with networks of environmental monitoring sensors and can increase the accuracy of numerical models provide decision makers with real-time and predictive tools. We will describe the current status of the project with particular emphasis on the integration of real-time sea-level data into the Massachusetts Bay Hydrodynamic Model and the IOOS Cyberinfrastructure.

Peretti, C. T., Scripps Institution of Oceanography, La Jolla, USA, cperetti@ucsd.edu
Munch, S. B., Stony Brook University, Stony Brook, USA, smunch@notes.cc.sunysb.edu

AN EVALUATION OF ECOLOGICAL PHASE SHIFT INDICATORS UNDER REALISTIC CONDITIONS

Forecasting ecological phase shifts is an important challenge due to the devastating effects they can have on ecosystem users. Recent work has generated numerous statistical indicators for the prediction of impending shifts, however, past indicator evaluations have generally been carried out under idealized conditions. Using the three-group fishery model by Biggs et al. (2009), we tested a suite of indicators under the ecologically realistic conditions of high, correlated noise with short time series and a rapidly changing driving variable. We found that all indicators perform poorly under realistic conditions with the exception of the variance indicator. In contrast to expectations from previous work, the noise spectrum does not have a strong effect on indicator performance. The amount of data used to calculate the indicator had a large impact on performance and the value of the spectral ratio was not a reliable indicator of an impending shift. Future research should focus on techniques that incorporate multiple data sources simultaneously, thus reducing the time needed to detect an impending shift.

Pflister, C. A., University of Chicago, Chicago, USA, cpfister@uchicago.edu
McCoy, S., University of Chicago, Chicago, USA, mccoy@uchicago.edu
Wootton, J. T., University of Chicago, Chicago, USA, twootton@uchicago.edu
Martin, P., University of Chicago, Chicago, USA, pmartin@uchicago.edu
Colman, A., University of Chicago, Chicago, USA, asc25@uchicago.edu
Archer, d., University of Chicago, Chicago, USA, d-archer@uchicago.edu

A RECORD OF CARBON CYCLE CHANGE IN MODERN AND ANCIENT CALIFORNIA MUSSELS FROM THE NORTHEAST PACIFIC

The northeast Pacific shows declines in δ13C that are greater than expected based on models of atmospheric CO2 and ocean exchange. We asked whether a dominant and ecologically important shelled species, the California mussel (Mytilus californianus), shows changes in isotopic chemistry that indicate changes to ocean carbon cycle or other environmental parameters. We analyzed shell material within annual growth bands of mussels that grew coincident with temporally-intensive pH sampling on Tatoosh Island, WA (since 2000), that were in archived collections (1960s-1990s), and that were found in native American middens (1010 to 1340 bp). Modern shells exhibited an inverse relationship between δ18O and the Pacific Decadal Oscillation. The δ13C in modern shells declined as upwelling and atmospheric CO2 increased and pH declined. Archival shells did not exhibit the high rate of decline of δ13C seen in modern shells, which was 2.5 times greater than expected based on atmospheric CO2 levels. Incorporating changes in upwelling regime, inferred from multiple data sources, also does not recapture the observed rate of δ13C decline. We conclude that a more expansive set of mechanisms is impacting carbon cycle changes at this site, and discuss alternative hypotheses, such as alterations to the nearshore food web that could be involved in these trends.

Phan, S., Columbia University, New York, USA, dn.susanphan@gmail.com
Subramaniam, A., LDEO/Columbia University, New York, USA, alt@ldeo.columbia.edu

REMOTE SENSING OF SEDIMENT CONCENTRATION IN THE HUDSON RIVER USING MODIS/AQUA LAND BANDS

With daily, near-global coverage dating back to 2002, high resolution data from the Moderate Resolution Imaging Spectroradiometer (MODIS) Aqua satellite is a useful tool to study long-term trends in the sediment load of rivers around the world. We developed and tested a combination of numeric and statistical filtering criteria in order to use daily reflectance data from MODIS/Aqua 250-m resolution bands to...
construct long-term time series of sediment load in the Hudson River. The filters were used to remove interference due to physical sources such as clouds, land contamination, high view angle, or varying sun angles and to select for the appropriate pixels to be used in constructing a robust time series. A very strong correlation was found between reflectance data filtered for all five criteria and in situ measurements taken concurrently with satellite overpass ($R^2=0.93$), and a moderate correlation was found between reflectance and daily averaged in situ sediment data ($R^2=0.59$). The five criteria are all simple numerical or statistical filters that can be tested and applied on satellite data from other rivers around the globe.

Phillips, P. J., US Geological Survey, Troy, USA, piphilli@usgs.gov

Kolpin, D. W., US Geological Survey, Iowa City, USA

Buxton, H. T., US Geological Survey, Trenton, USA

PHARMACEUTICAL FORMULATION FACILITIES AS SOURCES OF PHAR- MACEUTICALS TO WASTEWATER TREATMENT PLANTS

Facilities involved in the manufacture of pharmaceutical products are an under-investigated source of pharmaceuticals to the environment. Between 2004 and 2009, 35 to 38 effluent samples were collected from each of three wastewater treatment plants (WWTPs) in New York and analyzed for seven pharmaceuticals including opioids and muscle relaxants. Two WWTPs (NY2 and NY3) receive substantial flow (>20% of plant flow) from pharmaceutical formulation facilities (PFF) and one (NY1) receives no PFF flow. Samples from NY1 WWTP across the United States were analyzed once for these pharmaceuticals as part of a national survey. Maximum pharmaceutical effluent concentrations for the national survey and NY1 effluent samples were generally <1 μg/L. Four pharmaceuticals (methadone, oxycodone, butalbital, and metaxalone) in samples of NY3 effluent had median concentrations ranging from 3.4 to ~600 μg/L. Maximum concentrations of oxycodone (1700 μg/L) and metaxalone (3800 μg/L) in samples from NY3 effluent exceeded 1000 μg/L. Three pharmaceuticals (butalbital, carisoprodol, and oxycodone) in samples of NY2 effluent had median concentrations ranging from 2 to 11 μg/L. These findings suggest that current manufacturing practices at these PFFs can result in pharmaceutical concentrations from 10 to 1000 times higher than those typically found in WWTP effluents.

Phillips, V. J., University of Regina, Regina, Canada, phillips.vanessa@gmail.com

Ziegler, J., University of Regina, Regina, Canada, ziegljac@uregina.ca

Leavitt, P. R., University of Regina, Regina, Canada, peter.leavitt@uregina.ca

TRANSPORT AND DEGRADATION OF UREA THROUGH A LOTIC SYSTEM IN THE NORTHERN GREAT PLAINS: IMPLICATIONS FOR DOWNSTREAM WATER QUALITY

Urea is the most popular N-fertilizer used in the world. Recent experimental studies in the northern Great Plains have shown that direct application of urea can degrade water quality in P-rich systems. However, little is known about the transport and degradation processes that control the export of urea from the landscape to receiving freshwaters. To evaluate whether urea from land is exported by lotic systems to lakes, we surveyed a ~225 km reach of a headwater stream to a receiving lake in central Saskatchewan, and conducted in situ experiments to estimate how urea degraded under diverse environmental conditions. Analyses reveal that while urea is degraded substantially during transport, export of terrestrial sources to lakes was regulated mainly by river discharge. In addition, point source influence was apparent only during low flow regimes. Ultimately, urea produced through urban and agricultural activities is transported effectively to downstream lakes, where it can degrade water quality.

Piehler, M. F., UNC Chapel Hill, Institute of Marine Sciences, Morehead City, USA, piehler@unc.edu

Schwartz, R., University of South Carolina, Baruch Marine Field Laboratory, Georgetown, USA, besc.squash@gmail.com

Thompson, S. P., UNC Chapel Hill, Institute of Marine Sciences, Morehead City, USA, sthompson@email.unc.edu

Brush, M. J., Virginia Institute of Marine Science, Gloucester Point, USA, brush@vims.edu

LAND USE AFFECTS COASTAL STREAM DISCHARGE AND LOADING OF NUTRIENTS AND SUSPENDED SOLIDS

Streams transport landscape-derived materials to receiving waters. Watersheds with high levels of development have been shown to export more nutrients and sediments, which in excess are pollutants. Coastal streams have received more attention recently, but still have not been studied to the extent that upland streams do. Eight coastal streams in the New River Estuary, NC, USA were assessed for two years, during which flow was measured continuously and water samples were collected during base- and throughout storm-flow. Water samples were analyzed for nutrient (nitrate, ammonium, total nitrogen, phosphate, dissolved organic nitrogen) and total suspended solid (TSS) concentrations. Land cover was quantified using the 2001 National Land Cover Database. More developed watersheds had increased freshwater discharge and load of some constituents (nitrate, ammonium, TSS) and increased importance of storm versus base flow delivery. Despite the relatively low intensity of development in our watersheds, relationships of development to magnitude and timing of transport material were documented. A comprehensive understanding of how watershed characteristics and climatic parameters influence material delivery is requisite for sound decision making regarding coastal land use.

Piepho, M., University of Potsdam, Potsdam, Germany, piepho@uni-potsdam.de

Martin-Creuzburg, D., University of Constance, Konstanz, Germany, Dominik.martin-creuzburg@uni-konstanz.de

Wacker, A., University of Potsdam, Potsdam, Germany, wackera@uni-potsdam.de

SIMULTANEOUS EFFECTS OF LIGHT INTENSITY AND PHOSPHORUS SUPPLY ON THE STEROL CONTENT OF PHYTOPLANKTON

Sterol profiles of microalgae and their change with environmental conditions are of great interest in ecological food web research and taxonomic studies alike. Here, we investigated effects of light intensity and phosphorus supply on the sterol content of freshwater phytoplankton and assessed potential interactive effects of these important environmental factors on the sterol composition of algae. We identified sterol contents of four common phytoplankton genera, Scenedesmus, Chlamydomonas, Cryptomonas and Cyclotella, and analysed the change in sterol content with varying light intensities in both a high-phosphorus and a low-phosphorus approach. Sterol contents increased significantly with increasing light in three out of four species. Phosphorus-limitation reversed the change of sterol content with light intensity, i.e. sterol content decreased with increasing light at low phosphorus supply. Generally sterol contents were lower in low-phosphorus cultures. Data suggest a possible sterol limitation of growth and reproduction of herbivorous crustacean zooplankton during summer when high light intensities and low phosphorus supply decrease sterol contents of algae.

Pierson, J. L., UMCES, Cambridge, USA, jpierson@umces.edu

Roman, M., UMCES, Cambridge, USA, roman@umces.edu

Stoecker, D., UMCES, Cambridge, USA, stoecker@umces.edu

Houde, E., UMCES, Cambridge, USA, houde@umces.edu

Decker, M., Yale, New Haven, USA, marybeth.decker@yale.edu

Elliott, D., UMCES, Cambridge, USA, delliott@umces.edu

Barba, A., UMCES, Cambridge, USA, abarba@umces.edu

Liu, K., UMCES, Cambridge, USA, kliu@umces.edu

DIFFERENTIATING THE IMPACTS OF HYPOXIA ON COPEPODS FROM FOOD WEB EFFECTS IN CHESAPEAKE BAY

Hyoxia (dissolved oxygen <2 mg L$^{-1}$) is prevalent in the mesohaline portion of the Chesapeake Bay each summer, with lower oxygen concentrations generally found further north. We sampled two stations, one hypoxic (treatment) and one normoxic (control), in May, August, and September 2010. We examined the fitness and behavior of copepods in varying hypoxic and environmental conditions, but under similar temperature and salinity regimes on each cruise. In May, hypoxia was established at our treatment but not the control station; we found large numbers of bay anchovy eggs and A. tonsa copepods. By August the treatment station was anoxic and sulfidic while the control station had normoxic bottom water, and there were large numbers of gelatinous zooplankton and larger bay anchovy larvae, but A. tonsa were scarce. In September hypoxia was retreating and both stations were well mixed and A. tonsa were abundant. Vertically stratified net tows, samples from Niskin bottles, and hydrographic data, as well as experimental data show how zooplankton populations and individuals respond to varying hypoxic conditions and pelagic communities.

Piil, K., Aarhus University, Aarhus, Denmark, kristoffer.piil@biology.au.dk

Carlsten, D. H., Aarhus University, Aarhus, Denmark

Niggemann, J., Aarhus university, Aarhus, Denmark

Lomstein, B. A., Aarhus University, Aarhus, Denmark, bente.lomstein@biology.au.dk

FATE OF ACIDIC AMINES AND AMINO SUGARS IN BLACK SEA SEDIMENTS

The spatial and down-core distribution of bacteria and organic matter compositional changes were investigated at five sites with contrasting water depth in the Black Sea. The objective of the present study was to investigate how bacterial activity shaped...
the composition of organic matter during diagenesis. This was done by estimating the contribution of unique bacterial biomolecules (D-amino acids and muramic acid) from enumerated DNA-stainable bacterial cells to the respective measured concentrations. The diagenetic status of the sediment was evaluated from decreases in the contribution of amino acid carbon to total organic carbon and the production of non-protein amino acids from their protein precursors. The permanently anoxic Black Sea offers a unique possibility to study diagenetic changes that are purely due to microbial activity.

Pimentel, M., Laboratório Marítimo da Guia, Faculdade de Ciências da Universidade de Lisboa, Cascais, Portugal, marta.pimentel@fc.ul.pt
Repolho, T., Laboratório Marítimo da Guia, Faculdade de Ciências da Universidade de Lisboa, Cascais, Portugal, biotiago@yahoo.com
Narciso, L., Laboratório Marítimo da Guia, Faculdade de Ciências da Universidade de Lisboa, Cascais, Portugal, lfnarciso@fc.ul.pt
Rosa, R., Laboratório Marítimo da Guia, Faculdade de Ciências da Universidade de Lisboa, Cascais, Portugal, rosa@fc.ul.pt

PHENOTYPIC THERMAL ACCLIMATIZATION AND SEA URCHIN REPRODUCTION IN AN OCEAN WARMING CONTEXT

In the last decades, an increasing coastal warming trend has been observed in western coast of Portugal (2.7°C century⁻¹) and additional warming (3°C) is expected in the coming century. Warming is predicted to dictate profound impacts on life-history biology and early ontogenetic stages are believed to be the most vulnerable to ocean change within a life cycle. To determine the influence of parental (phenotypic) thermal acclimatization on reproduction in a realistic ocean warming scenario, we exposed adult sea urchins, Paracentrotus lividus, to long-term (3 months) acclimation at present (18°C) and future temperatures (21°C). The impact of environmental warming in fertilization rates and in early ontogeny, namely: i) cleavage and gastrulation, ii) larval growth, survival and malformation rates (from 4- to 8-armed plateus) and iii) metamorphosis is discussed.

Pirtle-Levy, R., North Carolina State University, Raleigh, USA, rspirtle@ncsu.edu
Thomas, C. J., North Carolina State University, Raleigh, USA, cthomas@ncsu.edu
Belicka, L. L., Florida International University, Miami, USA, lbelicka@fiu.edu
Jaffe, R., Florida International University, Miami, USA, jaffe@fiu.edu
DeMaster, D. J., North Carolina State University, Raleigh, USA, demaster@ncsu.edu

TROPHIC ECOLOGY OF ANTARCTIC BENTHIC MEGAFAGNA: A LIPID BIOMARKER APPROACH

Fatty acid biomarkers were used to examine the diet of dominant benthic megafauna along a latitudinal gradient (63°S-68°S) on the deep (500-600m) continental shelf of the western Antarctic Peninsula as part of the project FOODBANC52. Samples of surface plankton, surface sediment, and body wall tissue from two dominant holothurian species (Protobolida sp. and Molpadia sp.) were collected during July 2008 (winter) and February-March 2009 (summer) to assess biochemical responses of season or location. Bacterial markers (branched-chain 15:0 and 17:0) present in all sample types suggesting a source of labile POM to the benthos regardless of season or location. Bacterial markers (branched-chain 15:0 and 17:0) present in surface sediment and holothurian tissue suggest bacterial reworking might be an important factor in the trophic ecology of benthic deposit-feeders. The prevalence of diatom and bacterial markers is consistent with the presence of a year-round “food bank” for benthic deposit-feeders.

Pitt, K. A., Griffith University, Gold Coast, Australia, k.pitt@griffith.edu.au
Rissik, D., Griffith University, Gold Coast, Australia, D.Rissik@griffith.edu.au
Arthur, M., Griffith University, Gold Coast, Australia
Warnken, J., Griffith University, Gold Coast, Australia, k.pitt@griffith.edu.au

IDENTIFYING THE DRIVERS OF JELLYFISH BLOOMS IN SOUTHEAST QUEENSLAND, AUSTRALIA

Identifying the drivers of jellyfish blooms is a major challenge. In subtropical, south-east Queensland, Australia, the rhizostome medusa, Catostylus mosaicus, often forms spectacular blooms. Since 2002, the Queensland government’s Ecosystem Health Monitoring Program has recorded monthly the presence or absence of C. mosaicus concurrently with numerous water quality parameters at 250 coastal and estuarine locations throughout southeast Queensland. Water parameters measured include temperature, salinity, nutrients, chlorophyll a, dissolved oxygen saturation, and turbidity. More than 24,000 observations are now available. We used logistic regressions to try to identify the drivers of jellyfish occurrence. Although statistically significant, the ability of the models to predict the inter-annual occurrence of C. mosaicus was poor. In years when jellyfish were present, however, wind-driven currents were the major determinants of spatial patterns of distribution.

Plant, J. N., Monterey Bay Aquarium Research Institute, Moss Landing, USA, jplante@mbari.org
Johnson, K. S., Monterey Bay Aquarium Research Institute, Moss Landing, USA, johnson@mbari.org
Riser, S. C., University of Washington, Seattle, USA, riser@ocean.washington.edu
Swift, D., University of Washington, Seattle, USA, swift@ocean.washington.edu
Coletti, L. J., Monterey Bay Aquarium Research Institute, Moss Landing, USA, coletti@mbari.org
Sakamoto, C. M., Monterey Bay Aquarium Research Institute, Moss Landing, USA, saca@mbari.org
Jannasch, J. W., Monterey Bay Aquarium Research Institute, Moss Landing, USA, jaha@mbari.org

PRODUCTIVITY AT PAPA: TWO YEARS OF DATA FROM BIOLOGICAL SENSORS ON PROFILING FLOATS IN THE NORTHEAST PACIFIC

Two Apex profiling floats, deployed near Ocean Station Papa in the Gulf of Alaska, have been profiling these high nutrient low chlorophyll waters (HNLC) to 1000 meters once every 5 days for 2.4 and 0.6 years. These floats have remained within a 1 x 3 degree latitude x longitude box during their deployments. In addition to a CTD package, both floats are equipped with nitrate and oxygen sensors, and the newer float also records chlorophyll fluorescence and optical backscatter. The nitrate and oxygen sensor data are used to determine the net community production rates and carbon export over depth and time by combining the sensor data with a one-dimensional mixed layer model that is initialized with each density profile and driven by 6-hourly meteorological forcing. This allows changes in chemical concentration due to biology and physics to be separated. The results yield an improved understanding of rates and variability for nutrient supply, productivity, remineralization and biomass in these HNLC waters.

Plum, C. T., University of Oldenburg/ICRM, Wilhelmshaven, Germany, christoph.plum@uni-oldenburg.de
Hillebrand, H., University of Oldenburg/ICRM, Wilhelmshaven, Germany
THE IMPORTANCE OF RESOURCE LIMITATION AND DIVERSITY IN STOICHIOMETRIC INTERACTIONS

Despite the progress made in explaining the stoichiometric interplay between consumers and resources, it remains unclear whether consumer or producer diversity influences the effects of material imbalances in trophic interactions. To test the hypothesis that the number of species in a trophic group alters the nutrient dynamics in a pelagic community, we conducted a laboratory experiment under a semi-continuous regime with species of marine phytoplankton and zooplankton. We first tested the effect of resource supply and producer diversity on the stoichiometry of the interaction between phyto- and zooplankton. According to our expectations, decreased light intensity and nitrogen supply led to lower phytoplankton biomass and abundance compared to non-limited cultures. However, these effects of limitation varied between the different algae species. Copepod biomass was significantly higher feeding on +N monocultures while grazing rates were higher with -N high light food, indicating compensation for poor food quality. Compared to single species, copepod biomass increased significantly when feeding on mixed algae cultures under light and nitrogen limitation. Our results indicate that stoichiometric constraints of trophic interactions are mediated by producer diversity.

Pohnert, G., Friedrich Schiller University, Jena, Germany, Georg.Pohnert@uni-jena.de
Vidoudez, C., Friedrich Schiller University, Jena, Germany, charles.vidoudez@uni-jena.de
Paul, C., Friedrich Schiller University, Jena, Germany, Carsten.paul@uni-jena.de
Spielmeyer, A., Friedrich Schiller University, Jena, Germany, Astrid.Spielmeyer@uni-jena.de
Prince, E., Paine University, Paine, USA, eprince@paine.edu
Barofsky, A., Friedrich Schiller University, Jena, Germany, Alexandra.barofsky@uni-jena.de
CHEMICAL INTERACTIONS OF PLANKTONIC ALGAE WITH THEIR ENVIRONMENT: HIGH VARIABILITY REVEALED BY METABOLOMICS AND BIOASSAYS

It is well established that unicellular algae from the plankton have established significant space and time variability, with significant spatial differences and complex interrelations in the northern Arabian Gulf (Kuwait) and the southern part of the Arabian Gulf (Kuwait Bay). This study focused on the variation, with significant spatial differences and complex interrelations in the Arabian Gulf. The bio-optical characteristic of the Kuwait's waters (North-Western part of the Arabian Gulf) was studied for the first time during 2005-2009, including in situ measurement of ocean color radiance. High values of chlorophyll and total suspended matter concentrations have been previously reported for these waters, associated with phytoplankton abundance and re-suspension of bottom sediments. The AOP and IOP of Kuwait's waters displayed a pronounced, but irregular seasonal and inter-annual variation, with significant spatial differences and complex interrelations in the northern Arabian Gulf, especially in Kuwait Bay. The main regional distinction between the northern waters compared to the southery area is the sharp differences in the total attenuation and absorption as well as remote sensing reflectance. Approaches to the local OCR algorithm development for the territorial waters of Kuwait are discussed.

Popp, B. N., University of Hawaii, Honolulu, USA
Bradley, C. J., University of Hawaii, Honolulu, USA
Longenecker, K. R., Bishop Museum, Honolulu, USA
Langston, R., Windward Community College, Honolulu, USA
Pyle, R., Bishop Museum, Honolulu, USA
Comparisons of the Trophic Structure of Reef Fishes
Differences in the trophic dynamics of fish communities found on deep and shallow reef ecosystems were investigated using bulk tissue and individual amino acid stable isotopic compositions. Reef fishes were collected from approximately 100m in a mesophotic coral ecosystem in the Aiu channel between the Hawaiian Islands of Maui and Lanai as well as on shallow water (10-30m) reef ecosystems off the south coast of Maui. Compound-specific isotopic analysis of amino acids is a new technique that avoids many of the short-comings of traditional bulk stable isotope analyses. We are using differences in the nitrogen isotopic compositions of glutamic acid and phenylalanine to calculate the trophic position of reef fishes and the bulk isotopic compositions to compare sources of carbon and nitrogen to the ecosystem. Although gross trophic structure appears similar between deep- and shallow-water ecosystems, higher-resolution dietary analysis using compound-specific isotopic analysis of amino acids suggests there is unexpected low overlap among many co-existing species. The implications of these results for the use of mesophotic coral ecosystems as refugia for fishes will be discussed.

Porter, J. W., University of Georgia, Athens, USA
Meyers, M. K., University of Georgia, Athens, USA
Lipp, E. K., University of Georgia, Athens, USA
Joyner, J., University of Georgia, Athens, USA
Park, A., University of Georgia, Athens, USA
Wares, J., University of Georgia, Athens, USA
Sutherland, K. P., Rollins College, Winter Park, USA
Ruzicka, R., Florida Fish & Wildlife, St. Petersburg, USA
Semon, K., Florida Fish & Wildlife, St. Petersburg, USA
THE 2009 WHITE POX OUTBREAK AND RECOVERY AMONG ELKHORN CORAL IN THE FLORIDA KEYS

In epidemiological investigations, it is unusual to observe the development, spread, and recovery from a zoonotic on a previously marked host population. Such an opportunity occurred during the 2008-2009 white pox outbreak (acroporid serratiosis) among Acropora palamata colonies on Looe Key Reef in the Florida Keys. White pox signs were absent from all survey locations in June, 2008. However, by June, 2009, 44% of Looe Key elkhorn colonies exhibited white pox signs. Disease prevalence increased to 60% by August, 2009, but began falling thereafter to 38% in September. By November, no active signs of the disease existed within the surveyed population on Looe Key. Partial, but not whole-colony mortality occurred. These data, demonstrating rapid recovery from white pox, are in striking contrast to previous assessments of this disease (Porter et al., 2001). Substantial recovery from this zoonotic could be interpreted as evidence for the acquisition of resistance to white pox by Florida Keys elkhorn corals, as a decrease in virulence in the disease itself, or as a combination of both.

Porter, E. F., University of California, Berkeley, USA
Goni, M. A., Oregon State University, Corvallis, USA
Moore, E., Boston University, Boston, USA
Kurtz, A., Boston University, Boston, USA
SOURCES AND DISTRIBUTION OF ORGANIC MATTER SEQUESTERED IN FLOODPLAIN SEDIMENTS FROM THE FLY RIVER, PAPUA NEW GUINEA

The Fly River fluvial system in Papua New Guinea contributes a significant portion of the global organic matter (OM) flux into the marine environment. This OM flux is potentially altered by an extensive system of floodplains where fluvial-derived organic materials can a) accumulate and be stabilized, b) undergo degradation and modification and c) be amended by inputs from floodplain vegetation. We used a combined elemental, isotopic and biomarker approach to characterize the sources and composition of OM deposited along the Fly River floodplain. Alkaline cupric oxide oxidation was performed and characteristic products were quantified using gas chromatography-mass spectrometry. The results suggest that floodplain OM is a heterogeneous combination of allochthonous soil materials originating from the uplands and autochthonous angiosperm plant detritus. The input of organic matter from woody and non-woody angiosperm sources demonstrates the incorporation of surrounding grassland and forest vegetation. Except for high-elevation areas within the floodplain boundary above the level of maximum inundation, analysis of down-core sediments indicates the active sequestration of OM in the floodplain.

Posch, T., University of Zurich / Limnological Station, Kilchberg, Switzerland
Perthaler, J., University of Zurich / Limnological Station, Kilchberg, Switzerland
Salcher, M. M., University of Zurich / Limnological Station, Kilchberg, Switzerland
WARMING PREVENTS HOLOMIXIS AND THUS FAVOURS PERSISTENT BLOOMS OF THE TOXIC CYANOBACTERIUM PLANKTOThRIX SPP. – LONG-TERM DATA (40 YEARS) OF LAKE ZURICH

Lake Zurich (Switzerland) is a large, deep (130m) mesotrophic lake in a densely populated region. It serves as the major source of drinking water for >1.5 million people. In the past, the toxic cyanobacterium P. rheasens has shown recurrent mass development during autumn and winter, first described already for the year 1897. However, its growth depends on stable stratification of the water column and mixed events. Partial mixing of the upper water body (down to 40m) occurs in autumn, whereas holomixis usually takes place in early spring (March or April). During the last three decades increasing air-temperatures have caused a gradual warming of epilimnetic water-strata. Consequently, holomixis of the lake is often prevented, thus leading to less transport of the cyanobacterium into the deep hypolimnion, where the population is diminished due to the collapse of gas vesicles. Presently, cyanobacterial biomass in the metalimnion increases already during spring, leading to pronounced blooms throughout the year. Our forty years long-term dataset documents the change in mixes as deduced from oxygen budgets, and it links this phenomenon with cyanobacterial population dynamics.
Potter, J. D. University of New Hampshire, Durham, USA, jody.potter@unh.edu
McDowell, W. H., University of New Hampshire, Durham, USA, bill.mcdowell@unh.edu

PATTERNS OF DISSOLVED ORGANIC CARBON IN A HIGHLY URBANIZED WATERSHED IN PUERTO RICO

Dissolved organic carbon (DOC), nitrogen, and other chemical constituents (Cl, NO$_3$, NH$_4$, DON, & PO$_4$) were quantified in the Rio Piedras, a highly urbanized watershed (up to 80% urban) in the San Juan metro area. Water samples were collected yearly at 40 sites throughout the watershed since 2004. Mean annual DOC and DON concentrations ranged from 1.3 to 10.4 mg C L$^{-1}$ and 0.1 to 1.8 mg N L$^{-1}$, respectively. Preliminary findings indicate that the concentration of DOC, DON, NH$_4$, & PO$_4$ all increased with the fraction of urban land, while NO$_3$ did not. The lack of a relationship between urban land use and NO$_3$ contrasts with patterns in most other regions. The ratio of DOC:Cl and DON:Cl both showed a positive, linear trend with the amount of urban land, while DOC:DON decreased with urbanization. Urbanization has a significant effect on the biogeochemistry of C on this tropical island.

Potter, M. F. University of South Florida, St. Petersburg, USA, mfpotter@mail.usf.edu

Fanning, K. A. University of South Florida, St. Petersburg, USA, kal@marine.usf.edu

AMMONIUM-SILICA RELATIONSHIPS IN ANOXIC WATERS

Monthly nutrient analyses in the eastern Caraíco sub-basin are part of the CA-RIACO time-series program. Analytical methods were adapted from the nutrient protocols of the WOCE WHP project. In 2002-2009, ammonium and silicic acid in anoxic Caraíco-basin waters exhibited a linear relationship, having a least-squares regression with a slope of 0.484 ($r^2 = 0.898$). Interestingly, based on data from a 1988 Knorr study, a similar relationship appears to exist in the Black Sea -- the only other major, permanently anoxic body of seawater -- although the Black Sea least-squares regression has a different slope ($0.386$, $r^2 = 0.997$). Such a linear relationship between inorganic fixed nitrogen and silica does not appear to exist in any oxygenated body of seawater. For example, the Caribbean portion of the WOCE A22 line shows a decidedly curvilinear distribution of points in a plot of [nitrate + nitrite] against silica. The Caraíco ammonium-silica relationship has been analyzed on a month-by-month basis between 2002 and 2009 and has not changed in that entire time. The nature of the relationship is still a subject of on-going research.

Potter, T. L., USDA-Agricultural Research Service, Tifton, USA, tom.potter@ars.usda.gov

Bosch, D. D., USDA-Agricultural Research Service, Tifton, USA, david.bosch@ars.usda.gov

Diepaa, A., Jobos Bay National Estuarine Research Reserve, Aguirire, Puerto Rico, adepaa@drra.gobierno.pr

Sotomayor, D., University of Puerto Rico, Mayaguez, Puerto Rico, dsotomayor@uprm.edu

Ardila, G., University of Puerto Rico, Mayaguez, Puerto Rico, gerson.ardila@upr.edu

Vega, J., University of Puerto Rico, Mayaguez, Puerto Rico, jacqueline.vega@upr.edu

Strickland, T. C., USDA-Agricultural Research Service, Tifton, USA, tim.strickland@ars.usda.gov

Hubbard, R. R., USDA-Agricultural Research Service, Tifton, Bob.hubbard@ars.usda.gov

Lowrance, R. R., USDA-Agricultural Research Service, Tifton, USA, Richard.Lowrance@ars.usda.gov

PESTICIDE FATE AND TRANSPORT FROM FARM FIELDS ADJACENT TO THE JOBOS BAY NATIONAL ESTUARINE RESEARCH RESERVE

Agriculture is a primary land-use in the Jobos Bay National Estuarine Research Reserve (JBNERR) watershed located on Puerto Rico’s southeast coast. Crop production in near-shore areas depends on pesticides for weed, disease and insect control. There are continuing concerns about their potential for adverse ecotoxicological impact on the Bay and bordering wetland habitats. Over the past three years we have evaluated pesticide fate and transport from a farm field adjacent to JBNERR’s Mar Negro mangrove forest region. Active ingredients and selected degradates of products used for silage production were monitored in shallow groundwater, drainage ditches, and estuarine waters. Residues, levels detected, and their timing indicated that surface water drainage associated with tropical storm events is a primary pathway for pesticide residue transport. Companion studies showed that loading of a frequently used product, atrazine, to Mar Negro and the Bay was likely reduced due to very rapid degradation in cropped soil. We conclude that mitigation measures, including storm water detention and treatment, and improved pest management practices are needed to protect Mar Negro and other critical JBNERR habitats.

Poudel, S., Umass, Boston, USA, sujii82@yahoo.com

Harris, J. L., Arkansas State University, Arkansas, USA, omilbob@ast.com

Christian, A. D., Umass, Boston, USA, Alan.Christian@umb.edu

Tenenbaum, D., Umass, Boston, USA, david.tenenbaum@umb.edu

COMMUNITY CLASSIFICATION AND DISTRIBUTION PATTERNS OF FRESHWATER MUSSELS OF STRAWBERRY RIVER, ARKANSAS

The purpose of this study is to determine if there are distinct communities of freshwater mussels in the Strawberry River, Arkansas, and if environmental variables influence these communities. The Strawberry River watershed is located in the Ozark Mountains in northcentral Arkansas. Based on previous studies of interior highland mussels, we expected distinct low, mid, and high order stream mussel communities. Mussels were surveyed from headwaters to mouth and resulted in 38 species from 57 sites. Environmental variables of land cover, geology, soil type, and drainage area were calculated at local and subwatershed scale using GIS. Mussel presence/absence and environmental variables were analyzed using Principle Components Analysis (PCA). Ambilina plicata was the most abundant species, representing 17% of all individuals collected. The cumulative percent of variation explained for PCA axes 1 - 3 for mussels and environmental variables were approximately 40% and 48%, respectively. Contrary to expectations, we did not observe distinct mussel communities. However, some environmental variables (developed open space, cultivated crops and alluvial soil at subwatershed scale and dolostone and alluvium at local scale) were correlated with the mussel PCA pattern.

Poulsen-Ellestad, K. L., Georgia Institute of Technology, Atlanta, USA, kpoulson@gatech.edu

Sieg, R. D., Georgia Institute of Technology, Atlanta, USA, drew.sieg@gatech.edu

Kubaneck, J., Georgia Institute of Technology, Atlanta, USA, jula.kubaneck@biology.gatech.edu

ALLELOPATHY OF A RED TIDE DINOFLAGELLATE HAS CONTEXT-DEPENDENT IMPACTS ON PHYTOPLANKTON

Allelopathy has been hypothesized to play an important role in shaping planktonic communities by affecting competitive outcomes among phytoplankton species. We studied how a variety of ecological conditions affected the efficacy of allelopathic compounds produced by the red tide dinoflagellate, Karenia brevis. To determine how complex ecological conditions respond to K. brevis allelopathy, a natural, mixed plankton assemblage was exposed to allelophatic K. brevis extracts. Although these extracts were allelopathic in lab studies, some taxa were not susceptible to these allelopathic compounds, whereas the growth of other phytoplankton groups was stimulated by extract addition. In lab-based studies, cell physiological state and cell concentration of comparator species were both important in dictating the susceptibility of competitors to allelopathy. We found that the diatom Skeletonema costatum was most susceptible to K. brevis allelopathy when in earlier growth stages (lag stage) rather than later growth stages, demonstrating that K. brevis allelopathy is highly context-dependent. This context-dependency may make it challenging to determine the relative importance of K. brevis allelopathy in natural systems.

Prairie, Y. T., UQAM, Biological sciences, Montreal, Canada, prairie.yves@uqam.ca

del Giorgio, P. A., UQAM, Biological sciences, Montreal, Canada, del_giorgio.paul@uqam.ca

Teodoru, C., UQAM, Biological sciences, Montreal, Canada, teodoru.cristian@courrier.uqam.ca

Tremblay, A., Hydro-Québec, Montreal, Canada, Tremblay.Alain@hydro.qc.ca

Rates of Carbon Mineralization in the Recently Flooded Eastmain-1 Boreal Hydropower Reservoir, Québec.

The 603 km$^2$ Eastmain-1 hydropower reservoir was flooded in late 2005 and has been followed annually to estimate the rates at which the flooded soil carbon is remineralized and emitted at the surface. Pre-flooded terrestrial carbon inventories estimated the flooded carbon pool to average about 25 kg C m$^{-2}$. After the initial very large pulse, carbon dioxide emissions rapidly declined from 830 g C m$^{-2}$ yr$^{-1}$ to less than 230 g C m$^{-2}$ yr$^{-1}$ in the 4th year after flooding. Integration over these initial years suggests that only that only 5-10% of the soil C stock is mineralized over that time period. The long-term fate of this carbon pool will be explored as a function of several projections of the time-course of CO2 emissions. Lastly, we will evaluate the observed GHG of a function of its hydropower generating capacity to adequately compare it to other forms of electricity production.
Prater, C., University of Arkansas, Fayetteville, USA, cpr014@uark.edu
Evans-White, M. A., University of Arkansas, Fayetteville, USA, mevanswh@uark.edu
Norman, E. J., University of Arkansas, Fayetteville, USA, ejn012@uark.edu

IMPACTS OF EUTROPHICATION OF SHREDDING INSECT COMMUNITIES IN OZARK STREAMS

Anthropogenic nutrient enrichment can cause significant positive changes in benthic detrital quality and reductions in quantity, which could alter the community structure of shredding insects that rely on these food resources. Detritus, insect, and water samples were taken from 8 sites in Ozark Highland headwater streams along an increasing total phosphorus (TP) gradient to examine whether detritus quality and reductions in quantity, which could alter the community structure of shredding insects that rely on these food resources. Detritus, insect, and water samples were taken from 8 sites in Ozark Highland headwater streams along an increasing total phosphorus (TP) gradient to examine whether detritus quality and reductions in quantity, which could alter the community structure of shredding insects that rely on these food resources.

Regression analyses indicated that TP enrichment enhanced detrital quality measured as carbon:phosphorus (R^2=0.66, p<0.01) but had no effect on detrital standing stocks (p>0.05). Shredder biomass was negatively related (R^2=0.74, p<0.01) and abundance was positively related (R^2=0.57; p=0.02) to TP. These patterns were driven by decreases in Tipula sp. and increases in Ephemerella sp. and Pycnopside sp., which could be due to dietary stoichiometric constraints of these organisms.

Our study contributes rare information about detrital and insect stoichiometry and biomass simultaneously across a TP gradient and provides further evidence that phosphorus eutrophication may negatively impact shredding insect communities by altering the ecological stoichiometry of detritus-decomposer interactions.

Pratt, P. D., Northrop Grumman Aerospace Systems, Redondo Beach, USA, patty.pratt@ngc.com
Haus, B. L., DKK, Redondo Beach, USA

H-BRDF: A NEW SIMULATION TOOL FOR INVESTIGATING OPTICAL CLOSURE USED IN VALIDATING OCEAN COLOR PRODUCTS

HydroLight-BRDF is an extension of the well known application HydroLight created by Dr. Curtis A. Mobley and Sequoia Scientific Inc. This tool is used by Northrop Grumman to create valid models of the ocean using a wide variety of built-in validation data. The application provides a BRDF for the water-leaving and surface-reflected radiance which can then be coupled to any atmospheric Radiative Transfer Model to ascertain predicted Top-Of-The-Air radiance, TOA radiances. Since the BRDF can also be used in conjunction with the surface irradiance, it can be utilized in validating the performance of the retrieval of ocean color for NPP. Using this tool for Optical Closure, one can compare measurements from satellite and airborne sensors as well as from in-situ instruments for validation. This paper describes the benefits and the methods used in adapting this simulation tool for product validation.

Prechtl, M., Oregon State University REU, Corvallis, USA, prechtlm@oid.orest.edu

IMPACTS OF OCEAN ACIDIFICATION ON THE HATCHING AND EARLY LARVAL DEVELOPMENT OF CALANUS PACIFICUS, CALANUS MARSHALLAE AND EUPHASIA P ACIFICA

Despite their importance to oceanic food webs, little research has been done on the impact of ocean acidification on zooplankton. We investigated effects of ocean acidification on hatching and development of two copepod species, Calanus pacificus and Calanus marshallae, and one species of euphausiid, Euphausia pacifica. Euphausiids and copepods were collected off the coast of Newport, Oregon. Eggs were collected and placed into beakers with mesh bottoms. The beakers were put into tanks of varying pH and samples were preserved after 3 and 8 days (Calanus pacificus was preserved after 5 and 8 days). We found evidence that decreasing pH slows development for all three species under investigation. There were no significant differences in hatching success between the pH treatments, but a larger proportion of larval deformity was observed for all species in the lower pH treatments. However, the effects of pH on development are slight and more data is needed in order to determine the significance of these results. Further investigation of how decreasing pH affects internal development is needed in order to fully study the consequences of ocean acidification.

Price, H. L., University of Wollongong, Wollongong, Australia, hlp995@uow.edu.au
Jolley, D. F., University of Wollongong, Wollongong, Australia, d.jolley@uow.edu.au
Zhang, H., The Lancaster Environment Centre, Lancaster University, Lancaster, United Kingdom, h.zhang@lancaster.ac.uk

A HIGH RESOLUTION STUDY OF ARSENIC, SELENIUM AND PHOSPHATE FLUXES FROM SPIKED MARINE SEDIMENT BY SIMULTANEOUS DEPLOYMENT OF DGT AND DET PROBES

Well established marine sediment mesocosms were spiked at depth with arsenic and selenium, equilibrated for 24-48h, and then analysed by deploying sediment probes; DGT containing ferrhydrite and TiO2 binding layers and a DET probe. Analyte porewater depth distributions were compared to sorption activity of arsenic, phosphate, selenium, manganese, vanadium and uranium on the DGT binding layers. Sharp features were observed in porewater profiles for iron and manganese at depths of ~8cm and ~4cm, the latter aligning with porewater arsenic availability to DGT, and correlated well with published data indicating the two main areas of re-mobilisation. Quantitative DGT measurements of phosphate, arsenic and vanadium, when compared with porewater profiles, suggest re-supply of phosphate from solid phase between depths of ~1-3.5cm with simultaneous depletion of vanadium and arsenic, with arsenic likely precipitated as sulphides or Fe/Mn (oxy)hydroxides in addition to adsorption to biomarker layers. Selenium was not DGT labile. Combined deployments of DGT/DET are able to document the controlling phases for arsenic, phosphate and trace metal release and estimate the flux and re-supply activity of DGT labile analytes.

Prague, R., Lamont-Doherty Earth Observatory-REU, Palisades, USA, rodricoprue@gmail.com
Nitsche, F., Lamont-Doherty Earth Observatory, Palisades, USA, f.nitsche@ldeo.columbia.edu
Kenna, T., Lamont-Doherty Earth Observatory, Palisades, USA, tkenna@ldeo.columbia.edu

DETERMINING THE SEDIMENT BUDGET OF THE LOWER HUDSON RIVER

Sediment is a major component of the Hudson River Estuary, constantly being re-suspended and deposited. A detailed sediment budget is key for management of the estuary including development, optimizing dredging, restoration, and mitigating future sea-level changes. Using industrial seismic interpretation software and X-ray fluorescence spectrometry, we identified the thickness and distribution of 20th century sediment deposition by mapping the sediment layer with elevated levels of anthropogenic lead, which is a characteristic for sediment deposition since 1920/1930. These sediments are of special concern because of high amounts of contaminants that were being introduced into the estuary during this time. By combining analysis of the sediment layer with elevated levels of contaminants that were being introduced into the estuary during this time.
Puigcorbé, V., Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain, vinya.puigcorbe@uab.cat
Masqué, P., Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain, pere.masque@uab.cat
Benitez-Nelson, C., University of South Carolina, Columbia, USA, cbnelson@geol.sc.edu
Bode, A., Instituto Español de Oceanoografía, La Coruña, Spain, antonio.bode@co.ieo.es
Scharek, R., Instituto Español de Oceanoografía, Gijón, Spain, rscharek@gieo.es
Fernández de Puelles, M. L., Instituto Español de Oceanoografía, Palma de Mallorca, Spain, mluz.fernandez@ia.eio.es
Latasa, M., Instituto Español de Oceanoografía, Gijón, Spain, latasa@gieo.es

Determination of POC export using a combination of 234Th/238U and 210Pb disequilibria in the NW Mediterranean

The extent to which atmospheric carbon is sequestered by the ocean via the biological pump is a question that has become paramount if one is to understand the global carbon cycle. Here, carbon export from oceanic surface waters of the Northwestern Mediterranean Sea was obtained using both 234Th/238U and 210Pb disequilibria in the upper water column. Th, Pb and Po are particle-reactive, but Po appears to be uniquely assimilated into planktonic cells, thus providing a direct link to plankton physiology. Seawater particles from sediment traps and plankton tow net samples were collected during three cruises in 2009, that covered pre, mid, and post phytoplankton bloom conditions. The response of both tracers to the bloom at the light of their different characteristics will be discussed. We also would like to improve our knowledge about the interactions of these radioisotopes with plankton to determine the role that it could play in the estimation of POC fluxes with both approaches.

Purce, D., Washington State Department of Ecology Shorelands and Environmental Assistance Program, Olympia, USA, d_purce@yahoo.com

A GLOBAL TROPICAL CYCLONE DAMAGE HISTORY FOR THE WORLD’S CORAL REEFS: 1985-2008

Coral reefs are subject to stressors which interact to shape their form and function. Examining how stressors interact requires mapping their intensity and timing. High resolution global databases that do so for key stressors (bleaching, acidification, human impacts) have recently been published. However, no such data exists for physical damage from tropical cyclone (TC) waves. To address this, we reconstructed TC wind speeds in GIS using meteorological models and a global TC track database every hour across the world’s tropical regions (1 km resolution) from 1985-2008. The resultant data was validated using a combination of in situ, QuikScat, and coarser scale model data. An extensive field survey of the Great Barrier Reef (TC Ingrid, 2005) established that maximum wind speeds delineate zones within which damage is likely if vulnerable corals are present. Given this, we assessed damage potential at every reef from each of 2,690 TCs to produce a global probable TC damage history over the recent past. Limiting human impacts may be particularly useful at reefs within TC ‘hotspots’ that are also crucial to global reef connectivity.

Pusch, M. T., Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, pusch@igb-berlin.de
Gücker, B., Federal University of São João del Rei, São João del-Rei, Brazil, guecker@ufsj.edu.br
Brauns, M., Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, mario.brauns@ufz.de
Voss, M., Leibniz Institute for Baltic Sea Research, Rostock, Germany, maren.voss@io-warnemuende.de

EFFECTS OF TERTIARY-TREATED WASTEWATER DISCHARGE ON ECO-SYSTEM FUNCTIONING AND FOOD WEB STRUCTURE IN AN URBAN STREAM

Tertiary wastewater treatment is common in developed countries, but little is known about the effects of best-practice wastewater treatment plant (WWTP) on the biological structure and function of urban stream ecosystems. We found that discharge of treated wastewater resulted in increased concentrations of total organic C, total N, and total P in the sediments, as well as in enhanced whole-stream community respiration, gross primary production and areal nitrate retention rates. As a consequence, the trophic basis of invertebrate production shifted from upstream natural and agricultural resources to urban resources, i.e., wastewater-derived organic matter as well as autochthonous primary production based on wastewater-derived nutrients. WWTP effluent resulted in a partial turnover of species, but invertebrate production at urban sites exceeded that at agricultural sites. Our results suggest that contemporary urban stressors in developed countries affect secondary producers less severely than historically recorded, but still significantly impact urban streams by loss of sensitive invertebrate species, eutrophication, and reduced nutrient-retention efficiency.
expected by chance at the deepest sites surveyed. Understanding both the evolutionary and ecological mechanisms that influence deep-sea coral community assembly is imperative to successfully conserve these species, particularly in the face of global climate change and continued oil exploration.

Quinones-Rivera, Z. J., University of Regina, Regina, Canada, zoraida.quinones@uregina.ca
Finlay, K., University of Regina, Regina, Canada, kerri.finlay@uregina.ca
Leavitt, P. R., University of Regina, Regina, Canada, peter.leavitt@uregina.ca
Wissel, B., University of Regina, Regina, Canada, bjornen.wisse@uregina.ca

ASSESSING EFFECTS OF METABOLIC ACTIVITY AND HYDROLOGY ON DISSOLVED OXYGEN AND DISSOLVED INORGANIC CARBON DYNAMICS IN HARDWATER LAKES USING STABLE ISOTOPIES

Dynamics of dissolved oxygen (DO) and dissolved inorganic carbon (DIC) are affected differently by metabolic and hydrologic processes. Oxygen responds quickly to ambient productivity levels, and the majority of fluxes occur between water column and atmosphere. While in softwater lakes DIC and DO dynamics are similar, in hardwater lakes DIC is largely controlled by watershed processes. To evaluate the relative importance of metabolic and watershed processes on DO and DIC dynamics, as well as their coupling, we analyzed seasonal changes of both concentrations and stable isotopes of DO and DIC in seven Qu’Appelle Valley lakes, a chain of hard-water lakes in western Canada. Oxygen dynamics indicated a clear seasonality with large-scale wave forcing and sediment characteristics, we estimate the corresponding diffusivity and tidal water flows for Baltic Proper sediments every 6th hour based on diffusive processes in porous sediments have been more difficult to implement. Based on a model for porous sediments combined with long-term and large-scale wave forcing and sediment characteristics, we estimate the corresponding diffusivity and tidal water flows for Baltic Proper sediments every 6th hour over a two-year period. The results will indicate what variables that have a major influence on the diffusivity in time and space. The results are also compared to the corresponding bottom stress estimates founded on the same forcing functions.

Rakhukumar, K., University of California Santa Cruz, Santa Cruz, USA, krakhuku@ucsc.edu
Goebel, N., University of California Santa Cruz, Santa Cruz, USA, ngoebel@ucsc.edu
Venerziani, M., University of California Santa Cruz, Santa Cruz, USA, milenav@ucsc.edu
Edwards, C., University of California Santa Cruz, Santa Cruz, USA, cedwards@ucsc.edu
Broquet, G., Laboratoire des Sciences du Climat et de l’Environnement, France, guillaume.broquet@ipsl.fr
Moore, A., University of California Santa Cruz, Santa Cruz, USA, ammoore@ucsc.edu
Zehr, J. P., University of California Santa Cruz, Santa Cruz, USA, zehrj@ucsc.edu

WAVE DRIVEN DIFFUSIVITY IN THE SURFICIAL SEDIMENTS OF THE BALTIC PROPER, BALTIC SEA

Porewater exchange across the water-sediment interface is a crucial transport process controlling redox and nutrient exchange processes. The friction controlled turbulent boundary-layer flow has been in focus for a long time but flux estimates based on diffusive processes in porous sediments have been more difficult to implement. Present study focuses on wave-driven diffusivity in the shallow sediments of the Baltic Proper. Based on a model for porous sediments combined with long-term and large-scale wave forcing and sediment characteristics, we estimate the corresponding diffusivity and tidal water flows for Baltic Proper sediments every 6th hour over a two-year period. The results will indicate what variables that have a major influence on the diffusivity in time and space. The results are also compared to the corresponding bottom stress estimates founded on the same forcing functions.

Ralahia, N. N., Louisiana Universities Marine Consortium, Cocodrie, USA, nralahia@lumcon.edu
Ren, L., Patrick Center for Environmental Research, the Academy of Natural Science, Philadelphia, USA, ren@acnatsci.org
Turner, R. E., Louisiana State University, Baton Rouge, USA, euturne@lsu.edu
Morrison, W. M., Louisiana Universities Marine Consortium, Cocodrie, USA, wmorrison@lumcon.edu

HOW DOES MISSISSIPPI RIVER WATER AFFECT PHYTOPLANKTON GROWTH IN THE ADJACENT UPPER BARATARIA BASIN?

The Davis Pond Diversion was constructed to introduce Mississippi River water into upper Barataria Basin for coastal restoration. High loads of nutrients and changes in salinity are hypothesized to expose three fresh to brackish water bodies to increasing extent and duration of freshwater algal blooms, including harmful algae. Experiments in 2003–2004 with 10-1 microcosm bioassays showed that nitrogen was the primary limiting nutrient and phosphorus was a secondary limiting factor in some seasons. Experiments in 2005–2006 simulated Mississippi River diversions with proportionally greater additions of Mississippi River water to lake water. The response was for a chlorophyll a biomass increase with the addition of nutrient rich Mississippi River water. In Lakes Cataouatche and Salvador, 1% replacement by Mississippi River water caused 1–7% and 9-16% chlorophyll increases correlated with dissolved inorganic nitrogen. The more Mississippi River was added the greater the increase in chlorophyll, indicating that filling these lakes will cause massive algal blooms. There were also species shifts from marine to freshwater and diatom to colonial cyanobacteria, including toxic forms.

Raghukumar, K., University of California Santa Cruz, Santa Cruz, USA, krakhuk@ucsc.edu
Goebel, N., University of California Santa Cruz, Santa Cruz, USA, ngoebel@ucsc.edu
Venerziani, M., University of California Santa Cruz, Santa Cruz, USA, milenav@ucsc.edu
Edwards, C., University of California Santa Cruz, Santa Cruz, USA, cedwards@ucsc.edu
Broquet, G., Laboratoire des Sciences du Climat et de l’Environnement, France, guillaume.broquet@ipsl.fr
Moore, A., University of California Santa Cruz, Santa Cruz, USA, ammoore@ucsc.edu
Zehr, J. P., University of California Santa Cruz, Santa Cruz, USA, zehrj@ucsc.edu

WAVE DRIVEN DIFFUSIVITY IN THE SURFICIAL SEDIMENTS OF THE BALTIC PROPER, BALTIC SEA
The resilience of the coral holobiont. This integrated approach increases understanding of the bacterial community of the same coral colonies. Sequencing of the bacterial 16S rRNA genes revealed a shift in the coral-associated microbiomes. Twelve colonies of the reef-building coral Acropora millepora were investigated. Cooling effects on climate at local scales. Reef-building corals are major contributors to Dimethylsulfide (DMS) emissions, derived from the breakdown of dimethylsulfoniopropionate (DMSP). The availability of N, P, and Si plays a fundamental role in coastal phytoplankton dynamics. Nutrient ratios can be strongly modified during estuarine transit, which is not enough accounted for in studies linking watersheds and coastal zones. A major difficulty of sampling in macro-tidal estuaries is that these ecosystems are generally characterized by heterogeneities at small and/or large spatial and temporal scales resulting from physical and biological processes. Understanding the origin of heterogeneities and estimating the ranges of variability are crucial to model ecosystems and understand their functioning. In this study, we investigate the interactions between elemental benthic cycles. The interactions between these two estuaries of the Bay of Brest (NW France). The interactions between the Si benthic cycle. The interactions between these elements are discussed, as both play a limiting role during the spring productive season.

Raimond, M., Laboratoire des Sciences de l'Environnement Marin, Plouzané, France, raimond@univ-brest.fr
Ragueneau, O., Laboratoire des Sciences de l'Environnement Marin, Plouzané, France, olivier.ragueneau@univ-brest.fr
Andrieux-Loyer, F., DYNECO Pelagos, IFRMER, Plouzané, France, andrieux@ifremer.fr
Khalil, K., Ecole Supérieure de Technologie d'Essaouira, Essaouira, Morocco, khalil_karima@yahoo.fr
Keroul, R., DYNECO Pelagos, IFRMER, Plouzané, France
Philippon, X., DYNECO Pelagos, IFRMER, Plouzané, France
Soetaert, K., NIOO-KNAW, Centre for Estuarine and Marine Ecology, Yerseke, Netherlands
Rabouille, C., Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, France, christophe.rabouille@lsce.ipsl.fr
Mémery, L., Laboratoire des Sciences de l'Environnement Marin, Plouzané, France, laurent.memer@univ-brest.fr

MODELING OF SEASONAL COUPLING AND DECOUPLING OF ELEMENTAL BENTHIC CYCLES (P, Si, N, C) ALONG SALINITY GRADIENTS OF TWO SUBTIDAL TEMPERATE ESTUARIES
The availability of N, P, and Si plays a fundamental role in coastal phytoplankton dynamics. Nutrient ratios can be strongly modified during estuarine transit, which is not enough accounted for in studies linking watersheds and coastal zones. A major difficulty of sampling in macro-tidal estuaries is that these ecosystems are generally characterized by heterogeneities at small and/or large spatial and temporal scales resulting from physical and biological processes. Understanding the origin of heterogeneities and estimating the ranges of variability are crucial to model ecosystems and understand their functioning. In this study, we investigate the interactions between elemental benthic cycles. The interactions between these two estuaries of the Bay of Brest (NW France). The modeling of the C, N, and P cycles suggests the presence of authigenic mineral formation in one of the estuaries, associated to an episodic event. The importance of these reactions, which influence strongly the P fluxes at the sediment-water interface, seems to be strongly linked to the Si benthic cycle. The interactions between these elements are discussed, as both play a limiting role during the spring productive season.

Raina, J. B., James Cook University/Australian Institute of Marine Science/AIMS@JCU, Townsville, Australia, j.raina@aims.gov.au
Lutz, A., James Cook University/Australian Institute of Marine Science/AIMS@JCU, Townsville, Australia, a.lutz@aims.gov.au
Tapiolas, D., Australian Institute of Marine Science, Townsville, Australia, d.tapiolas@aims.gov.au
Motti, C., Australian Institute of Marine Science, Townsville, Australia, c.motti@aims.gov.au
Wills, B. L., James Cook University, Townsville, Australia, bette.wills@jcu.edu.au
Bourne, D. G., Australian Institute of Marine Science, Townsville, Australia, d.bourne@aims.gov.au

INFLUENCE OF DMSP AVAILABILITY ON CORAL ASSOCIATED BACTERIA Dimethylsulfide (DMS) emissions, derived from the breakdown of dimethylsulfoniopropionate (DMSP), are integral for cloud formation and exert potentially major cooling effects on climate at local scales. Reef-building corals are major contributors to the production of DMSP and DMS, and these compounds also potentially have an important role in structuring coral-associated bacterial communities. The dynamics of DMSP production during thermal anomalies and its effect on coral-associated microbes was investigated. Twelve colonies of the reef-building coral Acropora millepora were subjected to two water temperatures (27°C and 32°C) for a period of three weeks. A novel quantitative-NMR approach was developed to measure DMSP concentrations in coral tissue and demonstrated a two-fold increase in DMSP in corals exposed to 32°C compared to controls held at 27°C. Furthermore, deep sequencing of the bacterial 16S rRNA genes revealed a shift in the coral-associated bacterial community of the same coral colonies. This integrated approach increases our current understanding of coral-microbial associations, the effect of temperature stress on coral microbial symbionts and the role of organic sulfur compounds in the resilience of the coral holobiont.

Raimond, N., National Institute of Oceanography, Dona Paula, India, raimond@nio.org
Paul, J. T., National Institute of Oceanography, Dona Paula, India, paul@nio.org
Fernandes, V., National Institute of Oceanography, Dona Paula, India, veronica@nio.org

PHILODINA MEGALOTROCHA

Walsh, E. J., University of Texas at El Paso, El Paso, USA, ewalsh@utep.edu
Hamdan, L. K., University of Texas at El Paso, El Paso, USA, lhamdan2@miners.utep.edu
Walsh, E. J., University of Texas at El Paso, El Paso, USA, ewalsh@utep.edu

GENETIC VARIATION WITHIN AND AMONG CHIHUAHUAN DESERT POPULATIONS OF THE BDELOID ROTIFER PHILODINA MEGALOTROCHA
Global climate change is shifting water availability and desert aquatic systems are highly vulnerable. These systems are characterized by ephemeral waterbodies that fill during seasonal rain events. Bdeioid rotifers are often a dominant component of these habitats. Bdeioids disperse through cryptic biogeographic stages and many species are assumed to be globally distributed. However, recent studies have found substantial levels of genetic variation among populations indicating cryptic speciation within this group. Our goal is to determine levels of genetic diversification within (n = 3) and among (n = 17) populations of Philodina megalotrocha in the Chihuahuan Desert.
ert. Based on partial COI sequences, genetic distances among populations ranged from 0.0 to 19.7% while variation within populations was relatively less (0 to 3.5%). *P. megalotrocha* populations were distributed among five monophyletic clades with deep genetic divergences. These genetic distances are comparable to levels found between species delimited by morphology. Thus, biodiversity of this group is likely underestimated and their role in desert aquatic communities is unknown. As aridification intensifies, the conservation of aquatic habitats will be better informed by accurate estimates of biodiversity.

**Ramos Álvarez, A.** University of Oxford, Oxford, United Kingdom, antares.ramos.alvarez@gmail.com
Speight, M. R., University of Oxford, Oxford, United Kingdom, martin.speight@zoology.ox.ac.uk

**PUBLIC POLICY RECOMMENDATIONS: MANAGING PUERTO RICO’S MARINE ORNAMENTAL FISHERY WITH AN INTEGRATIVE APPROACH**

The marine ornamental fishery in Puerto Rico has been legislated and thus managed without proper ecological and social data that provide efficient resource management practices. Acute user-manager conflict has taken place as a result. A study was carried out using an interdisciplinary approach so that policy recommendations could be provided. The main goals of the project were: understanding user perspectives and socio-economic relationship to the trade, carrying out a global trend analysis, conducting regional species population and habitat assessments, and identifying management and enforcement obstacles. The results provided an integrative approach to the management of the marine ornamental fishery in Puerto Rico, which is being adapted into public policy recommendations. The results of the study provide management recommendations that include both social and environmental benefits that are applicable to Puerto Rico and serve as management guidelines to other island-nations.

**Rasera, M. K.** U.S. Department of the Interior, Herndon, USA, michael.rasera@boemre.gov
Cluck, R. E., U.S. Department of the Interior, Herndon, USA, rodney.e.cluck@boemre.gov
Dhanju, A., U.S. Department of the Interior, Herndon, USA, amardeep.dhanju@boemre.gov

**MEETING SCIENCE AND DATA NEEDS FOR COASTAL AND MARINE SPATIAL PLANNING ON THE UNITED STATES OUTER CONTINENTAL SHELF**

The United States Outer Continental Shelf (OCS) consists of approximately 1.8 million ocean acres. Compared to coastal areas, relatively less scientific data is available on the OCS. The U.S. Department of the Interior’s Bureau of Ocean Regulation Management and Enforcement (BOEMRE) plays an important role in Coasal and Marine Spatial Planning (CJSSP) as the only agency authorized to grant renewable energy, marine mineral (sand and gravel) and oil and gas leases on the Outer Continental Shelf. BOEMRE’s Environmental Studies Program conducts numerous scientific investigations to support the Department of Interior’s commitment to conduct coastal and marine spatial planning in an ecosystem-based manner using the best available science. Much of this research is conducted in partnership with other DOI agencies such as the Fish and Wildlife Survey and U.S. Geological Survey as well as other Federal Agencies such as the National Oceanic and Atmospheric Administration. An overview of current CIMP studies will be provided including experimenting with high definition video imagery to survey avian populations, mapping the location of deepwater coral communities, and examining the human dimensions of conflict among different groups of ocean users.

**Rassouldazdegan, F.** LOV, Villefranche-sur-mer, France, rassould@obs-vlfr.fr
Herndl, G. J., University of Vienna, Vienna, Austria, Gerhard.Herndl@univie.ac.at
Mari, X., IRD, Hanoi, Viet Nam, xavier.mari@ird.fr
Weinbauer, M. G., LOV, Villefranche-sur-mer, France, wein@obs-vlfr.fr

**BLACK CARBON: A NEW FACTOR SHAPING MICROBIAL FOOD WEBS**

Black carbon (BC), the incomplete combustion of fossil fuels and biomass, is well recognized as factor influencing climate and as health hazard. BC is found in the dissolved and particulate fraction of seawater, however, the role of BC for the diversity and functioning of microbial food webs is poorly known. Using BC reference material in experimental studies, bacteria and particularly viruses rapidly attached to BC particles. This resulted in changes of the free-living and attached bacterial community composition e.g. favouring the oil-spill genus Glaciecola. The attachment of viruses was also reflected by a reduction of viral production and viral infection of bacteria and could be one of reasons for the increased bacterial production observed by BC additions. Another reason could be the observed increase of particle aggregation by BC additions (also observed during an in situ BC aerosol dry deposition event). Exposure to UV (thus mimicking atmospheric transport) increased the bioavailability of BC. Preliminary experiments also showed that bacterial production and respiration rather than primary production was influenced. Thus, BC could increase the heterotrophy in the ocean. BC could not only directly contribute to refractory organic material in the ocean but also influence the microbial carbon pump indirectly by shifts in the diversity and functioning of the microbial food web.

**Rastorgueff, P.** Université de la Méditerrannée - COM - DIMAR UMR CNRS 6540, Marseille, France, pierre-alexandre.rastorgueff@univmed.fr
Harmelin-Vivien, M., Université de la Méditerrannée - COM - DIMAR UMR CNRS 6540, Marseille, France, mireille.harmelin@univmed.fr
Richard, P., Université de la Rochelle - LIENS UMR CNRS 6250, La Rochelle, France, pierre.richard81@univ-lr.fr
Chevaldonné, P., Université de la Méditerrannée - COM - DIMAR UMR CNRS 6540, Marseille, France, pierre.chevaldonne@univmed.fr

**DIETARY FEEDING STRATEGIES AND RESOURCE PARTITIONING MITIGATE THE EFFECTS OF OILGOTROPHY FOR MARINE CAVE MYSIS**

The trophic characteristics of several mysid species (*Crustacea: Mysida*) were investigated in shallow Mediterranean underwater caves by means of C and N stable isotope ratios. Due to darkness and confinement, no autochthonous primary produc-
tion occurs inside these caves that rely exclusively on allochthonous inputs. Previous studies have demonstrated that mysids can be a major component of organic matter transfer in coastal ecosystems. This is also true in the studied caves where some species of mysids feed outside the caves at night. We explored here the feeding habits of five species of cave-dwelling mysids to document possible food partitioning between them and determine whether they rely directly on outside food resources (migration outside the caves) or use organic matter settled inside (migration restricted to different parts of the cave). By their feeding migrations and population abundance, mysids are shown to mitigate the oligotrophy of marine caves in different ways. Their feasts are undoubtedly a resource used by detritivores, but they are also a choice prey to a suite of cave-dwelling predators such as fish, cnidarians and carnivorous sponges.

Casamayor, E. O., Centro de Estudios Avanzados de Blanes, Blanes, Spain, casamayo@ceab.csic.es
Crump, B. C., Horn Point Laboratory, Maryland, USA, bcrump@umces.edu
Kling, G. W., University of Michigan, Michigan, USA, gwk@umich.edu
Lindström, E., University of Uppsala, Uppsala, Sweden, eva.lindstrom@ebc.uu.se
Perfectti, F., Universidad de Granada, Granada, Spain, fperfectt@ugr.es
Van der Gucht, K., Ghent University, Ghent, Belgium, Katrien.vandergucht@UGent.be

NESTEDNESS IN MICROBIAL METACOMMUNITIES OF LAKE LANDSCAPES

Nestedsness analysis has become widely used to describe patterns of species occurrences and to understand their underlying mechanisms mostly in faunas of islands and fragmented habitats. Nestedsness measures the degree to which species assemblages are representative subsets of larger assemblages. Microbial ecologists, since the advent of DNA-based molecular technologies, have started to test general ecological patterns and use the diverse and well-developed metrics provided by the macroecology. Lakes are considered classic examples of insular systems. In this study, we determined the nestedsness of bacterial assemblages in ten metacommunities from well contrasted (boreal, alpine, temperate) landscapes. We obtained nestedsness metrics using the software by Ulrich (2006). The matrix temperature ranged from 24.6 to 34.5 °C (IP represents an entirely nested assemblage and 100°C a completely disordered assemblage) and the nestedsness values ranged from 0.66 and 0.76. The comparison with null models indicated that most of the bacterial metacommunities analysed were significantly nested. We also explored the environmental and geographical factors potentially involved in the generation of the gradient from the most nested to the most idiosyncratic metacommunity.

Record, N. B., University of Maine School of Marine Sciences / Gulf of Maine Research Institute, Portland, USA, nrecord@gmri.org
Pershing, A. J., University of Maine School of Marine Sciences / Gulf of Maine Research Institute, Portland, USA, andrew.pershing@maine.edu

BIODIVERSITY DYNAMICS IN THE GULF OF MAINE PELAGIC ZOOPLANKTON COMMUNITY

One of the driving questions behind studies of biodiversity is how biodiversity patterns change through time, and what processes relate to these changes. Pelagic systems are highly dynamic, with biodiversity levels changing at diel, seasonal and interdecadal time scales. We examined the dynamics of biodiversity in the Gulf of Maine pelagic zooplankton community in the context of established biodiversity theories, such as the energy-richness hypothesis, and the mid-domain effect. Taxonomic data came from the Gulf of Maine continuous plankton recorder transect, spanning the years 1961–2006. We found that results depended highly on the temporal scale used. While temperature was highly correlated with biodiversity at a seasonal scale, the strong inter-decadal shifts in biodiversity appear unrelated to temperature. Phytoplankton biomass, in contrast, showed a strong correlation with inter-decadal shifts in diversity. The dynamic nature of biodiversity and the role of time scale are important factors when testing biodiversity hypotheses in pelagic systems.

Reed, J. K., Harbor Branch Oceanographic Institute, Florida Atlantic University, Fort Pierce, FL, USA, reedj12@hbio.fau.edu
Messing, C., Nova Southeastern University, Fort Lauderdale, FL, USA
Walker, B., Nova Southeastern University, Ft. Lauderdale, FL, USA
Brooke, S., Marine Conservation Biological Institute, Bellevue, WA, USA
Brouwer, M., South Atlantic Fishery Management Council, Charleston, SC, USA
Correa, T., RSMAS, University of Miami, Miami, Florida, USA
Farrington, S., Harbor Branch Oceanographic Institute, Florida Atlantic University, Fort Pierce, FL, USA.

**DISTRIBUTION AND CHARACTERIZATION OF DEEP-SEA CORAL ECOSYSTEM HABITATS OFF SOUTHEASTERN UNITED STATES**

The deep-sea (>200 m) seafloor off the southeastern U.S. has extensive deep-sea coral ecosystems (DSCE) habitats including: deep-water coral mounds; various hard-bottom habitats such as the Miami Terrace and Pourtalés Terrace off Florida; and deep island slopes off western Bahamas and northern Cuba. The dominant structure-forming scleractinian corals are Lophelia pertusa and Enallopsammia profunda; other structure-forming taxa include stony corals, gorgonians, black corals, and sponges. Since 1999, we have documented with 241 submersible and ROV dives, extensive regions of deep-water, high-relief features which we have confirmed as DSCE habitat. We estimate a total of 39,910 km² of DSCE habitat in the region from northeastern Florida through the Straits of Florida, and provide ArcGIS maps showing the distribution and types of deep-sea coral habitats. In 2010, the U.S. Department of Commerce designated a large portion of this region in U.S. waters as the Deep-water Coral Habitat Areas of Particular Concern (CHAPCs), protecting 59,570 km² of bottom. This was based on extensive input by the South Atlantic Fishery Management Council (SAFMC) and decades of work by numerous scientists.

**Reese, B. K., Texas A&M University, College Station, USA, brandi@ocean.tamu.edu**

**Romero, B. F., Texas A&M University, College Station, USA, rome1453@neo.tamu.edu**

**Shepard, A., Texas A&M University, College Station, USA, ashep90@neo.tamu.edu**

**Dowd, S., Medical Biofilm Research Institute, Lubbock, USA, scot.dowd@ars.usda.gov**

**DuMarco, S., Texas A&M University, College Station, USA, sdmarino@tamu.edu**

**Morse, J. W., Texas A&M University, College Station, USA, morse@ocean.tamu.edu**

**Mills, H. L., Texas A&M University, College Station, USA, hmills@ocean.tamu.edu**

**BENTHIC AND PELAGIC MICROBIAL ECOLOGY IN THE NORTHERN GULF OF MEXICO HYPOXIC ZONE**

The physical and geochemical parameters of the northern Gulf of Mexico hypoxic zone has been monitored and characterized for decades, however the microbial processes that deplete the oxygen in the water column and sediment have remained vaguely understood. Popular models attribute the water column hypoxia to benthic microbial respiration associated with organic matter deposition including riverine inputs and phytoplankton blooms. While these processes may partially explain hypoxia near the mouth of the Mississippi and Atchafalaya Rivers, the organic matter concentrations, porewater geochemistry and microbial community activity in more western sediments fail to follow this model. Sediment and water column samples were collected in 2009 and 2010 at the 20 m isobath, offshore from the Atchafalaya River mouth (i.e., western hypoxic zone), for molecular and geochemical processing.

**Regeaud-de-Gioux, A., IMEDEA-CSIC, Esporles, Spain, aurore.regueaud@imedea.uib-csic.es**

**Duaire, C. M., IMEDEA-CSIC, Esporles, Spain, carlosduaire@imedea.uib-csic.es**

**GLOBAL PATTERNS IN OCEANIC PLANKTONIC METABOLISM**

The rates gross primary production (GPP) and respiration (CR) of plankton communities in the ocean were evaluated here on the basis of a data set comprising 3597 estimates of GPP and CR by plankton communities within the euphotic zone. Metabolic differences were observed among the different oceanic regions, latitudinal bands and hemispheres. Despite the improvement relative to previous assessments, the data set on plankton metabolism represents less than 20 % of the ocean surface with a dominance of measurements in chlorophyll-rich, coastal waters and North Atlantic waters. Plankton communities increased metabolic rates in coastal locations compared to open-ocean ones due to high nutrients concentration and organic carbon inputs. High respiration was observed in the Northern Hemisphere compared to that in the Southern Hemisphere due to the prevalence in the North to great human activity and river discharge. The results presented here show that the scaling between GPP and CR is not universal across the ocean with a variability to 5 to 10-fold in the mean CR expected for any given GPP among oceanic basins. Heterotrophic communities were prevalent in the continental shelf stations and in the Northern Hemisphere, which receives relative high allochthonous inputs of organic carbon. Our estimates suggested a negative metabolic balance for the upper ocean, suggesting that has to be taken with caution due to the sparse coverage of estimates of metabolic rate in the ocean.

**Reilly, R., Center for Quantitative Fisheries Ecology, Norfolk, USA, reilly@odu.edu**

**Jones, C. M., Center for Quantitative Fisheries Ecology, Norfolk, USA, cjoness@odu.edu**

**Grosch, C. E., Center for Coastal & Physical Oceanography, Norfolk, USA, enquist@ccpo.odu.edu**

**Schaffer, J. J., Center for Quantitative Fisheries Ecology, Norfolk, USA, jschaff@odu.edu**

**LIFE HISTORY SCANS QUANTIFY INGRESS PATTERNS OF ATLANTIC MENHADEN IN CHESAPEAKE BAY**

Fish recruitment success is set during early life history stages, when environmental conditions influence survivorship greatly. Considering the widespread biological and physical changes which are occurring on a global scale, understanding the sources of recruits to our fisheries is an integral step in their proper conservation. Otolith chemistry has proven to be a powerful tracer of fish origin in several natural systems. Conducting life history scans of otoliths to reconstruct environmental histories is a rapidly increasing area of otolith chemistry research. To date, technical progress of measuring elemental concentrations in otoliths has progressed more rapidly than appropriate application of statistical analysis of these data. A new approach to these analyses is the application of spectral analysis to the time series obtained from a laser ablation ICP-MS scan. Doing so allows us to make use of the full spatial and temporal aspects of our data, without making assumptions about their independence or distribution. Here, we demonstrate the use of spectral analysis on life history scans of juvenile Atlantic menhaden (Brevoortia tyrannus) as a means of identifying varying patterns of ingress into Chesapeake Bay.

**Reimer, J. J., Universidad Autonoma de Baja California, Ensenada, Mexico, queenanleish@yahoo.com**

**Huerta-Diaz, M. A., Universidad Autonoma de Baja California, Ensenada, Mexico, mhuertadiaz52@yahoo.com**

**THE USE OF IRON, C,S, AND C,P RATIOS AS REDOX PROXIES: EXAMPLE FROM THE HYPERSALINE SEDIMENTS OF GUERRERO NEGRO, BAJA CALIFORNIA SUR, MEXICO**

Hypersaline environments and microbial mats, which are often associated with these environments, present a unique opportunity to study redox sensitive processes, which may be used as proxies to the geologic past. Sediment samples were collected along a salinity gradient (47-125 psu) in the Guerrero Negro (GN) saltern on the Baja California peninsula. Iron redox proxies have been used to determine theoxic state of sediments and oceanic bottom waters. Reactive iron concentrations suggested Fe pyrite limitation (in general, degrees of pyritization ~100%). (C,P)org (organic carbon to organic phosphorus ratios), which have also been used to estimate sediment oxic state and also to determine the intensity of redox sensitive organic matter (OM) remineralization, were determined to be higher (2.5x104-8.2x105) than values previously reported in the literature for anoxic sediments. Organic C to pyrite-sulfur ratios (211-1640) were also determined to be most similar to those reported for the Permian period. GN sediments may serve as good proxies to times during the geologic past when Fe was limiting; there were high levels of OM, and anoxic sediments were prevalent.

**Reinthaler, T., University of Vienna, Vienna, Austria, thomas.reinthaler@univie.ac.at**

**Alvarez-Salgado, X. A., CSIC Instituto de Investigaciones Marinas, Vigo, Spain, xsaldago@im.csic.es**

**Alvarez, M., IEO Centro Oceanografico de A Coruña, A Coruña, Spain, vanaken.h, Royal Netherlands Institute for Sea Research, Den Burg, Netherlands, hrnrdl.g, University of Vienna, Vienna, Austria**

**LINKING MICROBIAL ECOLOGY TO THE BIOGEOCHEMISTRY IN THE DEEP EASTERN NORTH ATLANTIC OCEAN USING OPTIMUM MULTIPARAMETER ANALYSIS**

During three cruises conducted in the eastern North Atlantic, we followed the North Atlantic Deep Water (NADW) from 65°N to 31°S. Using salinity, temperature and nutrient data we performed an optimum multiparameter analysis (OMPA) of the source Iceland Scotland Overflow (BSO), Labrador Sea (LSW), Lower Deep (LDW) and Mediterranean Overflow (MOW) water types, which contribute to the NADW. The relationship between geochemical (dissolved oxygen, organic and inorganic nutrients) and microbial (prokaryotic biomass and activity) variables along the NADW
salinity maximum was examined with least-squares regression models corrected for the effect of mixing by including the proportions of the source water types. Our results indicate that particulate organic matter (POM) with an average C: H: O: N: P composition of (124–145): (203–235): (30–90): 13: 1 is the major substrate for the prokaryotic community. This composition is consistent with the remineralization of the more labile N- and P- rich compounds during sedimentation of organic matter into the dark ocean. N and P are mineralized at a higher rate in the northern as compared to the subtropical North Atlantic. Concomitantly, inorganic rather than dissolved organic nutrients explained the latitudinal variability in the prokaryotic heterotrophic biomass, the latter exhibiting a significantly higher turnover rate in the subtropical than in the northern North Atlantic.

Reisenbichler, K. R., MBARI, Moss Landing, USA, reki@mbari.org
Okuda, C. M., MBARI, Moss Landing, USA, okcr@mbari.org
Robison, B. H., MBARI, Moss Landing, USA, robh@mbari.org

CONTINUING DEVELOPMENT OF MBARI'S MIDWATER RESPIROMETRY SYSTEM AS A TOOL TO INVESTIGATE PHYSIOLOGICAL LIMITATIONS TO THE DISTRIBUTION OF DEEP PELAGIC ANIMALS

Mounting evidence of the broadening and intensification of oxygen minimum zones (OMZs) in oceans around the world suggest that we will also see changes in the vertical distribution of animals who’s populations border the upper or lower limits of these features. The in situ midwater respirometry system (MRS) being developed at MBARI is a promising tool for studying the oxygen consumption rates and limitations of these organisms within the range of oxygen concentrations at which they are normally found. By measuring respiration rates at depth, we can eliminate the variables introduced during normal laboratory measurements (e.g., reduced pressure, animal perturbation during transfer and variable seawater chemistry) to more directly ascertain the importance of oxygen concentration in determining the vertical distribution of these species. This presentation will describe the development of the ROV deployed, 4000 m rated, eight chamber MRS systems, problems encountered and progress to date.

Relles, N. J., Virginia Institute of Marine Science, Gloucester Point, USA, nrelles@vimms.edu
Jones, D. O., National Oceanography Centre, Southampton, United Kingdom, dlj@noc.soton.ac.uk

CORAL COVER CHANGE DETECTION TO IDENTIFY POTENTIAL AREAS OF MANAGEMENT CONCERN ON BONAIRE, NETHERLANDS ANTILLES

The island of Bonaire, Netherlands Antilles, has been a marine protected area since 1979. The Bonaire National Marine Park extends to the 60 m depth contour and allows fishing to traditional methods, prohibits anchor dropping and charges a nature fee to underwater visitors to provide moorings and support management. Coral cover along the leeward coast of the island was mapped (from aerial photographs) in the early 1980s out to a depth of 20 m. Quickbird® satellite images of the island, collected in 2008 and 2009, were combined with in situ ground truthing to create comparable maps of coral cover for the present-day. Change detection analysis was used to determine areas of significant habitat alteration, both negative, from coral to sand/rubble, and positive, from sand/rubble to coral. Areas of negative change were identified as problem areas for potential increases in marine protection. The results of this research will be used by marine park managers to focus future coral protection efforts and influence marine management decisions.

Rellinger, A. N., University of South Alabama, Mobile, AL, USA, arellinger@disl.org
McParland, E. L., University of South Carolina, Columbia, SC, USA, mcpelanr@email.sc.edu
Kieber, D. J., State University of New York, College of Environmental Science and Forestry, Syracuse, NY, DJKiieber@esf.edu
Kiene, R. P., University of South Alabama, Mobile, AL, USA, rkiene@disl.org

EFFECTS OF HYDROGEN PEROXIDE ON OXIDATIVE STRESS AND DMS PRODUCTION IN PHAEOSCHISTIS GLOBOSA

DMSP and its cleavage product DMS have been proposed to have antioxidant functions in marine phytoplankton. We tested whether hydrogen peroxide (H₂O₂) caused oxidative stress and enhanced cleavage of DMSP into DMS in the single celled form of Phaeoschistis globosa (CCMP 627), a species with high DMSP lyase activity. Fv/Fm (maximum efficiency of photosystem II) was used as an indicator of oxidative stress. Treatment of P. globosa cultures (30–300 μg Chl a/L) with 20-90 μM H₂O₂ generally resulted in progressively lower Fv/Fm (greater stress), although some cultures recovered after several hours and in some the Fv/Fm was unaffected by H₂O₂. In most experiments, DMS production was stimulated by additions of 30-90 μM H₂O₂, and in some cases DMS production increased even though H₂O₂ did not affect Fv/Fm. Peroxide consumption tests show that P. globosa can consume peroxide although this rate varied. We conclude that oxidative stress, in the form of H₂O₂, triggers DMS production in P. globosa. Variations in the response to H₂O₂ in P. globosa might be due to light history and variable rates of H₂O₂ consumption.

Relistab, C., University of Jyväskylä, Centre of Excellence in Evolutionary Research, Jyväskylä, Finland, christian.relistab@juu.fi
Lohu, K. R., University of Jyväskylä, Centre of Excellence in Evolutionary Research, Jyväskylä, Finland, katja-riikka.lohi@juu.fi
Karvonen, A., University of Jyväskylä, Centre of Excellence in Evolutionary Research, Jyväskylä, Finland, ansu.it.karvonen@juu.fi
Jokela, J., Eawag, Aquatic Ecology, Dübendorf, Switzerland, jukka.jokela@eawag.ch

PARASITE INFECTIONS IN THE EYE LENSES OF FRESHWATER FISH – ANALYZING COMMUNITY STRUCTURE BY PYROSEQUENCING OF NATURALLY POOLED SAMPLES

Eye flukes (Diplostomum, Trematoda) are ubiquitous parasites of freshwater fish infecting the lenses of over 100 fish species worldwide. They increase their hosts’ predation risk and cause significant problems in aquaculture. The lenses of fish are normally infected by more than one eye fluke species, resulting in complex parasite communities shaped by various ecological and evolutionary factors. We asked how parasite communities differ among fish species, and which factors might play an important role in determining them. We analyzed the parasite species composition of several fish species and experimentally tested spatial, temporal and immunization effects. For species identification we applied pyrosequencing, allowing us to overcome taxonomic difficulties and use naturally pooled community samples (whole lenses). We report a high frequency of multiple species infections and significant differences in community structure among fish species. Some Diplostomum species were host specialists whereas others were generalists. However, the infection patterns seem to be strongly influenced by spatial and temporal effects. Our study provides an example of how quantitative pyrosequencing can be used to answer evolutionary and ecological questions in natural parasite communities.

Renagi, O., PNG University of Technology, Lae, Papua New Guinea, ora.renagi@gmail.com
Ridd, P. V., James Cook University, Townsville, Australia, peter.ridd@jcu.edu.au
Stieglitz, T. C., Australian Institute of Marine Science, Townsville, Australia, thomas.stieglitz@jcu.edu.au

QUANTIFYING THE SUSPENDED SEDIMENT DISCHARGE TO THE OCEAN FROM THE MARKHAM RIVER, PAPUA NEW GUINEA

The Markham River is a small river draining a tropical mountain range with altitudes between 1000 to 3000 m. The river has an estimated sediment load of 12 Mtyr⁻¹ and discharges directly into a submarine canyon. Occasionally, hyperpycnal flow is generated at the river mouth. Profiles of salinity and suspended sediment concentrations (SSC) show that sediment is dispersed via a plume with components at both the surface, intermediate depth along isopycnal surfaces and near the sea bed. Estimates of the horizontal sediment flux gradient of the surface plume along the estuary axis suggest that about 80% of sediment discharged is lost within a distance of 2 km from the river mouth. SSCs, between 500 – 1500 mg/l-1 were observed at intermediate depths during periods of high and low discharge. SSCs near the seabed of between 250 and 750 mg/l-1 suggest that layers of significantly elevated density exist near the seabed, moving down steep seafloor slopes. The SSC data confirms that the Markham River is a high yield river suitable for studies of sediment transport mechanisms analogous to systems during low stand sea levels.

Reul, N. R., IFREMER, plouzané, France, nreul@ifremer.fr
Chapron, B., IFREMER, plouzané, France, bchapon@ifremer.fr
Brachet, S., IFREMER, plouzané, France, sbrachet@ifremer.fr
Salisbury, J., UNH, Durham, USA, joe.salisbury@unh.edu
Vandemark, D., UNH, Durham, USA, doug.vandemark@unh.edu

RECENT PROGRESS IN THE SEA SURFACE SALINITY REMOTE SENSING FROM SPACE

We enter now in a new era of global Sea Surface Salinity (SSS) observing systems from space with the recent successful launch of the ESA Soil Moisture and Ocean Salinity (SMOS) mission, and the future NASA Aquarius/SAC-D mission. These new satellite SSS observing systems are as well complemented by an increased
number of devices deployed in situ. In Reul et al. 2009, we have moreover demonstrated that Sea Surface Salinity (SSS) can be as well retrieved from Space in warm seas using data from the AMSR-E satellite, giving access to an almost 10 year period sampling of SSS in the tropics. The Cersat Salinity Center is a research group of the French Institute of Research for the Exploitation of the Sea (Ifremer) and our activities are focused on the challenge of Sea Surface Salinity (SSS) Remote Sensing from space. In this talk we will present recent results from the ESAs Soil Moisture and Ocean Salinity (SMOS) satellite mission and its global SSS mapping capacities, AMSR-E method for the Tropical Atlantic and Indian oceans, as well as SSS mapping methods based on the relationships between SSS and ocean color products to reach the coastal domain. With these new SSS products, useful study can now be started for ocean circulation modeling, climate studies, bio-optics and bio-chemistry of the ocean.

Reuscher, M. G., Texas A&M University - Corpus Christi, Corpus Christi, USA, Michael.Reuscher@tamuc.edu

Shirley, T. C., Texas A&M University - Corpus Christi, Corpus Christi, USA, Thomas.Shirley@tamuc.edu

BODIOWITY OF FAUNAL ASSEMBLAGES IN PROXIMITY TO DEEP-WATER CORALS OF BRITISH COLUMBIA
During the “Finding Coral” cruise in 2009, we explored seven different sampling sites at the continental slope of Northern British Columbia with one-man Deepworker-submersibles. The goals of the survey included the observation and quantification of diversity of deep-water corals and their associated fauna. High definition videos were recorded and up to four 200 m transects were conducted during each dive. For quantification purposes 15 still images (quadrats) of each transect were extracted from the videos. Organisms on each image were identified to the lowest taxon possible and counted. The resulting species list was used to calculate α-diversity of different sampling sites. For the calculations we used the taxonomic distinctness measurement, an index that is based on the Simpson index but that includes phylogenetic relationships of the observed fauna. Relative coral cover of each transect was measured in order to test the hypothesis that increased coral coverage was correlated with higher biodiversity. The Bray-Curtis index was used for measurements of β-diversity, the turnover rate of α-diversity among sampling sites.

RICARUTE, M., University of Puerto Rico, Mayaguez, Puerto Rico

PRELIMINARY PROTEOMICS IN BLEACHED AND HEALTHY CARIBBEAN CORAL
Coral bleaching is highly likely in the Caribbean in 2010 and could be as severe as in 2005. Thermal stress and bleaching in corals affect the following processes: oxidative stress, Ca2+ homeostasis, cytoskeletal organization, cell death, calcification, metabolism, protein synthesis and heat shock protein activity. In order to understand the molecular and cellular basis of bleaching in Caribbean corals, we have measured gene expression changes associated with thermal stress and bleaching using proteomics of the scleractinian corals (Acropora spp.). In the present study, we investigated alterations in proteins of healthy and bleached Acropora by two-dimensional (2D) gel electrophoresis followed by liquid chromatography-tandem mass spectrometry, protein identification. Preliminary data of a protocol-development identified 136 differentially expressed proteins that had a two-fold or greater change in expression (51 spots were up-regulated and 85 were downregulated), compared to the control cultures (healthy tissue corals), and 11 were common proteins. Diseased coral by bleaching significantly changed the expression of several components. The preliminary results will be confirmed at the gene expression level by qRT-PCR.

Rice, F. J., City University of New York, New York, New York, USA, riceford@gmail.com

Stewart, G. M., City University of New York - Queens College, New York, New York, USA, Gillian.Stewart@qc.cuny.edu

SHIFTS IN LONG ISLAND SOUND ZOOPLANKTON SIZE AND DIVERSITY REFLECT CLIMATE CHANGE
Data from the Connecticut Department of Environmental Protection (CT DEP) and historical data from a large scale survey carried out in the 1950s (Riley et al., 1956) suggest average annual surface temperatures in the Central Basin of LIS have risen 1.5°C over the past 60 years while nutrient levels have remained equivalent. These data confirm the observation of Rosenzweig (2008) that sea surface temperatures in LIS have increased 1°C over the past 30 years, much faster than the regional and global average. Dufrasne et al. (2009) and Huntley and Lopez (1992) suggest the most important members of the zooplankton (copepods) will decrease in size with warming temperatures. Climate Change can also affect copepod community structure by facilitating invasion by southern species and increasing species richness (Stachowicz et al., 2002). Preliminary results of my surveys suggest both of these processes are occurring in LIS. New subtropical species of Calanoid, Cyclopooid, and Harpacticoid copepods have appeared, and the mean prosome length of Acartia tonsa for August has decreased from 1009um to 912um, suggesting LIS is shifting to a more subtropical zooplankton regime.

Richards, B. P., Heidelberg University, Tiffin, USA, prichard@heidelberg.edu

Baker, D. B., Heidelberg University, Tiffin, USA, dbaker@heidelberg.edu

INCREASING TRENDS IN DISSOLVED PHOSPHORUS IN LAKE ERIE TRIBUTARIES: THE ROLE OF AGRICULTURAL PRACTICES
Lake Erie is the smallest of the Laurentian Great Lakes, and the most subject to anthropogenic eutrophication, which has worsened significantly in recent years. Phosphorus, the limiting nutrient, comes primarily from runoff from Lake Erie’s largely agricultural watershed. Loads of sediment and particulate phosphorus entering the lake have decreased over the last 35 years, due primarily to erosion control measures. By contrast, dissolved reactive phosphorus loads declined initially but have increased rapidly since about 1995, and these highly bioavailable loads are now as high or higher than in the 1970s, when the lake was considered ‘dead’. Suggested causes include increased soil phosphorus concentrations, focusing of phosphorus in the upper several centimeters of the soil (stratification), application of fertilizer and manure in the fall and winter, and application of fertilizer and manure to the soil surface without incorporation. The objectives of this presentation are to communicate results of recent research designed to evaluate the relative importance of the causes for increased dissolved phosphorus loading proposed above, and to suggest better management practices and explore why they are not already in place.

RICHARDSON, C. J., DUKE UNIVERSITY WETLAND CENTER, DURHAM, USA, curtis@duke.edu

Hartman, W. H., Duke University Wetland Center, Durham, USA, WH3@duke.edu

PHOSPHORUS BIOGEOCHEMISTRY AND WETLAND FUNCTION ON THE LANDSCAPE
Historically wetlands were considered the filtering or storage systems for nutrients on the landscape and thus understood in developing the role of wetlands in storage, release and cycling of P. In this paper I address a series of studies that may help us better comprehend the importance changes in P biogeochemistry in wetland systems over time. NMR analysis reveals what forms of P are found in natural and restored wetlands on former agricultural and suggests microbial alterations help in the development of more complex and less available P species over time. At the landscape scale we are interested in the capacity of wetlands to store P addition, without reducing wetland function. A P loading threshold for wetlands is developed from the national wetland database and reveals an interesting pattern of P storage and an environmental P threshold. This paper presents key studies that provide an assessment of where we are in terms of our knowledge of wetland P biogeochemistry as it relates to wetland water quality functions.

Richardson, T. L., University of South Carolina, Columbia, USA, tamlrichardson@gmail.com

Hill, L. S., University of South Carolina, Columbia, USA

Baranowski, M. R., University of South Carolina, Columbia, USA

Swanstrom, J. A., University of South Carolina, Columbia, USA

Shaw, T. J., University of South Carolina, Columbia, USA

Myrick, M. L., University of South Carolina, Columbia, USA, myrick@mail.chem.sc.edu

SENSORS FOR CHARACTERIZATION OF PHYTOPLANKTON SIZE AND TAXONOMIC COMPOSITION USING SPECTRAL FLUORESCENCE SIGNATURES AND IMAGING MULTIVARIATE OPTICAL COMPUTING
Our research focuses on developing sensors for the in situ discrimination of phytoplankton size and community composition. The technological basis, imaging multivariate optical computing (IMOC), uses fluorescence excitation spectral information combined with optical discriminant analysis to ‘bar code’ different phytoplankton taxa. Excitation spectra are collected using a single-cell spectral fluorometer. With IMOC, uses fluorescence excitation spectral information combined with optical discriminant analysis to ‘bar code’ different phytoplankton taxa. Excitation spectra are collected using a single-cell spectral fluorometer. With IMOC, uses fluorescence excitation spectral information combined with optical discriminant analysis to ‘bar code’ different phytoplankton taxa. Excitation spectra are collected using a single-cell spectral fluorometer. With IMOC, uses fluorescence excitation spectral information combined with optical discriminant analysis to ‘bar code’ different phytoplankton taxa. Excitation spectra are collected using a single-cell spectral fluorometer. With IMOC, uses fluorescence excitation spectral information combined with optical discriminant analysis to ‘bar code’ different phytoplankton taxa. Excitation spectra are collected using a single-cell spectral fluorometer. With IMOC, uses fluorescence excitation spectral information combined with optical discriminant analysis to ‘bar code’ different phytoplankton taxa.
on phytoplankton size is acquired by the instrument’s use of the camera in “streak” mode. To date, we have produced a set of MOEs that successfully classify a diatom (Thalassiosira pseudonanana), a coccolithophore (Emiliania huxleyi) and a cyanobacterium (Synechococcus sp.) in a mixed-species culture. A sea-going instrument has been prototyped and will be tested using natural phytoplankton communities. Construction of additional MOE sets is also underway.

Richey, J. E., University of Washington, Seattle, USA, jrichey@uw.edu
Krusche, A. V., Centro de Energia Nuclear na Agricultura, Piracicaba, Brazil, alex@caena.usp.br
Ellis, E. E., University of Washington, Seattle, USA, ellis@uw.edu

HOW CARBON DYNAMICS IN LARGE TROPICAL RIVERS MIGHT RESPOND TO GLOBAL CHANGE*
The large rivers of the tropics account for a significant fraction of the flux of carbon to the oceans and of fluvial CO2 to the atmosphere. It follows logically that global change will have consequences, but what? Here we speculate on how change might affect tropical rivers, based primarily on results from the Amazon and Mekong. The first problem in understanding fluvial carbon dynamics at scales larger than relatively easily measured discrete streams. How do carbon fluxes change, from small seeps and streams to the mouths of the biggest rivers? Recent results from the Amazon show pronounced coherence of carbon with the hydrograph across multiple scales, where pCO2 and DOC rises and falls directly with river stage, with inverse distributions of dissolved O2 and pH. Outgassing increases from large rivers to small. These general patterns are reflected in major and minor ions, nutrients, sediments and sediment composition. Similar patterns are seen on the Mekong, offset by differences in the weathering environments. Implications for changes resulting from runoff patterns and increasing hydroelectric development are considered.

Richier, S., National Oceanography Centre, Southampton, United Kingdom, s.richier@noc.soton.ac.uk
Macey, A. I., National Oceanography Centre, Southampton, United Kingdom, aim103@noc.soton.ac.uk
Pratt, N., National Oceanography Centre, Southampton, United Kingdom, np2009@noc.soton.ac.uk
Ragni, M., University of Essex, Essex, United Kingdom, mragni@essex.ac.uk
Lawson, T., University of Essex, Essex, United Kingdom, talwson@essex.ac.uk.uk
Moore, C. M., National Oceanography Centre, Southampton, United Kingdom, c.moore@noc.soton.ac.uk
Bibby, T. S., National Oceanography Centre, Southampton, United Kingdom, tsb@noc.soton.ac.uk

QUANTIFICATION OF KEY METABOLIC PROTEINS DRIVING BIOGEOCHEMICAL CYCLES IN NATURAL POPULATIONS OF TRICHODESMIUM SPP.
Open-ocean diazotrophic cyanobacteria, such as Trichodesmium spp. are of particular importance to global biogeochemical cycles, due to their contribution to both the carbon (C) cycle via primary production and to the nitrogen (N) cycle because of their ability to fix N2 in an area corresponding to almost half of the Earth’s surface. We quantified the relative abundances of key metabolic proteins that drive biogeochemical cycles in Trichodesmium colonies collected between 31°25’N and 0°16’N as part of the Atlantic Meridional Transect (AMT19) cruise. Pool sizes of key proteins involved in nitrogen and carbon fixation such as nifH (iron [Fe] protein of nitrogenase), psaB (D1 protein of PSII), psaC (core subunit of PSI) and the Fe-stress-induced protein isiA were investigated. Protein abundances were further related to physiological rates within Trichodesmium populations to indicate how these cyanobacteria aclimatize to their natural environment through changes in the proportion and activity of key metabolic complexes. Importantly the isiA protein was present in all collected Trichodesmium samples, suggestive of an iron-stressed physiology under these conditions.

Ridgwell, A. J., University of Bristol, Bristol, United Kingdom, andy@sea2o.org

OCEAN ACIDIFICATION: THE ‘OTHER CO2 PROBLEM’?
Concerns regarding ocean acidification, widely known as the ‘other CO2 problem’, have stimulated a wide spectrum of research into the effects on organisms and ecosystems of changes in ocean carbonate chemistry. As a result, the uptake of CO2 by the ocean has stimulated a wide spectrum of research into the effects on organisms and ecosystems of changes in ocean carbonate chemistry. As a result, the uptake of CO2 by the ocean chemistry cannot be disentangled from other CO2-driven (climatic) changes. Hence, in predicting future impacts as well as interpreting the geological record acidification is arguably the ‘same CO2 problem’. Here I will review what we know, or think we know, about global-scale impacts related to ocean acidification and their relationship to other climatic changes, and what the geological record can tell us.

Riedel, B., University of Vienna, Vienna, Austria, bettina.riedel@univie.ac.at
Zuschin, M., University of Vienna, Vienna, Austria, martin.zuschin@univie.ac.at
Stachowitsch, M., University of Vienna, Vienna, Austria, michael.stachowitsch@univie.ac.at

MARINE MACROBENTHOS: BEHAVIOUR AND SURVIVAL AS INTEGRATED INDICATOR OF OXYGEN THRESHOLDS AND MORTALITY EVENTS
Oxygen in shallow coastal marine ecosystems has dramatically changed over past decades, and hypoxia has become a recognised global key stressor. Monitoring
coastal zones to assess and maintain ecological integrity is an essential strategy, and bioindicators are necessary to provide information on ecosystem status. Using an experimental underwater-chamber, we create small-scale anoxia in a community setting in the Northern Adriatic Sea (Mediterranean). The in situ experiments successfully mimic full-scale hypoxia/anoxia and reveal a clear sequence of species-specific macrobenthic behaviours and mortalities correlated to specific oxygen thresholds. This yield of new details, at a more nuanced scale of resolution than ever before in the field, helps our understanding of benthic community status of on three levels: 1) The behaviour of organisms provides information on the present status (e.g. diver observations, imaging methods); 2) The community composition (e.g. survival of tolerant species, size of recolonizing epifauna) can help to pinpoint and define the spatial extension of past mortalities. 3) Combined, this information complements laboratory studies and provides a useful tool to gauge the effects of a future expansion of hypoxia/anoxia.

Riley, J. S., National Oceanography Centre, Southampton, Southampton, United Kingdom, Jennifer.Riley@noc.soton.ac.uk
Sanders, R., National Oceanography Centre, Southampton, Southampton, United Kingdom, R.Sanders@noc.soton.ac.uk
Leakey, R., Scottish Association for Marine Science, Oban, United Kingdom, ray.leakey@sams.ac.uk
Achterberg, E. P., National Oceanography Centre, Southampton, Southampton, United Kingdom, eric@noc.soton.ac.uk
Tyrell, T., National Oceanography Centre, Southampton, Southampton, United Kingdom, Toby.Tyrell@noc.soton.ac.uk
COMMUNITY COMPOSITION AND FAecal Pellet Export Under-NEATH Arctic Sea Ice

The Arctic is warming faster than any other region on the planet, showing trends of decreasing summer sea ice extent and thickness. Such alterations may impact below sea ice primary production, thereby affecting total particulate organic carbon (POC) export. Understanding current sub-ice rates and pathways of POC export is necessary to compare with future changes. This study examines sinking particles from two ice covered sites; North Svalbard and East Greenland, sampled in a quasi-lagrangian style using a Marine Snow Catcher during summer 2010. Faecal pellets, although 50% less common than aggregates, contained on average ~30 times more carbon style using a Marine Snow Catcher during summer 2010. Faecal pellets, although 50% less common than aggregates, contained on average ~30 times more carbon.

Rincón-Díaz, M. P., International Institute of Tropical Forestry, USDA Forest Service, San Juan, Puerto Rico, mrincondiaz@fs.fed.us
Solorzano, M., International Institute of Tropical Forestry, USDA Forest Service, San Juan, Puerto Rico, msolorzano@fs.fed.us
Crain, B., International Institute of Tropical Forestry, USDA Forest Service, San Juan, Puerto Rico, bcrain@fs.fed.us
Herrera-Montes, M. I., International Institute of Tropical Forestry, USDA Forest Service, San Juan, Puerto Rico
Ortiz-Rosa, S., International Institute of Tropical Forestry, USDA Forest Service, San Juan, Puerto Rico, sortizrosa@fs.fed.us
Quiñones, M., International Institute of Tropical Forestry, USDA Forest Service, San Juan, Puerto Rico, mquinones@fs.fed.us
Potts, G., International Institute of Tropical Forestry, USDA Forest Service, San Juan, Puerto Rico, gpotts@fs.fed.us
Gould, W., International Institute of Tropical Forestry, USDA Forest Service, San Juan, Puerto Rico, wgould@fs.fed.us

USING LANDSCAPE FEATURES TO CLASSIFY WATERSHEDS AND FRESH-WATER HABITATS, AND TO QUANTIFY HUMAN FOOTPRINTS IN RIVERINE SYSTEMS OF PUERTO RICO

Landscape features such as geology, elevation, topography, and the climate of Puerto Rico produce a complex system of rivers that is also modified by land use patterns. For management and conservation of freshwater resources agencies have grouped the rivers of Puerto Rico within their own watershed boundary delineations. Despite the fact delineations exist, there is a lack of understanding of how landscape features influence watersheds and rivers. There is a need for classifying and linking the latter based on relative homogeneous features to unify conservation and management plans. In addition, due to the fact that Puerto Rico has an increasing process of urbanization there is a need to understand the influence of the human footprint on riverine habitats. We proposed first, to characterize and classify water bodies in a hierarchical framework from watershed to stream levels by establishing relative homogeneous landscape features, and second to quantify the human influence on riverine areas by analyzing land cover classes for Puerto Rico. Preliminary results of this study are shown in this presentation.

RIVERO-CALLE, S., JOHNS HOPKINS UNIVERSITY, BALTIMORE, USA, SRIVERO1@HUEDU
ARMSTRONG, R. A., UNIVERSITY OF PUERTO RICO, MAYAGUEZ, Puerto Rico, royaarmstrong@yahoo.com
ECOLOGICAL ASPECTS OF SPONGES IN MESOPHOTIC CORAL REEFS

Information regarding taxonomy and ecology of sponges in MCE is scarce. The goal was to characterize MCE distribution in five areas of Puerto Rico using over 1116 images obtained with the Seabed Autonomous Underwater Vehicle (AUV). Influence of geomorphology, depth, location, turbidity and distance from land was evaluated. Geomorphology is a determinant factor for MCE community composition but not so for coral species composition. Coral, macroalgae and total live cover tend to increase with distance from land and decrease with turbidity. Depth is an indirect factor: regression analyses suggest that effects of the factors are stronger with depth and that 50-100m depth ranges are possibly more sensitive. It is suggested to refer to these ecosystems as MREs (Mesophotic Reef Ecosystems). Three transition patterns may be indicating a change to true mesophotic ecosystems: 1) gorgonian to black coral, 2) Agaricia-dominance, 3) coral-to-sponge dominance. Sponge species richness (77) is greater than corals (28), in both cases tend to decrease with increasing depth. Morphology of sponges seems to be related to depth and location, whereas color is related to geomorphology, turbidity and location.

Rivkin, R. B., Memorial University of Newfoundland, St. John's, Canada, rivkin@mun.ca
MICRObIAL FOOD Web STRUCTURE AND CONNECTIONIVITY IN THE UPPER AND MESOPELAGIC LAYERS OF THE OCEAN: COMPARISON AMONG OCEAN REGIONS.

Our understanding of climate, ecosystem and biogeochemical processes depends upon a combination of conceptual developments and direct field observations. It is generally accepted that the upper ocean is under sampled with respect to key ecological and biogeochemical characteristics, both of which are largely controlled by the food web structure and activity. Far less known about the food webs and biogeochemistry in the mesopelagic layer of the World Ocean, and interactions and connectivity of food webs and fluxes between these euphotic and mesopelagic layers. For diverse regions of the World Ocean, the structure and composition of the heterotrophic microbial community was examined using a combination of field studies and meta-analyses, to assess the relationship within and between ocean regions and layers. Both the abundance and community structure of bacteria and protists vary with depth and region, and the depth-related connectivity appears to vary primarily with latitude and the temperature, and differential between the surface and ~100m. This variation has a potentially profound influence on nutrient and carbon remineralization and efficiency of organic carbon fluxes.

Roa Pascuali, L., Institut de Recherche Pour le Développement, Sète, France, lripascuali@yahoo.com, liliana.pascuali@gemres.fr
Demarco, H., Instituto de Investigaciónes para el Desarrollo, Sète, France, herv.e..demarco@ird.fr
Aristegui, J., Universidad de Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, jaristeuji@ub.edu.es
TESTING MODELS TO DETECT TRICHOcSPEMUM spp. PRESENCE IN THE CANARY ISLANDS REGION

Nitrogen-fixing cyanobacteria, Trichodesmium spp. could play an important role in climate change regulation. Two empirical models of different level of complexity and specifically developed for detection were tested. These algorithms, based on the SeaWiFS remote sensing reflectance, provide a synoptic approach of Trichodesmium spp. presence considering 3200 trichomes L-1 as a threshold for a bloom event. Based on the report of a bloom during August 2004, satellite data from July to September was used to test the algorithms. From in situ observations around Gran Canaria, our results shows a better match of the detections from the most statistically
Ocean exist. Researchers from the U.S. Geological Survey (USGS) and University of

However, few comprehensive data sets of carbonate system parameters in the Arctic

be undersaturated in late summer months when ice melt is at its greatest extent.

carbonate minerals in the next decade. Recent field results indicate parts may already

A THREE-DIMENSIONAL VIEW OF CARBON SYSTEM PARAMETERS OF

Hansen, M., U.S. Geological Survey, Saint Petersburg, USA, mhansen@usgs.gov

Dufore, C., U.S. Geological Survey, Saint Petersburg, USA, cdufore@usgs.gov

Liu, X., University of South Florida, Saint Petersburg, USA, liu@marine.usf.edu

Byrne, R., University of South Florida, Saint Petersburg, USA, byrne@marine.usf.edu

Yates, K. K., U.S. Geological Survey, Saint Petersburg, USA, kyates@usgs.gov

Robbins, L. J., U.S. Geological Survey, Saint Petersburg, USA, lrobbins@usgs.gov

Yates, K. K., U.S. Geological Survey, Saint Petersburg, USA, kyates@usgs.gov

Byrne, R., University of South Florida, Saint Petersburg, USA, byrne@marine.usf.edu

Liu, X., University of South Florida, Saint Petersburg, USA, liu@marine.usf.edu

Dufore, C., U.S. Geological Survey, Saint Petersburg, USA, cdufore@usgs.gov

Patsavas, M., University of South Florida, Saint Petersburg, USA, patsavas@usgs.gov

Hansen, M., U.S. Geological Survey, Saint Petersburg, USA, mhansen@usgs.gov

A THREE-DIMENSIONAL VIEW OF CARBON SYSTEM PARAMETERS OF

THE ARCTIC OCEAN

Models project the Arctic Ocean will become undersaturated with respect to

Carbone minerals in the next decade. Recent field results indicate parts may already

be undersaturated in late summer months when ice melt is at its greatest extent.

However, few comprehensive data sets of carbonate system parameters in the Arctic

Ocean exist. Researchers from the U.S. Geological Survey (USGS) and University of

South Florida (USF) collected high-resolution measurements of pCO₂, pH, total dis-

solved inorganic carbon (DIC), total alkalinity (TA), and carbonate (CO₃²⁻) from the

Chukchi Sea and Canada Basin that fill critical information gaps concerning Arctic

carbon variability. A Multi-parameter Inorganic Carbon Analyzer (MICA) was used to

collect over 22,000 measurements of air and sea pCO₂, pH, DIC along a 9,450

km trackline during August 2010. In addition, 240 discrete surface water samples and

nine vertical Niskin casts down to 3,000 m were analyzed shipboard for CO₃²⁻, pH, and TA.

These data are being used to characterize and model regional pCO₂, pH, and carbonate mineral saturation state. A high-resolution, three-dimensional map of these results will be presented.

Robeige, J. J., Saint Michael's College, Colchester, USA, jroberge@smcv.edu

McCabe, D. J., Saint Michael's College, Colchester, USA, dmcabbe@smcv.edu

THE EFFECTS OF PHOSPHORUS ON BENTHIC MACROINVERTEBRATES IN THE LAKE CHAMPLAIN BASIN

This research was undertaken to address the impacts of storm water run-off on phosphorus concentration and benthi macroinvertebrate communities in Vermont streams. Phosphorus and benthi macroinvertebrate samples were taken in 30 tribu-

taries of Lake Champlain over three years. Total phosphorus in grab samples was measured using the ascorbic acid method. Benthic macroinvertebrates from benthi kick samples were identified to family or genus. Several benthi community metrics including species richness, EPT (Ephemeropteran, Plecoptera, and Trichoptera) richness and Hydropsychidae (Trichoptera) abundance were calculated. Results show that as phosphorus levels increased in agricultural and urban watersheds, so did the abundance of Hydropsychidae, a benthic macroinvertebrate that is highly tolerant to disturbance. Both species richness and EPT richness tended to be lower in streams with higher phosphorus levels. The results have important implications for the selection of benthi metrics that respond to urban and agricultural land uses.

Robert, K., University of Victoria, Victoria, Canada, kroache@uvic.ca

Juniper, S. K., University of Victoria, Victoria, Canada, kjuniper@uvic.ca

CAMERAS, IMAGES AND UNDERWATER SURVEILLANCE: AN INTEGRAT-

ED APPROACH TO THE QUANTIFICATION OF BIOTURBATION BY THE

DEEP-SEA MEGABENTHOS

The mixing of sediments by the benthic megafauna strongly affects biogeochemical processes, but the contribution of individual species remains poorly understood. Geochemical measures of bioturbation generally provide an aggregate estimate of the total effect. Quantifying the contribution of individual organisms requires direct observation which are logistically challenging in the deep sea. Emerging camera-based systems permit real-time deployments and interactive sampling, providing a new tool for long-term studies of the benthos at high temporal resolutions. We report here on the development of a methodology approach to study bioturbation in a submarine canyon using video cameras remotely operated over the internet, through the NEPTUNE Canada observatory. A step-wise process was used to determine optimal observation schedule and image analysis techniques were developed to extract quantitative measures. Our integrative approach included the use of satellite imagery, scanning sonar and at-depth fluorometers to extend the field of view and characterize the influence of environmental parameters. Application of a Bayesian model to extrapolate data quantifying megafaunal locomotion patterns and appearance rates indicated complete sediment surface turnover every three months and significant contributions by different taxa.

Roberts, R. J., Louisiana Universities Marine Consortium (LUMCON), Chauvin, USA, roberts@lumcon.edu

Morrison, W., Louisiana Universities Marine Consortium (LUMCON), Chauvin, USA, wmorrison@lumcon.edu

Del Rio, R., Louisiana Universities Marine Consortium (LUMCON), Chauvin, USA, rdelrio@lumcon.edu

Pride, L., Louisiana Universities Marine Consortium (LUMCON), Chauvin, USA, lpride@lumcon.edu

Semmler, C. M., Louisiana Universities Marine Consortium (LUMCON), Chauvin, USA, csemmler@lumcon.edu

Semmler, C. M., Louisiana Universities Marine Consortium (LUMCON), Chauvin, USA, csemmler@lumcon.edu

Turner, R. E., Louisiana State University, Baton Rouge, USA, euturne@lsu.edu

SPATIAL AND TEMPORAL PATTERNS IN WATER COLUMN AND BENTHIC

RESPIRATION IN THE NORTHERN GULF OF MEXICO HYPOXIC ZONE

The largest zone of oxygen-depleted coastal waters in the United States, and second

largest in the world, occurs annually in the northern Gulf of Mexico downstream

from the discharges of the Mississippi (MB) and Atchafayaw Basins (AR). Large

changes in the riverine inputs of freshwater, nutrients, organic matter, and other

constituents over the last century have led to vast increases in the size and duration

of hypoxic conditions. Despite the growing interest in reducing the size and duration

of hypoxia, there have been few respiration rate measurements in bottom waters and

sediments in the region. We present data on inshore-offshore and vertical patterns in

water column respiration rates along bi-monthly transects off Terrebonne Bay (MB

plume water) and Atchafayaw Bay Delta Estuary (ARDE: AR plume water) as well

as from the lower AR and the ARDE. In addition, we will report benthic metabolism

rates from seven stations along a transect extending from the main stem AR and

Wax Lake Outlet river delta out to the 30m isobath (located ~85 km offshore) dur-

ing spring hypoxia development and summer maximal extent periods.

Young, B., Dickinson College, Carlisle, USA, youngb@dickinson.edu

Rabalais, N. N., Louisiana Universities Marine Consortium (LUMCON), Chauvin, USA, rabalais@lumcon.edu

Turner, R. E., Louisiana State University, Baton Rouge, USA, euturne@lsu.edu
Such as AAAS and ASLO.

branches, preparation of derivative materials for broader distribution to decision

knowledge of and response to ocean acidification. NRC reports represent committee

Challenges of a Changing Ocean

and in 2010 released the report

Ocean acidification, a consequence of human-made carbon dioxide emissions,

importance of these factors we measured uptake rates of inorganic (ammonium and

Uptake rates were measured in October 2008 during bloom initiation. All forms

of nitrogen were taken up, however ammonium uptake rates were greatest at the

northern stations while nitrate uptake rates were greatest at the southern stations.

The proportion of organic nitrogen uptake was larger at estuarine stations while total

measured nitrogen uptake was larger at estuarine stations while total

NITROGEN UPTAKE IN THE EASTERN GULF OF MEXICO DURING KAR-

Harmful Karenia brevis blooms occur annually in the eastern Gulf of Mexico. Although considerable information exists on the nutrient requirements, preferences, and uptake abilities of K. brevis culture isolates from laboratory experiments, little data are available on in situ nutrient dynamics during active blooms. Evidence suggests that multiple nutrient sources and forms likely support K. brevis blooms. The relative contribution of each source may depend upon bloom physiological state, environment, and location along a latitudinal gradient. In order to examine the importance of these factors we measured uptake rates of inorganic (ammonium and nitrate) and organic (urea and amino acids) nitrogen using stable isotope techniques at estuarine, coastal, and offshore stations along the southwest coast of Florida.

Uptake rates were measured in October 2008 during bloom initiation. All forms of nitrogen were taken up, however ammonium uptake rates were greatest at the northern stations while nitrate uptake rates were greatest at the southern stations.
The proportion of organic nitrogen uptake was larger at estuarine stations while total measured nitrogen uptake was greatest at coastal stations.

NATIONAL RESEARCH COUNCIL REPORT ON OCEAN ACIDIFICATION: DEVELOPING AND COMMUNICATING SCIENTIFIC ADVICE FOR POLICY-MAKERS

Ocean acidification, a consequence of human-made carbon dioxide emissions, affects marine life and ecosystems, thus changing the ecosystem services they provide to people around the world. In legislation passed in 2008, the U.S. Congress requested a study from the National Research Council (NRC) on ocean acidification to be funded by NOAA. With additional sponsorship from NASA, NSE and USGS, the NRC assembled a committee of independent experts to undertake this study and in 2010 released the report Ocean Acidification: A National Strategy to Meet the Challenges of a Changing Ocean. The report reviews the current state of knowledge, explores gaps in understanding, and offers recommendations for advancing knowledge of and response to ocean acidification. NRC reports represent committee consensus, with a stringent external review process overseen by the NRC to ensure quality, objectivity, and findings supported by scientific evidence. Report dissemination includes congressional testimony, briefings for the legislative and executive branches, preparation of derivative materials for broader distribution to decision makers and the interested public, and participation in professional society meetings such as AAAS and ASLO.

Robinson, C., University of East Anglia, Norwich, United Kingdom, carol.robinson@uea.ac.uk

Hardman-Mountford, N., Plymouth Marine Laboratory, Plymouth, United Kingdom

Serret, P., University of Vigo, Vigo, Spain

Kitidis, V., Plymouth Marine Laboratory, Plymouth, United Kingdom

The impact of coastal upwelling on the cycling of dissolved oxygen and carbon dioxide

Coastal upwelling regions significantly influence oceanic biogeochemistry and atmospheric chemistry through supply of water supersaturated with carbon dioxide, undersaturated in dissolved oxygen and rich in inorganic nutrients and photolabile dissolved organic matter (DOM). As part of the NERC UK SOLAS programme, we used sulphur hexafluoride and drifting buoys to follow an upwelled filament off the coast of NW Africa to determine how the cycling of dissolved oxygen and carbon dioxide is influenced by 1) the hydrography of the upwelling system, 2) the variability in plankton community structure and activity caused by supply of nutrient-enriched water, and 3) photodegradation of upwelled and recently produced DOM. The surface water signature of the upwelling plume was characterised by pCO2 concentrations > 600 µatm and dissolved oxygen saturations of 85%. Gross oxygen production ranged from 3 to 16 g C m-2 d-1, while photochemical breakdown of DOM released up to 0.3 g C m-2 d-1 and consumed up to 1.6 mmol O2 m-2 d-1.
The heterokonts (or stramenopiles) encompass diverse and ecologically successful lineages of chlorophyll c-containing algae, including diatoms, pelagophytes, and chrysophytes. Like haptophytes, photosynthetic heterokonts are secondary endosymbionts of the red lineage. However, despite their morphological diversity and ecological importance, evolutionary relationships among the various classes remain largely unresolved. Here we use both plastid and mitochondrial genome sequences from 21 taxa representing 10 major classes to reconstruct the phylogeny of the heterokonts. The organelar genome sequences provide insight into plastid to nuclear gene transfer in secondary endosymbionts and offer additional loci for diversity studies in the field. A more accurate phylogeny of the heterokont lineage has implications for timescales of evolution of the major classes and suggests priorities for future candidates for whole genome sequencing.

Rocker, D., ICBM, University of Oldenburg, Oldenburg, Germany, dagmar.rocker@icbm.de
Kisand, V., University of Tartu, Tartu, Estonia
Brinkhoff, T., ICBM, University of Oldenburg, Oldenburg, Germany
Schulz-Boettcher, B., ICBM, University of Oldenburg, Oldenburg, Germany
Rullkötter, J., ICBM, University of Oldenburg, Oldenburg, Germany
Simon, M., ICBM, University of Oldenburg, Oldenburg, Germany, m.simon@icbm.de

DECOMPOSITION OF HUMIC ACIDS BY ESTUARINE AND MARINE BACTERIAL COMMUNITIES

Humic substances (HS) are the most abundant natural organic compounds in aquatic and terrestrial environments. However, the bacterial degradation of HS in the estuarine salinity gradient and in coastal regions as a sink for HS is not well understood and the bacteria catalyzing the decomposition are poorly known. Therefore we carried out experiments to examine the decomposition of humic acids (HA), the high molecular weight fraction of HS, by marine and estuarine bacterial communities. These communities served as inocula of flow through systems fed with HA media of salinities of 28 and 14. HA were decomposed to >60% of the initial HA after 70 d. During the decomposition process the composition of the bacterial communities were largely dominated by Alphaproteobacteria, Actinobacteria and Gammaproteobacteria, whereas in the estuarine flow through systems they were dominated by Gammaproteobacteria, Actinobacteria and Alphaproteobacteria.

Rodilbaugh, K. J., Texas State University, San Marcos, USA, kr1209@txstate.edu
Nowlin, W. H., Texas State University, San Marcos, USA, w111@txstate.edu

BACTERIALLY MEDIATED CARBON AND NUTRIENT DYNAMICS IN A HIGHLY-IMPACTED RIVER SYSTEM

Rivers are critical in the transport and transformation of carbon (C) and inorganic nutrients exported from terrestrial landscapes, with suspended bacteria potentially playing critical role. This study evaluated carbon (C) and inorganic nutrient dynamics in the Rio Grande network (in Texas, USA) and examined trends in bacterial C use along a downstream gradient of highly arid to semi-tropical landscapes. Bacterial production (BP), bacterial respiration (BR), water color, dissolved organic carbon (DOC), and inorganic nutrients were measured at 9 sites in the Rio Grande and two of its major riverine tributaries (the Pecos and Devils Rivers). Sampling was conducted seasonally over a one-year period. BP and BR generally increased in a downstream direction along the drainage, although DOC did not substantially change along this gradient or with season. However, both bacterial growth efficiency (BGE) and bacterial carbon demand (BCD) differed significantly among sites and among seasons. This study indicates that an understanding of bottom-up controls on C availability is essential to the creation and implementation of conservation efforts in highly-impacted river systems.

Rodriguez, C., University of Puerto Rico, Bayamon, Puerto Rico, concepcion.rodriguez@upr.edu

THE POPULATION OF THE COMMON LAND CRAB CARDISOMA GUANHUMI IN HACIENDA LA ESPERANZA, MANATI PUERTO RICO

The involvement of citizens in the research projects is an activity that enhances understanding and appreciation of science. In this study, a Citizen in Science project, about the population dynamics of the land crab Cardisoma guanhumi, we want to promote the conservation of natural resources by monitoring the population of the land crab. In Puerto Rico, Cardisoma guanhumi is a very popular food item and as such its population is declining. To study the population dynamics, we selected eight locations for monthly monitoring of the crab. Volunteers from the Citizens in Science Project participate in the monthly censuses. To estimate abundance and survival, we are doing a mark recapture study. Measurements of crabs carapace width and length as well as weight and sexing of animals are necessary to determine population structure, and sex ratio. Preliminary results of this ongoing study showed that abundance of land crabs is highest during August with 120 estimated individuals. Population structure shows that the most abundant crab size, based on carapace width is between 70 - 80 mm. Sex ratio is almost 1:1. A total of 458 volunteers had participated in the monthly censuses (13 months). Preliminary results of the volunteer evaluation of the experience, demonstrate that volunteers were satisfied with the experience and expressed gaining new knowledge about the land crab and the scientific method.

Rodriguez, G. E., University of California Santa Barbara, Santa Barbara, USA, gabriel.rodriguez@lifesci.ucsb.edu
Rasweiler, A., University of California Santa Barbara, Santa Barbara, U.S. Virgin Islands
Reed, D. C., University of California Santa Barbara, Santa Barbara, U.S. Virgin Islands
Holbrook, S., University of California Santa Barbara, Santa Barbara, U.S. Virgin Islands

PATTERNS OF BIRTH AND LOSS: WHAT EXPLAINS THE BIOMASS DYNAMICS OF THE WORLD’S MOST PRODUCTIVE MARINE ORGANISM, MACROCYSTIS PYRIFERA?

Giant kelp (Macrocystis pyrifera) forests around the world exhibit strong seasonal variation in vegetative biomass. Data collected by the Santa Barbara Coastal Long Term Ecological Research (SBC LTER) project demonstrate that variations in biomass of Macrocystis in the Santa Barbara Channel are much better predicted by the abundance of fronds than the abundance of whole plants. We examined frond lifetimes over 36 months and measured possible factors affecting variation in those lifetimes, such as wave height, temperature and nutrients. We found that age was the best predictor of frond death, accounting for the majority (~65%) of the variance in frond loss and all other factors combined explain only ~10 % of the total variance in frond loss. Despite extensive studies on this iconic species, little is known about the role of progressive senescence and other factors that may affect the life spans of individual fronds. Possible mechanisms behind strong age-dependent mortality are investigated and compared with mechanisms that determine leaf longevity in terrestrial plants.

Rodriguez, C., US Geological Survey, Guaynabo, Puerto Rico, jrodr@usgs.gov

THE HYDROLOGY OF PUNTA CABULLON: A HYPSALINE WETLAND SYSTEM IN PONCE, SOUTHERN PUERTO RICO

The Punta Cabullon area, located in Ponce, southern Puerto Rico, is a wetland system with substantial tidal and saltflats, mangrove forest, and a small fringing reef. The land surface at Punta Cabullon is characterized by a sequence of lunate beach ridges resulting from a rapidly prograding coast. The interaction of the paleosalts contained within the relic beach ridges with the rainfall, seawater, and high evapotranspiration determine the physical, chemical and stable isotopic nature of Punta Cabullon. Hypersalinity in both, surface- and groundwater, results from high evapotranspiration in a setting where the episodic entrance of modern seawater and the recycling of inland paleosalts coexist. The partial isolation of the wetland from the sea during the dry season, incoming insignificant fresh ground-water flow, and the shallowness of the groundwater enhance the role of evapotranspiration in Punta Cabullón. The movement and direction of ground-water flow in Punta Cabullon is complex, being driven by temporal and spatial density variations.
Rodriguez-Diaz, M., Max-Planck-Institut für marine Mikrobiologie, Bremen, Germany, mrodrig@mpi-bremen.de
Hanke, A., Max-Planck-Institut für marine Mikrobiologie, Bremen, Germany
Timm, K., Max-Planck-Institut für marine Mikrobiologie, Bremen, Germany
Strous, M., Max-Planck-Institut für marine Mikrobiologie, Bremen, Germany

MINIMIZING ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL REDOX CYCLES IN SEA SEDIMENT.

Here we apply the theorem of Bass Becking “everything is everywhere but the environment selects” to the study of poly-phosphate (Poly-P) accumulating communities. The major groups of bacteria known for their ability to accumulate high weight polymers of poly-P in waste-water treatment facilities are Candidatus Accumulibacter, Tetrasphaera spp. and related. Instead, the most studied poly-P accumulating bacteria in the sea belong to the genera Beggiatoa and Thiomargarita. We reproduce the changing redox conditions used in EBPR (Enhanced Biological Phosphorus Removal) waste-water treatment plants with bacterial communities extracted from marine sediment. The extracted communities are cultivated in bioreactors designed to monitor the physico-chemical changes in the culture. Our aim is to better understand the poly-P accumulating communities and their metabolic responses. We study the cultures at the ecosystem, community, and single cell level through different techniques. This communication will explain our approach and the results obtained for the culturable bacteria isolated after applying these conditions, specially their poly-P storing ability.

Rodriguez-Matos, L., University of Puerto Rico, Mayaguez, Puerto Rico, siuli42004@gmail.com
Lado-Insua, T., University of Rhode Island, Narragansett, USA
Torres-Pratts, H., University Of Puerto Rico, Mayaguez, Puerto Rico
Rhyne, A. L., Roger Williams University, Rhode Island, USA
Schizas, N. V., University of Puerto Rico, Mayaguez, Puerto Rico

TWO DISTINCT, GEOGRAPHICALLY OVERLAPPING LINEAGES OF THE CORALLIMORPHARIAN RICORDIA FLORIDA (Cnidaria: Hexacorallia: Ricordeidae).

We examined the genetic variation of the Caribbean corallimorpharian Ricordia florida, which is heavily harvested for the marine aquarium trade. Eighty-four distinct individuals of R. florida were sequenced from Curacao, Florida, Guadeloupe, and Puerto Rico. Analysis of the nuclear ribosomal region uncovered two geographically partially overlapping genetic lineages in R. florida, probably representing two cryptic species. Lineage 1 was found in Florida and Puerto Rico and Lineage 2 was found in Florida, Puerto Rico, Guadeloupe, and Curacao. Pairwise genetic comparisons showed that the levels of intra-individual and intra-lineage variability (< 1%) were approximately an order of magnitude lower than the divergence (~9%) observed between the two lineages. The fishery regulations of the aquarium trade regarding R. florida as one species. More refined regulations should take into account the presence of the two genetic lineages and they should be managed separately, in order to preserve the long-term evolutionary potential of this corallimorpharian. The discovery of two lineages in R. florida illustrates the importance of evaluating genetic variability in harvested species prior to the implementation of management policies.

Roe, K. L., SIO-UCSD, La Jolla, USA, kroe@ucsd.edu
Barbeau, K. A., SIO-UCSD, La Jolla, USA, kbarbeau@ucsd.edu
Hogle, S. L., SIO-UCSD, La Jolla, USA, shogle@ucsd.edu
Castillo, R., UCSD, USA, rzcastil@ucsd.edu

UTILIZATION OF HEME AS AN IRON SOURCE BY MARINE ROSEOBACTER.

Heme, an iron-bound porphyrin molecule, is a fairly ubiquitous iron-containing prosthetic group in the biological world. Although the release of this form of iron by cell lysis or degradation in the marine environment could be a pathway for efficient recycling of iron in the upper ocean, the use of heme as an iron source by planktonic marine bacteria has not been well-studied. Marine bacteria in the Roseobacter lineage are key players in ocean biogeochemical cycles, and bioinformatics analysis of available genomes has revealed analogs to known heme transport proteins in several members of this lineage. Silicibacter TrichCH4B, a model marine Roseobacter strain, was used to investigate the biochemistry of heme utilization by marine Roseobacteria. The bacterium's utilization of heme was explored with growth experiments on heme substrates, RT-QPCR gene expression analysis, and radioactive uptake. Quantitative PCR techniques were also applied to characterize the quantity and phylogeny of heme transport genes in natural marine bacterial assemblages.

Roelke, D. L., Texas A&M University, College Station, USA, drroelke@tamu.edu
Brooks, B. W., Baylor University, Waco, USA
Grover, J. P., University of Texas at Arlington, Arlington, USA

A DECAD OF FISH-KILLING PRYMNESIUM PARVUM BLOOMS IN TEXAS: ROLES OF INFLOW AND SALINITY.

Fish-killing Prymnesium parvum blooms have occurred in south-central USA for ~30 years. Blooms were winter phenomena developing under conditions far from the growth optimum. Bloom thresholds of 10 x 106 cells l-1 were observed as a function of inflow and salinity. In Lake Possum Kingdom, blooms occurred only when 7-day accumulated inflows were <10 x 106 m3 and salinities were >1.5 psu. For Lakes Granbury and Whitney, blooms occurred when 7-day accumulated inflows were <20 x 106 m3 and <90 x 106 m3, and salinities were >0.5 psu. Inflow usually exceeded thresholds during the spring and early-summer months. Salinities typically exceeded these thresholds during the period of study prior to the spring of 2007. The spring of 2007 was a period of high precipitation, after which salinities were typically below thresholds. The linkage between incidence of P. parvum blooms, inflows and salinity is of concern because combined effects from human population increase and climate change could lead to periods of decreased inflow and increased salinity, which may then increase the frequency and magnitude of P. parvum blooms.

Roettgers, R., Helmholtz Center Geesthacht / Institute for Coastal Research, Geesthacht, Germany, roettgers@gsk.de
Koch, B., Alfred-Wegener-Institute for Polar- and Marine Research, Bremerhaven, Germany, boris.koch@awi.de

EVIDENCE FOR A SINGLE CHROMOPHOR/FLUOROPHOR IN THE OCEAN’S OXYGEN MINIMUM ZONE.

Light absorption spectra of CDOM from the oxygen minimum zone reveal the existence of absorption shoulder at ca. 410 nm. This shoulder can be found in nearly all subtropical and tropical oceans and is most pronounced in the depth of 200-500 m. Earlier studies of Broenkow and coworkers showed the existence of a red fluorescence in the ocean’s oxygen minimum zone, which were later related to a 420 nm absorption shoulder in the Arabian Sea by Breves et al. (2003). We performed fluorescence emission and excitation analysis of concentrated DOM samples from larger depth throughout the Atlantic Ocean and observed a clear signal of a distinct fluorophor that is separated from the bulk CDOM. Its fluorescence peaks at ca. 650 nm and the 630 nm-excitation spectra showed distinct absorption characteristics that coincide with the CDOM absorption shoulder at 410 nm. We postulate the existence of a single chromophor/fluorophor in the oxygen minimum zone of the global ocean that has distinct characteristic to separate it from the bulk CDOM/DOM pool.

Rojas, M. L., University of Puerto Rico, Mayaguez, Puerto Rico, monicrojas@gmail.com
Schizas, N. V., University of Puerto Rico, Mayaguez, Puerto Rico

GENETIC POPULATION STRUCTURE OF TWO BRITTLE STARS (OPHIOCOMA ECHINATA AND AMPHIPHILIS SQUAMATA) WITH CONTRASTING LIFE HISTORIES.

Echinoderm display a wide array of life histories, which can have a profound effect in the dispersal potential and population structure of species. The brittle stars Ophiocharina echinata and Amphipholis squamata exhibit differing modes of development. O. echinata is a spawner having asynchronous breeding cycles and A. squamata is a brooder, viviparous and self-fertilizing hermaphrodite. Mitochondrial (16S) and ribosomal nuclear DNA sequences (ITS-1) from 16 populations of O. echinata and five populations of A. squamata around the Caribbean indicate that O. echinata harbors moderate levels of genetic variability in 16S (163 specimens, 66 haplotypes). Ophiocoma echinata exhibit no significant population structure (16S; Fst = 0.00236; P = 0.38319) in the Caribbean. Amphipholis squamata however, has high levels of genetic variability (63 specimens, 45 haplotypes) and harbors two distinct genetic lineages. One of these is a newly discovered lineage of A. squamata around the world. Significant differences (16S; Fst = 0.63887; P = 0.0000) were observed between Puerto Rico and Florida. These data provide compelling evidence that life history traits influence the connectivity of geographically distant populations.
COASTAL HYDROLOGY OF THE ISLANDS OF BIMINI, BAHAMAS

Submarine groundwater discharge (SGD) can be used to determine sediment permeability, and combined with geology can infer an area's hydrology. Groundwater hydrology is especially critical on small oceanic islands not only because freshwater reserves are limited, but also because anthropogenic inputs carried within water can influence coastal ecology. Some of these inputs include chemicals, fertilizers, and sewage, and are known to cause problems such as harmful algal blooms and eutrophication. These incidences create cascading consequences for industries such as fisheries, recreation, and tourism. Thus, a better understanding of groundwater's connection with other systems is necessary. Characteristics of groundwater hydrology were investigated in Bimini, Bahamas. Results showed low flow rates and high salinities suggesting that much of the SGD in Bimini is recirculated seawater. Radium 223 and 224 levels also supported a lack of fresh groundwater being expelled along the coastline. However, wells on the island gave evidence to a deeper aquifer hydraulically disconnected from tide. This is first study of its kind on Bimini.

ROLLAND, D., Université Laval & Center for Northern Studies, Quebec city, Canada, delphine.rolland1@ulaval.ca

Vincent, W. F., Université Laval & Center for Northern Studies, Quebec city, Canada, warwick vincent@fsg.ulaval.ca

Laurion, I., Université Laval & INRS-ETE, Quebec city, Canada, isabelle.laurion@etc.inrs.ca

RECRUITMENT OF BLOOM-FORMING CYANOBACTERIA IN A DRINKING WATER RESERVOIR: FLUORESCENCE MAPPING OF BENTHIC SOURCE POPULATIONS

The alternation of planktonic and benthic life stages is an adaptive strategy that allows bloom-forming cyanobacteria to survive unfavourable conditions such as low temperature, low light and low nutrient concentrations. The overwintering benthic population that survives such conditions can provide an inoculum for pelagic blooms during the subsequent year. We hypothesized that lakes experiencing such blooms have localized benthic seed banks that act as ‘hot spots’ for subsequent recruitment into the pelagic zone. We tested this hypothesis in Saint-Charles Lake, a mesotrophic reservoir that provides drinking water for Quebec City and that has recently developed episodic blooms of Microcystis aeruginosa and Anabaena flos aquae. Specifically, we used a submersible phycocyanin fluorometer (MicroFluoBlue) to map the cyanobacterial content of surficial sediments, and took sediment cores for microscopy and pigment analysis. Additional cores were sampled to determine environmental controls on cyanobacterial recruitment from the sediments. Preliminary results suggest a heterogeneous distribution of cyanobacteria with localized benthic patches, consistent with the hypothesis of spatially restricted source populations.

Roman, M., University of Maryland, Center for Environmental Science, Cambridge, USA, roman@umes.edu

Pierson, J., University of Maryland, Center for Environmental Science, Cambridge, USA, jpierson@umes.edu

Brandt, S., Oregon State University, Corvallis, USA, stephen.brandt@oregonstate.edu

Kolesar, S., Oregon State University, Corvallis, USA, sarah.kolesar@oregonstate.edu

Sellinger, C., Oregon State University, Corvallis, USA, cynthia.sellinger@oregonstate.edu

Cowen, J., Louisiana State University, Baton Rouge, USA, jcowen@lsu.edu

Mason, D., NOAA, Ann Arbor, USA, doran.mason@noaa.gov

Stow, C., NOAA, Ann Arbor, USA, craig.stow@noaa.gov

Sable, S., Dynamic Solutions, LLC, Baton Rouge, USA, sable@dslc.com

Adamack, A., University of Michigan, Ann Arbor, USA, adamack@umich.edu

Sutter, B., NOAA, Saint Petersburg, USA, Buck.sutter@noaa.gov

CSCOR NGOMEX: EFFECTS OF HYPOXIA ON PRODUCTION POTENTIAL OF ECologically AND COMMERCIALLY IMPORTANT LIVING RESOURCES IN THE NORTHERN GULF OF MEXICO

The Northern Gulf of Mexico (NGOMEX) project examines the direct and indirect effects of hypoxia on living resources (neopanola in the Gulf). To assess the spatial and temporal impact of hypoxia on living resources, we applied a multi-scale and multi-stressor approach based on 6 years of spatially-explicit synoptic data. With the overall goal of providing quantitative tools to probabilistically forecast the effects of hypoxia on living resources, we are employing a battery of modeling approaches of varying complexity (individual – to ecosystem-level), spatial configuration (near-field plume to fine-scale spatial pelagic to the entire NGOMEX), and temporal duration (hourly to inter-annual). Specifically, we examined: the spatial extent and seasonal timing of hypoxia on fish growth, recruitment, and production potential; hypoxia’s effect on pelagic food web interactions in the pelagic zone; and, the most effective tools needed to forecast food-web interactions, habitat suitability, and fish production related to hypoxia. Preliminary results show how hypoxia in the NGOMEX can strongly impact pelagic food webs and production through unexpected, indirect pathways, potentially leading to production changes in economically and ecologically important fishes.

Romano, A., Columbia University and NASA-GISS, New York, USA, ar2235@columbia.edu

Gregg, W. W., Goddard Space Flight Center NASA, Greenbelt, USA, watson.gregg@nasa.gov

EASTERN BOUNDARY UPWELLING SYSTEM CLIMATE MODELING: UNCERTAINTIES DUE TO VERTICAL OCEAN DISCRETIZATION

The eastern boundary upwelling system is an area of tight ocean-atmosphere interaction and deep ocean upwelling which affect ocean dynamics, ecosystem structure and biological production and climate change through ocean carbon cycling and CO2 exchanges with the atmosphere. Here we address the sensitivity of the lower atmosphere dynamics and the ocean carbon cycle feedbacks to parameterizations of vertical ocean processes. We have coupled the same atmospheric and ocean biogeochemistry models to two distinct physical ocean models that differ primarily in the vertical coordinate system and the representation of vertical ocean processes. We assess the uncertainties in the climate model response due to different vertical ocean processes which affect nutrient supply to the surface, ecosystem biodiversity and surface carbon distributions in addition to atmospheric feedbacks to surface winds, cloud cover and CO2 exchanges.

Romero-Castillo, C., Instituto de Ciencias del Mar-CSIC, Barcelona, Spain, crisc@cim.es

Sarmento, H., Instituto de Ciencias del Mar-CSIC, Barcelona, Spain, hsarmento@icm.csic.es

Álvarez-Salgado, X. A., Instituto de Investigaciones Marinas-CSIC, Vigo, Spain, xsalgado@iem.csic.es

Gasol, J. M., Instituto de Ciencias del Mar-CSIC, Barcelona, Spain, pepgasol@icm.csic.es

Marrasé, C., Instituto de Ciencias del Mar-CSIC, Barcelona, Spain, celia@icm.csic.es

NET PRODUCTION/CONSUMPTION OF FLUORESCENT COLOURED SOLVED ORGANIC MATTER BY NATURAL BACTERIAL ASSEMBLAGES GROWING ON MARINE PHYTOPLANKTON EXUDATES

We examined the net uptake/release of coloured dissolved organic matter (CDOM) by one natural bacterial community growing on DOM exudates from four phytoplankton species cultured axenically. Phytoplankton exudates contained fluorescent humic- and protein-like substances. Bacterial increase was independent on the phytoplankton species producing the exudates. Humic-like substances excreted by phytoplankton (Ex/Em: 310 nm/392 nm; 566 peak-M), were consumed by bacteria in different proportions depending on the cultured phytoplankton species; about 30% of the humic-like substances excreted by S. costatum were consumed while the percentages reduced to only 5% and 10% for Chaetoceros sp. and M. pulvilia, respectively. On the contrary, bacteria produced humic-like substances that fluoresce at Ex/Em: 340 nm/440 nm (Coble's peak-C), i.e. more aromatic than those generated by phytoplankton. The fluorescent emission of the CDOM materials produced by prokaryotes was significantly (p < 0.05) higher than those produced by eukaryotes.

Romero, L. C., University of Southern California, Los Angeles, USA, lromero@usc.edu

Klein, N. J., University of Southern California, Los Angeles, USA, nicholjk@usc.edu

Barada, L., University of Southern California, Los Angeles, USA, barada@usc.edu

Vo, J., University of Southern California, Los Angeles, USA, jasonpv@usc.edu

Lisa, A. M., University of Southern California, Los Angeles, USA, alisa@usc.edu

Cutter, L., University of Southern California, Los Angeles, USA, lcutter@usc.edu

Gunderson, T., University of Southern California, Los Angeles, USA, tgunders@usc.edu
The response of nitrogen fixation to nutrient enrichment experiments in three contrasting U.S. western lakes was studied (eutrophic Clear Lake; mesotrophic Walker Lake; oligotrophic Lake Tahoe). We tested the effect of trace metals (iron, molybdenum as Mo(V), cobalt) and other nutrients (sulfate, phosphorus) in mesocosm experiments. We found distinct background nitrogen fixation rates, with highest rates at Clear Lake (44.7 ± 1.8 nmol N/L/h), intermediate rates at Walker Lake (1.7 ± 1.1 nmol N/L/h), and lowest at Lake Tahoe (0.1 ± 0.07 nmol N/L/h). On average, nitrogen fixation was stimulated above control values with the addition of phosphate Walker Lake (580% and 120%, respectively), and with Mo(V), cobalt and sulfate in Lake Tahoe (420%, 368% and 300%, respectively). Over-average, nitrogen fixation was stimulated above control values with the addition of Lake (1.7 ± 1.1 nmol N/L/h), and lowest at Lake Tahoe (0.1 ± 0.07 nmol N/L/h).
with good water quality (e.g. mayflies and caddisflies). Temporal fluctuations in stream hydrology were large and no seasonality was observed. Invertebrate assemblage composition and structure was highly variable, but not related to hydrology. Overall, macroinvertebrate assemblages in tropical urban rivers have a complex dynamic that is not simply explained by temporal changes in stream discharge.

Rose, J. M., NOAA/NMFS, Milford, USA, julie.rose@noaa.gov
Barrett, J., Connecticut Sea Grant College Program, New London, USA, juliana.barrett@uconn.edu
Clemenson, A. O., New York Sea Grant, Riverhead, USA, aoc@cornell.edu
Deonarine, S., New York State Department of Environmental Conservation, East Setauket, USA, sneadonar@gw.dec.state.ny.us
Pagach, J., Connecticut Department of Environmental Protection, Hartford, USA, jennifer.pagach@ct.gov
Parker, M., Connecticut Department of Environmental Protection, Hartford, USA, mark.parker@ct.gov
Tedesco, M. A., USEPA Long Island Sound Office, Stamford, USA, tedesco.mark@epa.gov

THE DEVELOPMENT OF A CLIMATE CHANGE MONITORING PROGRAM FOR AN URBAN ESTUARY
Long Island Sound is a highly urbanized estuary in the northeastern United States, with over eight million residents in the watershed. Anthropogenic pressures to the estuary, including increased population, habitat modification and water pollution, have long been identified. It is now recognized that climate change interactions with each of these pressures will add a layer of complexity to management efforts. This presentation will describe the development of one of the first comprehensive eustatine climate change monitoring strategies in the country, a process that has brought together scientists and managers from academic institutions, state and federal agencies, and nonprofits. Scientific and technical committees based in New York and Connecticut worked together to identify likely impacts of climate change on the estuary and ecosystem function, then proposed a comprehensive set of "sentinels," or indicators, to detect and measure these effects. Scientists were surveyed to generate rankings of these sentinel based upon the strength of the climate change impact and the availability of current and historical monitoring data. Pilot and full-scale monitoring programs are currently in development based upon this information.

Ross, S. W., Univ of NC at Wilmington, Wilmington, USA, rossus@uncw.edu
Brooke, S. D., Marine Conservation Biology Inst., Bellevue, USA, sandra.brooke@mcibi.org

DEEP-SEA CORAL ECOSYSTEMS OFF THE SOUTHEASTERN US AND IN THE GULF OF MEXICO: RESEARCH PROGRESS AND FUTURE DIRECTIONS
Research on deep-sea corals (DSC) has expanded greatly in US waters, especially off the southeastern US (SEUS) and in the Gulf of Mexico (GOM). As of 2000, knowledge of these habitats was represented by a few geological papers and a few inaccurate locations. Since then, it has become apparent that the continental slope from off North Carolina through the Straits of Florida (370-1000 m) contains thousands of coral mounds/ridges, ranging from a few meters to over 150 m tall. In addition to mound building, many species of deep corals also colonize emergent rocky substrata. These coral species occur in the GOM (300-1000+ m) from the north-central region to off West Florida; however, coral banks are more scattered and seem to cover less area in the GOM. DSC support high biodiversity, including undescribed species, and some fauna appear to have an obligate association with these deep reefs. In recognition of their ecological value and vulnerability, four huge protected areas were created off the SEUS (July 2010). We will review recent DSC research progress, information gaps, management activities, and future studies.

ROUYER, T., University of Oslo, Oslo, Norway, rouyer.tristan@bio.uio.no
HIDALGO, M., University of Oslo, Oslo, Norway, j.m.h.roldang@bio.uio.no
FROMENTIN, J. M., IFREMER, Sete, France, Jean.Marc.Fromentin@ifremer.fr
TIME SCALE DEPENDENT PROCESSES IN FISH STOCK FLUCTUATIONS
Determining whether fish stock fluctuations are due to stochastic forcing or deterministic processes is a central issue for fisheries ecologists. Recent theoretical studies have shown that age-structured populations act as a filter of environmental fluctuations. In theory, environmental fluctuations occurring slower than the generation time are tracked, while faster scales are amplified or dampened depending on life history traits. We investigated these concepts on a data set constituted by 40 fish stocks from the Northeast Atlantic. Using the wavelet decomposition we investigated (i) whether long-term fluctuations in abundance tracked long-term fluctuations in temperature and (ii) the link between the rhythm of the short-term fluctuations, life-history traits and exploitation. We found that (i) long-term fluctuations of abundance generally tracked long-term fluctuations in temperature and that (ii) intensely exploited stocks with a short life span displayed faster fluctuations. We conclude that acknowledging the interplay between stochastic forcing and deterministic processes may be of key importance for management and conservation.

Rowbotham, K. L., Western Michigan University, Kalamazoo, USA, kate.l.block@wmich.edu
Petkovic, H. L., Western Michigan University, Kalamazoo, USA, heather.petkovic@wmich.edu
Koretsky, C. M., Western Michigan University, Kalamazoo, USA, ckarla.koretsky@wmich.edu

STUDENT CONCEPTIONS OF EUROTYPICATION AND BIOGEOCHEMICAL CYCLING IN A FIELD-BASED UNDERGRADUATE COURSE
We examine student conceptions of complex environmental systems and biogeochemical cycles in an upper level, field-based, geochemistry course for undergraduates. Students engage in problem-based learning, collaboratively investigating a real-world environmental system – an urban lake in Michigan. Data collection includes experience, attitude, and knowledge surveys; students' individual and group work; and a series of semi-structured interviews with ~ 25% of the students in the course. The results of 2009 knowledge surveys indicated marked content knowledge gains. Pre-course scores ranged from -8 to 19 (median = 4) while post-course scores ranged from 7 to 25 (median = 21). Analysis of 2009 interview data and a preliminary examination of 2010 interview data indicate that students’ pre-course conceptions of eutrophication vary dramatically in correctness, completeness, and connectedness. Some students had almost no familiarity with or understanding of eutrophication. Many students initially appeared to understand the process of eutrophication but had difficulty clarifying and applying terminology and struggled to explain causal mechanisms. Post-course, 2009 interview subjects demonstrated a more accurate and cohesive understanding of eutrophication and related processes.

ROWLANDS, G. P., Nova Southeastern University, Dania Beach, USA, rowlands@nova.edu
Purks, S. J., Nova Southeastern University, Dania Beach, USA, purks@nova.edu
Riegel, B. M., Nova Southeastern University, Dania Beach, USA, riegb@nova.edu
Bruckner, A., Living Oceans Foundation, Landover, USA, bruckner@livingoceansfoundation.org
Renaud, P. G., Living Oceans Foundation, Landover, USA, prenaud@livingoceansfoundation.org

THE DIVERSITY, DISTRIBUTION AND MANAGEMENT OF CORAL REEFS IN THE SAUDI ARABIAN RED SEA
More than half of the Red Sea's coral reef is found within Saudi Arabian waters. Coastal development is rapidly gaining pace, and a regional, spatially-based, approach to management is urgently required. Anchoring this goal, we present analysis of a vast resource development is rapidly gaining pace, and a regional, spatially-based, approach to management may be of key importance for management and conservation. We highlight areas critical to regional objectives. Biologically diverse communities of high coral cover (100%) exist, particularly in shallow fringe habitats, however geographically expansive, highly-rugose, coral frameworks of lower cover (5-20%) should not be maligned. These areas represent a vast biological resource in which investment is also critical. We discuss our methods as a model for assessment elsewhere, and consider our results in light of current and future management aspirations.

Ruacho, A., University of California, Irvine, Irvine, USA, aruacho@uci.edu
Primeau, F. W., University of California, Irvine, Irvine, USA, fprimeau@uci.edu
Guidi, L., University of Hawaii, Honolulu, USA, lreggi@hawaii.edu
Stemmann, L., Universite Pierre et Marie Curie, and Laboratoire d'Oceanographie de Villefranche, Paris, France, stemmann@obs-vlfr.fr

CONTROLS ON THE REMINERALIZATION DEPTH PROFILE OF PARTICULATED ORGANIC CARBON IN THE OCEAN
The sinking flux of particulate organic carbon (POC) in the ocean is the key process that controls the partitioning of carbon dioxide between the ocean and atmosphere.
As such, POC fluxes regulate an important greenhouse gas and, consequently, the climate of the Earth. Using POC flux estimates derived from particle size distributions measured with the Underwater Video Profiler [Guidi et al. Limnol. Oceanogr., 2009] in the Atlantic, Indian, and Pacific Oceans as well as in the Mediterranean Sea, we estimated the parameters $J$ and $b$ for a Martin power law profile, $J(z) = J_0 e^{-b z}$, that describes the flux of POC, $J_0$, with depth. We find considerable variability in the $b$ exponent values and much of this variability is spatially auto-correlated. We use a Bayesian model comparison approach to test different parameterizations that relate the variations in the exponent $b$ with various environmental variables such as water temperature, in-situ oxygen concentration, atmospheric dust flux and ecological community composition. In addition we also test functional forms that are different than the Martin power law profile for the attenuation of the POC flux with depth.

Rubim, M. A., Federal University of Amazon, Manaus, Brazil, aneterubim@ufam.edu.br
Lima, R. M., Federal University of Amazon, Manaus, Brazil, rita_mileni@ufam.edu.br

INFLUENCE OF WATER LEVEL FLUCTUATION ON THE LIMNOCOLOGICAL CHARACTERISTICS OF PURAQUEQUARA BASIN, AMAZON, BRAZIL.

Puraquequara river basin, located in Manaus, Amazonas, was studied in order to have the seasonal variation pattern of physical and chemical water analyzed. The period studied included all the stages of drought and flood of 2005 (the driest in the last 47 years), of 2008 (the biggest flood in a hundred years) and of 2009 (when the hydrological cycle is considered normal). We evaluated the water temperature, conductivity, dissolved oxygen, pH, turbidity, transparency, ion ammonia, nitrite, nitrate, total nitrogen, orthophosphate and total phosphorus. The analysis of variance (ANOVA) showed significant differences between values of the forms of phosphorus, conductivity and turbidity in the two phases studied. The analysis of the main components (PCA) did not reveal a distinct pattern among the different years, but showed a tendency of clustering in the two phases of the river level. The results reveal the influence of the characteristics of the water coming from the tributaries that drain the basin during the drought and the overflow caused by the waters of the Amazon River during the flood, associated with the rainy season, which lasts during the flood. Financial support: FAPEAM/UFAM

Ruede, J. E., Humboldt State University, Arcata, USA, jeremyrude@yahoo.com

THE PHYLOGENETIC STRUCTURE OF STRINGRAY NEOTRYGON KUHLII IN INDONESIA.

The Coral Triangle encompasses the most diverse marine life in the world. During the Pleistocene glacial periods, sea levels dropped by 130 meters, revealing the Sunda Shelf. This resulted in limited genetic exchange between Pacific and Indian Ocean populations, divergent populations, and ultimately the biodiversity we see today. This study focuses on the phylogenetic structure of the stringray Neotrygon kuhlii in Indonesia and the social and conservation implications of its current distribution.

Rueda Roa, D. T., University of South Florida, College of Marine Science, St. Petersburg, USA, druedaro@mail.usf.edu
Achury, A., Fundación La Salle, Estación de Investigaciones Marinas EDIMAR, Punta de Piedras, Venezuela, aachury@edimar.org

RELATIONSHIP BETWEEN SEA SURFACE TEMPERATURES SEASONAL CHANGES AND THE GEOGRAPHICAL DISTRIBUTION OF SARDINES IN EASTERN VENEZUELA.

Caribbean sardine fisheries are concentrated in Eastern Venezuela (95%); area with seasonal upwelling which leads to important plankton blooms (sardine's food source). Sardine abundance and distribution was estimated with eight Acoustic Surveys (1995-1998). Analysis of concurrent Sea Surface Temperature imagery showed that during upwelling (Jan-May surveys) higher sardine biomass were found at intermediate temperature waters offshore in the upwelling plume. Newly upwelled cooler waters are nutrient rich and after few days are transported offshore by Ekman transport becoming warmer and the phytoplankton biomass increases in the upper water column. However, during the upwelling relaxation period (Sep-Dec surveys) the sardine abundance were higher in the cooler waters present along the north-facing coastlines and where chlorophyll concentrations were higher than those of the rest of the area. Sardine fisheries in this area are artisanal and occur up to 10km offshore. During relaxation period and during weak upwelling years the sardine catchability coefficient increases due to the concentration of sardine along the cooler coastal waters, this could lead to overexploitation. This might explain the 2006 sardine crash after 2 years of weak upwelling.

Ruef, W. M., University of Washington, Seattle, USA, wruef@uwashington.edu
Devol, A. H., University of Washington, Seattle, USA
Newton, J., University of Washington, Seattle, USA
Bassin, C., University of Washington, Seattle, USA
QUANTIFYING THE ROLE OF MARINE NUTRIENT LOADING TO UPPER LAYER PRODUCTION AND BOTTOM WATER HYPOXIA IN A COASTAL ESTUARY.

Southern Hood Canal (Puget Sound, Washington State) is a sensitive estuarine system undergoing prolonged hypoxia, biological stress and intermittent fish kills. To quantify nutrient loading to southern Hood Canal, high-frequency water column profiles of temperature, salinity, dissolved oxygen, chlorophyll fluorescence and nitrate were collected every 2-6 hours over multiple years using an autonomous mooring. A 3-layer box model (mixed layer, lower euphotic layer, aphotic layer) was used along with a salt balance to determine volume transports, which were combined with nitrate concentrations to determine N-loadings. Of the total natural N-loading from estuarine circulation, about half was used for new production in the mixed layer and could potentially contribute to lower layer hypoxia; the other half was used in the lower euphotic layer and did not contribute to hypoxia because the co-produced oxygen remained in the lower layer. As N-loading from septic and other anthropogenic sources entered the upper mixed layer, all potentially contributed to new production and hypoxia. This can be an important distinction to make when evaluating N sources in hypoxia studies of these types of systems.

Ruiz-Diaz, C. P., University of Puerto Rico, Rio Piedras Campus, San Juan, Puerto Rico, claudiapatriciaruiz@gmail.com
Toledo-Hernández, C., Environmental Protection Agency, Cincinnati, OH, USA, c.toledo_hernandez@yahoo.com
Sabat, A., University of Puerto Rico, Rio Piedras Campus, San Juan, Puerto Rico, amsabat@gmail.com
Marcano, M., University of Puerto Rico, Rio Piedras Campus, San Juan, Puerto Rico, mariano.marcano@upr.edu

THE SIMULATION THE INTERACTION AMONG SEA FAN COLONY ITS IMMUNE SYSTEM, AND A POTENTIAL PATHOGEN.

We present an ordinary differential-equations model describing pathogen-immune system in Gorgonia ventilata under optimal-immune condition (disease-free) and immune-compromised conditions (chronically-disease and terminally-diseased). The model has four assumptions: 1) polyps are the main unit of the coral; 2) polyps are homogenously distributed through the colony, which is assumed to only have a single compartment; 3) disease is caused by an endosymbiotic opportunistic-pathogen; 4) host-immune reaction is triggered by a signal. When an endosymbiotic opportunistic-pathogen exceeds a density threshold, it decreases or increases the density of polyps. Consequently, the colony emits a signal to its stem cells to differentiate into humoral and phagocytic cells (immune cells), to combat the pathogen. Under optimal immune conditions, the immune cells rapidly eradicate the pathogen and the polyps return to its equilibrium state. Under the immune-compromised conditions: 1) colonies remain chronically-disease. Here, colony and pathogen co-exist however; the maximum capacity for new polyp formation is never reached. 2) Coral is terminally-disease, thus coral's immune cells cannot stop the pathogen growth, the numbers of polyps go to zero and the colony dies.

Ruttenberg, K. C., University of Hawaii / SOEST, Honolulu, USA, kcr@soest.hawaii.edu
Dyhrman, S. D., Woods Hole Oceanographic Institution, Woods Hole, USA, sdyhrman@WHOI.EDU

DISSOLVED ORGANIC PHOSPHORUS PRODUCTION DURING A SIMULATED PHYTOPLANKTON BLOOM: EXPERIMENTS IN THE COASTAL OREGON UPWELLING REGION.

Four nutrient addition bottle experiments were conducted shipboard during the upwelling summer season off the coast of Oregon, USA, to examine the response of the coastal phytoplankton community to additions of nitrate and phosphate, relative to controls (no additions). Previous fieldwork in this area had revealed that the phytoplankton community produced phosphate-regulated alkaline phosphatase (APase), an indication of phosphate stress and possible phosphate limitation. Five-day incubation experiments were conducted on a subsequent cruise, using waters from mid-shelf sites, to examine rates of phosphate uptake, APase production, and to assess whether uptake of Dissolved Organic Phosphorus (DOP) was evident. Increases in DOP concentration occurred by day-5 in control and plus-P treatments in all experiments, suggesting that at high phosphate levels phytoplankton excrete...
higher levels of DOP than they otherwise would. APase activity was observed by day-5 in all plus-N and control bottles, indicating that the phytoplankton community was phosphate stressed. No DOP increase in plus-N treatments was observed in day-5 in all plus-N and control bottles, indicating that the phytoplankton community was phosphate stressed. APase activity was observed by doucette, g., noaa, charleston, usa, jbirch@mbari.org, jensen, s., mbari, moss landing, usa, sjensen@mbari.org

ryan, j., mbari, moss landing, usa, ryjo@mbari.org

ryan-keogh, t., j., school of ocean and earth sciences, university of southampton, national oceanography centre, southampton, united kingdom, t.ryan-keogh@noc.soton.ac.uk

bibby, t., s., school of ocean and earth sciences, university of southampton, national oceanography centre, southampton, united kingdom, tsb@noc.soton.ac.uk

nielsdottir, m. c., school of ocean and earth sciences, university of southampton, national oceanography centre, southampton, united kingdom, m.c.nielsdottir@soton.ac.uk

achterberg, e. p., school of ocean and earth sciences, university of southampton, national oceanography centre, southampton, united kingdom, eric@noc.soton.ac.uk

moore, c. m., school of ocean and earth sciences, university of southampton, national oceanography centre, southampton, united kingdom, cmm297@noc.soton.ac.uk
**S. Correa, A. M.** Florida International University, North Miami, USA, adymscorrea@gmail.com

**Baker, A. C.** University of Miami, Miami, USA, abaker@rsmas.miami.edu

**Vega Thurber, R. L.** Florida International University, North Miami, USA, rvegathurber@gmail.com

**VIRUSES ASSOCIATED WITH Symbiodinium (The Dinoflagellate Endosymbionts of Corals), AND THEIR POTENTIAL ROLE IN THE RESPONSE OF REEFS TO GLOBAL CHANGE**

Corals host microorganisms (e.g., Bacteria, viruses) capable of rapid evolution. Like these microbes, the dinoflagellate endosymbionts (genus *Symbiodinium*) of corals possess characteristics that underlie high adaptive capacities: they have extremely large population sizes, and are predominantly asexual with short generation times. Shifts in microbial diversity within corals can impact colony phenotypes and health, and represent a mechanism by which colonies acclimate to environmental stressors. The ability of coral-associated microorganisms to adapt to changing environments thus directly impacts the future trajectories of reefs. We characterized viral consortia from four *Symbiodinium* clades (A–D) that commonly associate with stony corals using transmission electron microscopy, pyrosequencing and bioinformatics. Results indicate phycodnaviruses and other viruses specific to *Symbiodinium* are induced following exposure to stress (e.g., elevated temperature) and may carry photosynthesis genes that assist *Symbiodinium* in coping with changing conditions. Preliminary viral inoculations of coral colonies suggest viruses may destabilize some individual Cnidarian-microbe symbioses by triggering disease and/or bleaching. Overall, viruses likely contribute to rapid evolution in Cnidarian-microbe symbioses and thus, the trajectories of coral reefs.

**Badger, J.** J.C. Venter Institute, San Diego, USA, jbadger@jcvi.org

**Allen, A. E.** J.C. Venter Institute, San Diego, USA, aallen@jcvi.org

**Burkepile, D. E.** Florida International University, North Miami, USA, dburkepi@fiu.edu

**Shantz, A.** Florida International University, North Miami, USA, shantz.a@gmail.com

**Welsh, R. M.** Florida International University, North Miami, USA, rory.welsh@gmail.com

**Burkepale, D. E.** Florida International University, North Miami, USA, dburkepale@fiu.edu

**Vega Thurber, R. L.** Florida International University, North Miami, USA, rvegathurber@gmail.com

**NUTRIENTS AND OVERFISHING IMPACT BACTERIAL COMMUNITIES ON REEF CORALS**

This study quantified changes in coral-associated bacterial communities following interactive top-down (herbivorous fish exclusion) and bottom-up (repeated addition of inorganic nutrients) treatments in a multi-year field experiment. We monitored benthic cover, coral and algal growth rates, fish diversity and abundance, as well as *Symbiodinium* communities on three coral species every 1 to 2 months. Bacterial diversity and abundance were assessed using Terminal-Restriction Fragment Length Polymorphisms (T-RFLPs) of 16S rDNA. Results suggest nutrient availability and herbivore pressure affect bacterial communities over time. Bacterial abundance increased following treatment initiation except in control (uncaged, ambient nutrients) colonies. Bacterial diversity increased in control treatments compared to corals in treatments where herbivores were excluded. Numerous scars from parrotfish bites were observed on uncaged corals. Predation may therefore be a mechanism that introduces novel bacteria and/or spreads diseases among corals. Since coral disease epizootics are common and since algae, nutrients, and elevated temperature are hypothesized to be mediators of these diseases, this multi-scale experiment provides important insights into the stability of reef coral-microbe symbioses and thus, the trajectories of coral reefs.

**Saeck, E. A.** Griffith University, Brisbane, Australia, e.saeck@griffith.edu.au

**Burford, M. A.** Griffith University, Brisbane, Australia, m.burford@griffith.edu.au

**O’Brien, K.** University of Queensland, Brisbane, Australia, k.obrien@uq.edu.au

**COASTAL PHYTOPLANKTON RESPONSE TO FLOOD EVENTS AFFECTED BY REMOVAL OF SEWAGE-DERIVED NUTRIENT INPUTS**

In recent times there has been considerable global effort towards reducing point source nutrient inputs to coastal ecosystems. While retrofitted sewage treatment plants have reduced nutrient loads, it has been difficult to determine the ecological consequences of these nutrient reductions, due to the spatial and temporal variability of ecosystem responses, the internal recycling of historical nutrient loads, and concurrent pressures from changes in land-use, climate and flow regimes. This task is further complicated in event-driven systems, where phytoplankton productivity and biomass peak following nutrient pulses delivered in flood events. For example, reductions in sewage-derived nutrient inputs to Moreton Bay, in sub-tropical Australia, have not corresponded to a reduction in phytoplankton biomass. To determine if sewage nutrient reductions have affected ecosystem response to event-driven nutrient pulses, we examined the response of phytoplankton populations to major flood events prior to and after major reductions in sewage nutrient inputs to Moreton Bay. This study highlights the importance of understanding ecosystem response to flood events as a means of characterising nutrient status of event-driven systems typical of the tropics and sub-tropics.

**Saito, M. A.** Woods Hole Oceanographic Institution, Woods Hole, USA, msaito@whoi.edu

**Moran, D. M.** Woods Hole Oceanographic Institution, Woods Hole, USA, dmoan@whoi.edu

**Allen, A. E., J.C. Venter Institute, San Diego, USA, aallen@jcvi.org**

**Bertrand, E. M.** Woods Hole Oceanographic Institution, Woods Hole, USA, ebertrand@whoi.edu

**Badger, J., J.C. Venter Institute, San Diego, USA, jbadger@jcvi.org**

**PHYSIOLOGICAL AND PROTEOMIC ANALYSES OF IRON LIMITED POLAR PHYTOPLANKTON**

Cultures of Antarctic strains of *Phaeocystis antarctica*, *Chaetoceros sp.* and *Nitzchia sp.* were grown in a suite of iron concentrations, under steady-state conditions and in EDTA metal-ion buffered media. Both diatoms showed a higher susceptibility to iron limitation than the two strains of *Phaeocystis antarctica*. Quantitative proteomic analyses were conducted on biomass from these experiments using transcriptome sequencing (454 cDNA sequencing and assembly) for database construction, followed by spectral counting for determination of relative protein abundance. Results demonstrated successful identification of proteins using this database approach, as well as suites of proteins clearly responding to iron stress and limitation. Changes in the proteome corresponded to the observed physiological changes in growth rate in all strains and colony formation in *Phaeocystis*. These results will be discussed in the context of the phytoplankton ecology and biogeochemical cycling in the Ross Sea.

**Sakagami, T.** Okinawa Institute Science and Technology, Okinawa, Japan, taichis@oist.jp

**Barber, R. T., Nicholas School Marine Laboratory, Duke University, Beaufort, USA**

**rbarber@duke.edu**

**SEASONAL CYCLE OF CHLOROPHYLL BIOMASS IN PERU COASTAL UPWELLING ECOSYSTEM**

The coast of Peru is located in the northern Humboldt Current System and is the most productive of the four major upwelling regions in terms of fish. Normal upwelling theory describes stronger upwelling favorable winds bring nutrient-rich water from below thermocline and makes higher chlorophyll concentration, but at Peru coastal upwelling region, stronger upwelling favorable winds create lower chlorophyll concentration in winter and weaker upwelling favorable winds create higher chlorophyll concentration in summer. To understand this opposite relationship between winds and chlorophyll concentration at Peru, we analyzed the climatology of the seasonal patterns of chlorophyll concentration, wind, and PAR along the coast of Peru with SeaWIFS and QuikSCAT satellite data. We found the seasonal climatology of chlorophyll concentration is controlled by three independent processes: dilution by Ekman transport, wind-driven deeper mixing, and wind-stress curl downwelling. The dilution mechanism decreases inshore chlorophyll concentration from March through May. Wind-driven deeper mixing decreases chlorophyll concentration from June to August. Wind-stress curl downwelling prevents chlorophyll concentration from expanding offshore on March, April, November and December.
Sakamoto, C. M., Monterey Bay Aquarium Research Institute, Moss Landing, USA, sac@mbari.org
Johnson, K. S., Monterey Bay Aquarium Research Institute, Moss Landing, USA, johnson@mbari.org
Riser, S. C., University of Washington, Seattle, USA, riser@ocean.washington.edu
Swift, D. D., University of Washington, Seattle, USA, swift@ocean.washington.edu
Coletti, L. J., Monterey Bay Aquarium Research Institute, Moss Landing, USA, coletti@mbari.org
Jannasch, H. W., Monterey Bay Aquarium Research Institute, Moss Landing, USA, jaha@mbari.org

NITRATE SENSOR PERFORMANCE CHARACTERISTICS ON PROFILING FLOATS

The MBARI ISUS nitrate sensor has been integrated into a Webb Research Apex profiling float. As of October 2010, eight floats have been deployed at diverse locations (HOT, Southern Ocean, Station Papa, BATS) and their data is available in real time at www.mbari.org/chemsensor/floatviz.htm. These floods pass 1000 m depth and profile to the surface at programmed intervals (usually 5 days), making measurements as the floats rise to the surface. There are sixty measurements of nitrate and oxygen on each profile and temperature, salinity, and pressure at 2 m intervals. Nutrients are measured at the surface as the floats rise to the surface. There are sixty measurements of nitrate and oxygen on each profile and temperature, salinity, and pressure at 2 m intervals. Nitrate is measured directly in seawater using the UV absorption spectrum from 217 to 240 nm. The precision of the ISUS instrument is estimated to be ±0.2 μmol L⁻¹, but issues with sensor calibration, biofouling, lamp drift, and temperature correction of the spectra may affect the absolute accuracy. Here, we evaluate the size of these effects by comparison to discrete samples and temporal changes at 1000 m.

Salcher, M. M., University of Zurich, Limnological Station, Kilchberg, Switzerland, msalcher@limnol.uzh.ch
Perthaler, I., University of Zurich, Limnological Station, Kilchberg, Switzerland, perthaler@limnol.uzh.ch
Posch, T., University of Zurich, Limnological Station, Kilchberg, Switzerland, posch@limnol.uzh.ch

SEASONAL BLOOM DYNAMICS AND ECOPHYSIOLOGY OF THE FRESHWATER SISTER CLADE OF SAR11 BACTERIA 'THAT RULE THE WAVES' (LD12, ALPHAPROTEOBACTERIA)

Alphaproteobacteria are common members of marine bacterioplankton, but are believed to be rare in lacustrine systems. However, uncultured Alphaproteobacteria of the freshwater LD12 lineage form a tight monophyletic sister group with the numerically dominant microbes in marine waters, the SAR11 clade (genus Pelagibacter). Comparative 16S rRNA sequence analysis reveals a global occurrence of LD12 bacteria in freshwater systems, even suggesting regional diversification. LD12 microbes exhibit distinct and annually recurring spatio-temporal distribution in lakes. During the summer months these ultramicrobacteria can form cell densities in the surface water layers that are comparable to those of their marine counterparts. LD12 bacteria had a pronounced preference for glutamine and glutamate over 7 other amino acids in situ, and they exhibited substantially higher affinity for these two substrates (and glycine) than the microbial assemblage in general. Thus, LD12 bacteria do not only share phenotypic and metabolic traits with Pelagibacter, but also appear to thrive in the analogous spatiotemporal niche in freshwaters. The two groups together form the only known monophyletic lineage of ultramicrobacteria that has successfully traversed the barrier between marine and freshwater habitats.

Salinas, S., Stony Brook University, Stony Brook, USA, santiago.salinas@stonybrook.edu
Siskisidis, J. A., Stony Brook University, Stony Brook, USA
Munch, S. B., Stony Brook University, Stony Brook, USA, smunch@notes.cc.sunysb.edu

TRANSGENERATIONAL PLASTICITY IN AN ESTUARIAN FISH AND ITS RELATIONSHIP TO CLIMATE CHANGE

Nearly all models used to predict ecological responses to climate change assume that the relationship between an individual’s life history (e.g., growth rate, maturation time, fecundity, mortality) and the environment is fixed or varies across generations at a negligible rate. However, in many species the environment experienced by the parents has a strong effect on the offspring phenotype they produce. This effect, known as transgenerational plasticity (TGP), is quite common in plants and invertebrates but has been largely neglected in fishes. Using sheepshead minnows (Cyprinodon variegatus) as a model system, we tested whether temperature experienced by parents prior to spawning affects the temperature dependence of growth and maturation in their offspring. We reared adult fish at three temperatures (24, 29, and 34 °C) and allowed them to spawn after 30 days. We then measured egg size, growth, and maturation time in their offspring at the same three temperatures. Results indicate that the parental environment significantly affects offspring life histories. Moreover, offspring perform best at the temperatures their parents experienced, suggesting that TGP may provide a mechanism by which populations may rapidly cope with climate change.

Salisbury, J., University of New Hampshire, Durham, USA, joe@salisbury.unh.edu
Vandemark, D., University of New Hampshire, Durham, USA
Red, N., Institut Francais de recherche et d’Exploitation de la Mer, Plouzane, France
Chapron, B., Institut Francais de recherche et d’Exploitation de la Mer, Plouzane, France, joe@salisbury.unh.edu
Campbell, J., University of New Hampshire, Durham, USA
Hunt, C., University of New Hampshire, Durham, USA
Wisser, D., University of New Hampshire, Durham, USA

SPATIAL AND TEMPORAL COHERENCE BETWEEN AMAZON DISCHARGE, SALINITY AND LIGHT ABSORPTION BY COLORED ORGANIC CARBON IN THE SURFACE WESTERN TROPICAL ATLANTIC

A five-year time series (2003-2007) of surface salinity estimated using Advanced Microwave Scanning Radiometer - Earth Observing System Satellite (AMSR-E) data documents a variable plume of freshened water emanating from the Amazon. Corresponding acdm absorption distributions estimated at 443 nm (acdm443) using Moderate Resolution Imaging Spectroradiometer (MODIS) data are generally coherent with salinity, but there are regions in which spatial patterns of salinity and acdm443 do not coincide. The time series shows that salinity is oppositely phased with Amazon River discharge, whereas acdm443 is in phase but lags discharge and typically remains high after maximum discharge. Along the low-salinity plume trajectory, acdm443 is inversely correlated with salinity, yet there is considerable deviation from conservative mixing behavior during all seasons. Anomalies in conservative mixing of acdm443 correspond to satellite-retrieved net primary productivity, suggesting the importance of phytoplankton biomass as a source of acdm. From May to October, negative anomalies in conservative mixing show a weak correlation to distance from the Amazon mouth along the plume trajectory, which is consistent with the notion of photo-oxidation of acdm as it ages.

Salisbury, S. K., Virginia Institute of Marine Science, Gloucester Point, USA, salisbury@vims.edu
Canuel, E. A., Virginia Institute of Marine Science, Gloucester Point, USA, ecanuel@vims.edu
Anderson, I. C., Virginia Institute of Marine Science, Gloucester Point, USA, iris@vims.edu
Tobias, C. R., University of Connecticut, Groton, USA, craig.tobias@uconn.edu
Stanhope, J. W., Virginia Institute of Marine Science, Gloucester Point, USA, jwu@vims.edu
Hardison, A. K., Brown University, Providence, USA, amber_hardison@brown.edu

AN INTEGRATED APPROACH TO EXAMINING THE EFFECTS OF PHYSICAL PROCESSES ON SHALLOW SEDIMENT BIOGEOCHEMISTRY

Microautotrophs, such as benthic microalgae that live at the water-sediment interface, are influenced by a variety of physical stressors like resuspension, salination and mixing, which subsequently affect the cycling of biogeochemically active elements. Isotopic labeling provides a useful tool for following the pathways of biogeochemical species within this dynamic regime, however introducing label without disturbing the biogeochemical and redox gradients within the sediments is challenging. The perfusionator is a novel experimental tool that allows in situ labeling of sediment porewaters. The perfusionators were introduced to stable isotopic tracers of carbon and nitrogen to the sediment microbial community in order to trace the cycling of these elements. Rigid plastic covers were deployed over half of the perfusionators to “dampen” the physical stressors and glass beads were used to track the sediment column turnover and mixing throughout the labeling experiment. The organic pools of interest were labeled successfully via the perfusionators. The covers reduced the amount of sediment mixing, making it possible to compare the effects of physical processes of differing magnitudes within the same physical regime.
Plants increase their chances of survival by rendering themselves unpalatable to herbivores. In some cases, it is beneficial for a plant to induce a defense against herbivores rather than automatically producing the defense. In this study, we found that the freshwater macrophyte Cabomba caroliniana and Egeria densa induce a defense upon direct grazing. We also observed that Egeria densa does not induce a defense through a waterborne cue released by an attacked conspecific. Additionally, we investigated whether the crayfish Procambarus clarkii could tell, from a distance, whether C. caroliniana was producing a defense. Our assays revealed a slight trend for the crayfish to spend more time foraging for non-induced C. caroliniana.

Salk, K., St. Olaf College, Northfield, USA, salk@stolaf.edu
Weissburg, M. J., Georgia Institute of Technology, Atlanta, USA, marc.weissburg@biology.gatech.edu

INDUCTION OF CHEMICAL DEFENSES IN THE FRESHWATER MACROPHYTES, CABOMBA CAROLINIANA AND EGERIA DENSIA

Sanchez, C. J., The University of Washington, Seattle, USA, pixelreflex@gmail.com
Turner, K. B., The University Of Washington, Seattle, USA, katherineturner@gmail.com
Morris, R. M., The University of Washington, Seattle, USA, morrisrm@uw.edu

STUDENT STORIES: DEVELOPING EFFECTIVE MULTIMEDIA CONTENT

Sánchez Biscos, N. E., Museo Nacional -Universidad Federal do Rio de Janeiro, Rio de Janeiro, Brazil, paulosampaio@gmail.com
De Paiva, P. C., Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, paulosampaio@gmail.com
Echeverría, C. A., LabCoest-Universidad Federal do Rio de Janeiro, Rio de Janeiro, Brazil, alejandro.echeverria@hotmail.com

BENTHIC ORGANISM TO USE AS BIOCITIC INDEX IN THE ENVIRONMENTAL ASSESSMENT OF GUANABARA BAY, RIO DE JANEIRO – BRAZIL

Sanchez Rivas, P. C., Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, paulosampaio@gmail.com
De Paiva, P. C., Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, paulosampaio@gmail.com
Echeverría, C. A., LabCoest-Universidad Federal do Rio de Janeiro, Rio de Janeiro, Brazil, alejandro.echeverria@hotmail.com

BENTHIC ORGANISM TO USE AS BIOCITIC INDEX IN THE ENVIRONMENTAL ASSESSMENT OF GUANABARA BAY, RIO DE JANEIRO – BRAZIL

Sanchez, C. J., The University of Washington, Seattle, USA, pixelreflex@gmail.com
Turner, K. B., The University Of Washington, Seattle, USA, katherineturner@gmail.com
Morris, R. M., The University of Washington, Seattle, USA, morrisrm@uw.edu

STUDENT STORIES: DEVELOPING EFFECTIVE MULTIMEDIA CONTENT

Sánchez Riscos, N. E., Museo Nacional -Universidad Federal do Rio de Janeiro, Rio de Janeiro, Brazil, paulo.sampaio@gmail.com
De Paiva, P. C., Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, paulosampaio@gmail.com
Echeverría, C. A., LabCoest-Universidad Federal do Rio de Janeiro, Rio de Janeiro, Brazil, alejandro.echeverria@hotmail.com

BENTHIC ORGANISM TO USE AS BIOCITIC INDEX IN THE ENVIRONMENTAL ASSESSMENT OF GUANABARA BAY, RIO DE JANEIRO – BRAZIL

Sanchez Rivas, P. C., Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, paulosampaio@gmail.com
De Paiva, P. C., Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, paulosampaio@gmail.com
Echeverría, C. A., LabCoest-Universidad Federal do Rio de Janeiro, Rio de Janeiro, Brazil, alejandro.echeverria@hotmail.com

BENTHIC ORGANISM TO USE AS BIOCITIC INDEX IN THE ENVIRONMENTAL ASSESSMENT OF GUANABARA BAY, RIO DE JANEIRO – BRAZIL

Sanchez, C. J., The University of Washington, Seattle, USA, pixelreflex@gmail.com
Turner, K. B., The University Of Washington, Seattle, USA, katherineturner@gmail.com
Morris, R. M., The University of Washington, Seattle, USA, morrisrm@uw.edu

STUDENT STORIES: DEVELOPING EFFECTIVE MULTIMEDIA CONTENT
INORGANIC NUTRIENT DYNAMICS IN THE COLORADO RIVER DELTA UNDER THREE DIFFERENT WATER SUPPLY SCENARIOS

The Colorado River (CR) flow has been altered during the twentieth century by the construction of dams and the use of water for domestic and agricultural consumption. Up until 2001 (when a dam was built to initiate wetland restoration in the delta region) the Hardy River (HR) was a source of nutrients (via natural water, agricultural drainage, and waste water) to the CR delta. In order to understand the changes in nutrient loading and nutrient ratios associated with increased/decreased water flow to the delta, data sets of nitrate, phosphate, and silicate (from 2010) were compared with similar studies from 1990 (water coming from the HR), and from 1993 (water coming from the CR). An overall decrease in nutrient concentrations were found under the new condition of null river input (no water flow from the CR nor HR), also higher N:P values were found in 1990 and elevated S:N values in 1993. These observations provide new insights into how anthropogenic activities alter this fragile ecosystem as a result of limiting the nutrient input with resulting consequenc- es to trophic structure and fisheries.

Santiago, M., Universidad del Turabo, Gurabo, Puerto Rico, msantiago188@gmail.com

NUTRIENT COMPOSITION AND RELATIONSHIPS TO SALINITY IN MANGROVE SEDIMENTS FROM DIFFERENT GEOLOGICAL ORIGINS

Mangroves around the world exist in both tropical and sub tropical areas. In Puerto Rico, mangroves are found in coastal inlets, along coasts and rivers, each with their own peculiarities and different sources of nutrients depending on their location and the amount of freshwaters that pass near of them. Productivity of these mangroves will depend on the concentration of organic and inorganic materials present. Mangroves grow in soils from a variety of geological origins, and similarly a variety of species can be found; Rhizophora mangle, Conocarpus erectus, Avicennia germinans or Lagun- cularia racemosa. Differences in the geological origins of mangrove soils affect the available phosphorous (P) in the root systems. Availability of nutrients has been identi- fied as a major factor that restricts mangrove growth. Factors such as salinity, anoxia, and the availability of fresh water are additional stressors. The purpose of this ongoing study is describe the nutrient composition of sediments and leaves (both fresh and senesced) of mangrove communities with different soil/geologic origins and describe and compare among these sites their structural development.

Santiago- Merced, N. C., Universidad Metropolitana, Caguas, Puerto Rico, nc_san- tiago555@hotmail.com

RELATIONSHIP OF LOTIC MACROINVERTEBRATE COMMUNITIES TO PHOSPHORUS AND SUSPENDED SOLIDS

Aguatic macroinvertebrates communities reflect land use and nutrient inputs from the surrounding watersheds. The use of benthic macroinvertebrates as biological indicators is a well-established approach to evaluating ecologic quality of fluvial systems. The purpose of this research was to study the biodiversity of macroinver- tebrates in different sinuous urban streams. Phosphorus (P) and Total Suspended Solids (TSS) were also studied as direct measures of water quality. For the macroinvertebrate collection, the methodology of Vermont Stream Assessment (VSA) was followed and, samples were stored in plastic bags with 100% ethanol for specimen preservation. The hypothesis that more urban streams would have lower biological diversity and higher P loading was tested. Benthic metrics were further evaluated as potential response variables to P and TSS. Finally, the hypothesis that filtering col- lectors would increase as TSS increased was tested. Hydrophyilidae abundance was positively associated with total P. There appear to be other trends that would merit additional investigation by adding more sites to the data set. Adding more sites was beyond the scope of my current study; but is planned for the upcoming field season.

Santos, R. Q., University of Miami/Rosenstiel School of Marine and Atmospheric Science, Miami, USA, rsantos@rsmas.miami.edu

HABITAT SUITABILITY MODELS FOR SUBMERGED AQUATIC VEGETATION (SAV) IN BISCAYNE BAY, FLORIDA, USA

Extensive water quality and submerged aquatic vegetation (SAV) monitoring activi- ties have been conducted in Biscayne Bay, Florida, USA, as part of the Comprehen- sive Everglades Restoration Plan (CERP). Within a restoration framework, habitat suitability models describing the abundance and distribution of SAV under water quality and restoration scenarios will be a valuable management tool. This study: (1) identifies significant environmental factors influencing the spatial dynamics of SAV.
in Biscayne Bay, and (2) combines identified significant environmental factors into predictive, GIS-based habitat suitability models. The suitability model for different SAV functional groups was constructed using BioMapper, a kit of GIS- and statistical tools designed to build habitat suitability models and maps for animal or plants. As expected, the distribution and percent cover of SAV functional groups in Biscayne Bay was mostly related to salinity patterns; with areas of variable salinity (i.e., adjacent to canals that discharge freshwater into littoral areas) exhibiting lower SAV species abundance and high variability in percent cover. The results of this modeling study can be used to set expected quantitative species or community targets under future restoration scenarios.

Santos-Flores, C. J., University of Puerto Rico-Mayaguez Campus, Mayaguez, Puerto Rico, charliejosesantos@yahoo.com

Sotomayor-Ramirez, D., University of Puerto Rico-Mayaguez Campus, Mayaguez, Puerto Rico

Martinez, G., University of Puerto Rico-Mayaguez Campus, Mayaguez, Puerto Rico

Pérez-Alegria, L. R., University of Puerto Rico-Mayaguez Campus, Mayaguez, Puerto Rico

Gualterro-Leal, D., University of Puerto Rico-Mayaguez Campus, Mayaguez, Puerto Rico

PERIPHERY BIOMASS AND SPECIES RICHNESS AS BIOINDICATORS IN FIVE REFERENCE STREAMS IN PUERTO RICO

Periphytonic communities and water quality in Puerto Rico were evaluated in 5 streams minimally impacted by human activity. Estimates of periphyton biomass (chlorophyll-a; ash free dry weight, AFDW) and algal richness (Margalef Index) were determined following APHA and EPA-recommended protocols. Benthic chlorophyll-a, ash free dry weight and autotrophic index criteria values (75th percentile) in reference streams were 11.2 mg/m2, 812 mg/m2, and 406, respectively. Higher nutrient concentrations, sestonic chlorophyll-a, and lower N:P ratios in sampling reaches of rivers within Subtropical Moist Forest and Subtropical Wet Forest regions (Bosque Olimpia, San Virón, and Culeyes) versus Subtropical Rain Forest and Lower Montane Rain Forest ecoregions (i.e. El Yunque and El Verde stations), reflect the model hypothesis that increasing anthropogenic impact increases P input relative to N, decreasing N:P ratios, leading to progression from P to N limitation. A total of 129 algal species were identified with Bacillariophyceae (diatoms) being the most diverse and abundant group in all streams. Diatom richness varied among the streams, suggesting the characterization of this group as a possible target to detect differences among least impacted streams.

Sarkodee-Adoo, J., Florida A & M University, Tallahassee, USA, judith1.sarkodee-adoo@famu.edu

Cherrier, J., Florida A & M University, Tallahassee, USA, jennifer.cherrier@famu.edu

Chasar, J., U.S. Geological Survey, Tallahassee, USA, lchasar@usgs.gov

MONITORING SHIFTS IN DRIVERS OF PRIMARY PRODUCTION IN TWO GULF OF MEXICO ESTUARIES FOLLOWING THE DEEPWATER HORIZON OIL SPILL

Following the Gulf of Mexico Deepwater Horizon oil spill, two potentially impacted estuaries have been intensively monitored in an effort to observe any shifts in macro-nutrients and other drivers of primary production. A weekly time series was conducted from May through September in Apalachicola Bay, Florida, which exchanges with the GOA at 4 sites, and Grand Bay, Mississippi, which is subject to tidal flushing from the GOA. One possible fate of the DWH oil is uptake by bacteria and subsequent respiration or assimilation in to bacterial biomass. Elevation in respirated dissolved inorganic carbon concentration has potential implications for phytoplankton communities, as a new carbon source, and for higher trophic levels. Constituents include ammonium and phosphate (limiting nutrients), total nitrogen, chlorophyll A, dissolved inorganic and organic carbon. These data should allow us to evaluate any trends in primary production associated with the release of oil from the Macondo wellhead.

Sarnelle, O., Michigan State University, East Lansing, USA, sarnelle@msu.edu

Wilson, A. E., Auburn University, Auburn, USA, wilson@auburn.edu

INTRASPECIFIC VARIATION: ROLE IN THE ECOLOGY OF HARMFUL PHYTOPLANKTON

Ecologists are becoming increasingly aware of and interested in adaptive variation within species, and how this variation affects our understanding of interactions among species and the environment. Individuals within a population or a species do not all possess identical traits (else there would be no raw material for adaptive change), even after accounting for familiar trait-determinants such as age and sex. With respect to the ecology of harmful phytoplankton (i.e., taxa that cause so-called HABs), we now know that there can be substantial variation in growth rate and specific toxin production across genotypes of the toxigenic cyanobacterium, Microcystis aeruginosa, both across and within populations. We also know that genotypes within a single grazer species (both freshwater and marine) can vary a lot in their ability to tolerate phytoplankton toxins, a finding that would seem to have major implications for top-down control of HABs. Recent findings in this emerging subdiscipline will be reviewed and the potential consequences of previously-unrecognized intraspecific variation discussed.

Sarthou, G., LEMAR - IUEM, Plouzane, France, Geraldine.Sarthou@univ-brest.fr

Bucciarelli, E., LEMAR-LEUM, Plouzane, France, Eva.Bucciarelli@univ-brest.fr

Chever, F., LDO - IUEM, Plouzane, France, Fanny.Chever@univ-brest.fr

Arhan, M., LPO - IUEM, Plouzane, France, Michel.Arhan@ifremer.fr

Speich, S., LPO - IUEM, Plouzanne, France, speich@univ-brest.fr

FE(II) DISTRIBUTIONS IN THE ATLANTIC SECTOR OF THE SOUTHERN OCEAN, ALONG A TRANSACT FROM THE SUBTROPICAL DOMAIN TO THE WEDDELL SEA GYRE

Fe(II) distributions were investigated in the Sub-Tropical South Atlantic and the Southern Ocean during the BONUS-Go2Hope cruise from 34 to 57°S (February-March 2008). Concentrations ranged from below the detection limit (9 pM) to values as high as 125 pM. The highest values were observed in the sub-tropical domain at around 200 m, and represented more than 70% of dissolved Fe (DFe). In the surface mixed layer, Fe(II) concentrations were always higher than the detection limit, with values higher than 60 pM south of 47°S, representing between 39 % and 63 % of DFe. Below 1500 m, concentrations were close to or below the detection limit (< 4% of DFe), except at two stations (over the Bouvet Triple Junction ridge region and in the Weddell Sea Gyre) where values remained equal to ~ 30-50 pM. Fe(II) oxidation rates were estimated in the surface and deep waters and ranged from 3 to 11 min, and from 10 to 72 min, respectively. These results are discussed considering different processes such as photoreduction, oxidation, biological production, sediment and/or hydrothermal inputs.

Sasse, T. P., Climate Change Research Centre, Faculty of Science, University of New South Wales, Sydney, Australia, t.sasse@unsw.edu.au

McNeil, B. L., Climate Change Research Centre, Faculty of Science, University of New South Wales, Sydney, Australia, b.mcneil@unsw.edu.au

INVESTIGATING NEW EMPIRICAL TECHNIQUES TO PREDICT PCO2 FROM STANDARD HYDROGRAPHIC DATA SETS IN THE NORTH ATLANTIC

Spatiotemporal limitations of in-situ pCO2 measurements have necessitated the adoption of new techniques in predicting sea water pCO2 in order to understand the oceans role in modulating atmospheric CO2. In particular, our understanding of CO2 interannual variability within the open ocean and coastal oceans is unclear. Here, we seek to probe the ability to predict oceanic CO2 using standard hydrographic properties (Temperature, Salinity, nutrients) which have a vastly larger global network of measurements. The Bermuda Time-series site (BATS) in the North Atlantic is used to investigate the capability of a new Optimised Multiple Linear Regression (OMLR) and also a Self-Organising Multiple Linear Output (SOMLR) technique, in capturing both seasonal to inter-annual pCO2 variations at BATS. Preliminary results show the techniques capture 80-90% of the seasonal to inter-annual variations found at BATS, and are spatially robust within the Western North Atlantic. This technique is used to quantify and understand seasonal to inter-annual variations in the wider North Atlantic CO2 sink that can be compared with direct and model estimates in the region.
Sastre, M., University of Puerto Rico at Humacao, Humacao, Puerto Rico, michel.mastres@upr.edu

Rodríguez, J., University of Puerto Rico at Humacao, Humacao, Puerto Rico

Núñez, J., University of Puerto Rico at Humacao, Humacao, Puerto Rico

Francis, V., University of Puerto Rico at Humacao, Humacao, Puerto Rico

Santiago, M., University of Puerto Rico at Humacao, Humacao, Puerto Rico

Olivieri, K., University of Puerto Rico at Humacao, Humacao, Puerto Rico

Nuñez, J., University of Puerto Rico at Humacao, Humacao, Puerto Rico

sastre@upr.edu

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the dinoflagellate

WATER QUALITY PARAMETERS

higher from January to May. The highest recorded density of

brows to March. The highest recorded mean density of

ary to March. The highest recorded mean density of

CDOM from regional coastal

optically important

between these spectral signals. As a result, retrieved Rrs spectra are often dominated

concentration. While variability in absorption properties is due to both dissolved

optical complexity derived from variability in biogeochemical constituents. The

The Gulf of Maine (GoM) is a productive temperate sea known for its characteristic

APPLICATION OF A RADIATIVE TRANSFER-BASED CDOM CORRECTION TO

RESERVOIRS

Zooplankton play an important role in aquatic and marine food webs because they consume a variety of prey, thereby exerting a selective control on their prey organ-

organisms. We studied the community composition and prey preferences of zooplankton

in two very different reservoirs in Central Arizona; in Saguaro Lake, the eutrophic

Salt River reservoir, and in the deeper and more oligotrophic Lake Pleasant which is a storage reservoir for Colorado River water. The goal of the study was to elucidate the role of the zooplankton community in shaping the different communities of phytoplankton in both lakes by applying a combination of microscopic and molecu-

lar techniques. We sampled the zooplankton monthly with a series of vertical net

tows and extracted the DNA of whole individuals to be able to determine their prey composition. The zooplankton community in Lake Pleasant is dominated by the cladoceran Daphnia and calanoid copepods, while eutrophic Saguaro Lake is domi-

nated by the cladoceran Bosmina and cyclopoid copepods. Our preliminary results show that their prey preferences range from coccoid cyanobacteria, green algae to heterotrophic protists and other zooplankton species.

Sauer, M. J., University of Maine, Walpole, USA, michael.sauer@unl.maine.edu

Roesler, C. S., Bowdoin College, Brunswick, USA, crosler@bowdoin.edu

APPLICATION OF A RADIATIVE TRANSFER-BASED CDOM CORRECTION TO

SATELLITE-BASED ESTIMATES OF CHLOROPHYLL IN THE GULF OF MAIN

The Gulf of Maine (GoM) is a productive temperate sea known for its characteristic optical complexity derived from variability in biogeochemical constituents. The concentration and absorption properties of these constituents are critically impor-
tant to remote sensing reflectance (Rs) measurements and estimates of chlorophyll concentration. While variability in absorption properties is due to both dissolved and particulate colored material, empirical satellite algorithms cannot differentiate between these spectral signals. As a result, retrieved Rs spectra are often dominated by the spectral absorbance of CDOM. In the GoM, CDOM is optically important the result of the delivery of high concentrations of CDOM from regional coastal rivers. Consequently, CDOM can be a source of one of the largest errors in the GoM regional satellite-based chlorophyll dataset. In this study, we investigate a sequence of radiative-transfer based reverse and forward modeling techniques (e.g. GSR) for removing the influence of CDOM absorption on GoM SeaWiFS/MODIS remote-
sensing reflectances and empirically derived satellite chlorophyll estimates (Csat). Standard product estimates of Csat from uncorrected and CDOM absorption-
corrected Rs are compared with mean discrete surface chlorophyll concentra-
tions. Error analyses computed for periods of high/low CDOM concentrations in combination with high/low chlorophyll concentration are used to identify the utility of the CDOM correction scheme.

Sawyer, T., Arizona State University, Tempe, USA, tyler.sawyer@asu.edu

Rickborn, A., Arizona State University, Tempe, USA

Neuer, S., Arizona State University, Tempe, USA, susanne.neuer@asu.edu

THE ROLE OF ZOOPLANKTON COMMUNITIES IN SHAPING THE COM-

MUNITY STRUCTURE OF PRIMARY PRODUCERS IN CENTRAL ARIZONA" RESERVOIRS

Zooplankton play an important role in aquatic and marine food webs because they consume a variety of prey, thereby exerting a selective control on their prey organ-

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in two very different reservoirs in Central Arizona; in Saguaro Lake, the eutrophic

Salt River reservoir, and in the deeper and more oligotrophic Lake Pleasant which is a storage reservoir for Colorado River water. The goal of the study was to elucidate the role of the zooplankton community in shaping the different communities of phytoplankton in both lakes by applying a combination of microscopic and molecu-

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nated by the cladoceran Bosmina and cyclopoid copepods. Our preliminary results show that their prey preferences range from coccoid cyanobacteria, green algae to heterotrophic protists and other zooplankton species.

Schade, F. M., Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, fran.schade@gmx.de

Lang, T., VTI-Institute of Fisheries Ecology, Cuxhaven, Germany, thomas.lang@vti.
bund.de

BLOOD ANALYSES OF EUROPEAN FLOUNDER: SPATIAL PATTERNS AND POSSIBLE ENVIRONMENTAL EFFECTS

Fish blood analyses are often used as a diagnostic tool to reveal environmental fish diseases. In the present study we investigate, if the blood of European Flounder (Platichthys flesus) can be used as an indicator to evaluate the environmental conditions of the Baltic Sea. During cruises in winter 2008 and summer 2009 various blood parameters of flounders were determined. Additionally we created a comprehensive atlas of flounder blood cells containing the development cycles and

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pathological characteristics of blood cells. Spatial sampling of the Baltic Sea identi- fi ed several explanatory variables of the flounder hemogram. Mainly season, habitat and gender influenced the blood values. Consequently it was possible to develop standard values for the hemogram of flounders, which can be used as a guideline for evaluation of fish health. From these findings we could verify, that flounders from heavily polluted areas show changed blood values, which shows that flounder blood is a suitable indicator to detect environmental pollution.

Schaeffer, B. A., EPA, Gulf Breeze, USA, schaeffer.blake@epa.gov
Conny, R., EPA, Gulf Breeze, USA, conmy.robyn@epa.gov
Aukamp, J. R., EPA, Gulf Breeze, USA, aukamp.jessica@epa.gov
Craven, G., EPA, Gulf Breeze, USA, craven.george@epa.gov
Daniels, K., EPA, Gulf Breeze, USA, porter.kathleen@epa.gov

OCEAN COLOR RADIANCE OF FOUR FLORIDA PAN-HANDLE ESTUARIES

Estuarine and coastal regions in the Gulf of Mexico possess major ecological and economic resources and, within these regions, submersed aquatic vegetation protect shorelines from erosion and provide habitat for fish and invertebrates. This project will improve decision making by quantifying stressor-response relationships and reference conditions related to water clarity that support SAV habitats in Gulf of Mexico estuaries. Remote sensing reflectance was measured in four northeast Gulf of Mexico estuaries (Pensacola Bay, Choctawhatchee Bay, St. Andrew Bay, and St. Joseph's Bay). Data will assist in the characterization of light attenuation and will be used to calibrate Moderate Resolution Imaging Spectroradiometer (MODIS) remote sensing products for deriving chlorophyll-a, water clarity, and sediment concentra-
tions in these estuaries. An AC-s quantified in-situ vertical profiles of absorption and scattering coefficients. Remote sensing reflectance [Rrs] and downwelling at-
tenuation [Kd] were determined from a hyperspectral surface acquisition system and hyperspectral profiling system between 400–735 nm at a 1 nm resolution.

Schalles, J. F., Creighton University, Omaha, USA, JohnSchalles@creighton.edu
Hladik, C. M., University of Georgia, Athens, USA, chladik@uga.edu
Seminaria, D. N., Creighton University, Omaha, USA, DrewSeminaria@creighton.edu
O'Donnell, J. P., Creighton University, Omaha, USA, JohnODonnell@creighton.edu

MAPPING COASTAL AND ESTUARINE CHLOROPHYLL CONCENTRA-
TIONS

Turbid, Case 2 water conditions complicate methods for optical retrieval of chloro-
 phyll and other water constituents. We've collected data for >300 stations (Chl 0.2 – 490 ug/L), using consistent methods for field spectroscopy and water analyses at >25 estuaries and adjacent coastal waters, with most observations at, or near seven National Estuarine Research Reserves located between Aransas Bay (Texas) and Delaware Bay. With most field measurements, NOAA-EESC airborne hyperspectral imagery was collected with the University of Nebraska’s AISA Eagle instrument. Re-
cently, we’ve begun mapping trials using “on the fly” boat equipment that includes a boom mounted optic fiber connected to spectroradiometer, YSI 6600 sonde with a boom mounted optic fiber connected to spectroradiometer, YSI 6600 sonde with flow-through cell, and coupled GPS tracking. Our Case 2 water algorithm, derived from station measurements, has been re-parameterized for AISA imagery classification, to produce synoptic maps at a 1 m resolution. We will present map products and geospatial analyses of the classified data, along with a critique of these approaches. Revealed geospatial patterns are leading to new, testable hypotheses for algal abundance related to estuarine circulation, nutrient sources, and intertidal benthic algae.

Scharé-Umpierre, M. T., University of Puerto Rico, Mayaguez, Puerto Rico, michelle.scharare@upr.edu
Nemeth, M. I., University of Puerto Rico, Mayaguez, Puerto Rico, michaelnemeth@hotmail.com
Appeldoorn, R. S., University of Puerto Rico, Mayaguez, Puerto Rico, richard.appeldoorn@upr.edu

CORAL REEF CONNECTIVITY AND ONTOGENIC MIGRATIONS OF REEF FISHES: TESTING LANDSCAPE SCALE VARIABLES AND REEF FISH SPATIAL DISTRIBUTION PATTERNS

The distribution of marine habitats influences the spatial patterns of fishes, such as where mangroves and seagrasses provide ecological nursery functions for coral reef fish species. Landscape composition and habitat configuration were quantified to address the distribution of ontogenetic stages of these species. Mona Island’s insular shelf was sampled by quantifying habitat metrics and fishes in 613, randomly stratified belt-transects. Landscape-based spatial patterns of ontogenetic stages were species-specific, and cross-shelf ontogenetic migrations were identified. Habitat and fish metrics correlated at distinct spatial scales and these relationships varied among species, suggesting ontogenetic requirements are species-specific and scale dependent. At the landscape scale, areas with small patches (100 m²) of coral habitat supported significantly higher fish densities, although their location across the insular-shelf influenced this relationship. Landscape ecology concepts were useful in detecting patterns of habitat use and ontogenetic connectivity of reef fishes that are applicable to evaluating the ecological value of a particular arrangement of habitats within spatial-based management schemes.

Scheel, L. P., National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, CA, USA, scheel@nceas.ucsb.edu
Pendleton, D. E., Northwest Fisheries Science Center, NOAA Fisheries Service, Seattle, WA, USA, Dan.Pendleton@noaa.gov
Hampton, S. E., National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, CA, USA, hampton@nceas.ucsb.edu
Holmes, E. E., Northwest Fisheries Science Center, NOAA Fisheries Service, Seattle, WA, USA, eli.holmes@noaa.gov
Schueerell, M. D., Northwest Fisheries Science Center, NOAA Fisheries Service, Seattle, WA, USA, Mark.Schueerell@noaa.gov
Katz, S. L., NOAA Office of National Marine Sanctuaries, Channel Islands National Marine Sanctuary, Santa Barbara, CA, USA, steve.katz@noaa.gov
Johns, D. G., Sir Alister Hardy Foundation for Ocean Science, Plymouth, United Kingdom, djob@shafs.ac.uk

USE OF MULTIVARIATE AUTOREGRESSION (MAR) ANALYSIS TO ASSESS MARINE PLANKTON COMMUNITY DYNAMICS FROM TIME SERIES DATA Multivariate autoregressive (MAR) models have proven to be useful tools for assessing food web interactions and stability in freshwater plankton communities. Although several high-resolution, multi-decadal datasets from freshwater systems have been analyzed with MAR, datasets of similar quality from marine environments are relatively scarce. One marine plankton dataset suitable for MAR application is weekly abundance data collected at station L4 in the English Channel by the Western Channel Observatory, Plymouth, UK. Results from MAR analysis of this 16-year time series were used to construct interaction networks for the local plankton community and serve as a basis for comparison of MAR results from other marine datasets. In particular, much of the long-term plankton monitoring data available for marine environments, such as those generated by the continuous plankton recorder (CPR) survey, consist of samples taken from multiple spatially-distributed points when MAR has primarily been used with fixed point data. Comparisons between L4 station and English Channel CPR MAR results indicate the model may not be appropriate for marine monitoring data derived from spatially distributed sampling schemes.

Schiaffino, M. R., Universidad de Buenos Aires, FCEyN, EGE & Consejo Nacional de Investigación Científica y Técnica, Buenos Aires, Argentina, rominaschaifino@ ege.fecn.uba.ar
Unrein, F., Instituto de Investigaciones Biotecnológicas-Instituto Tecnológico de Chascomús & CONICET, Chascomús, Argentina, funrein@intech.gov.ar
Gasol, J. M., Departamento de Biología Marina y Oceanografía, Instituto de Ciencias del Mar-CSIC, Barcelona, Spain, ppegasol@icm.csic.es
Massana, R., Departament de Biologia Marina i Oceanografia, Institut de Ciències del Mar-CSIC, Barcelona, Spain, ramonmassana@icm.csic.es
Balagué, V., Departament de Biologia Marina i Oceanografía, Institut de Ciències del Mar-CSIC, Barcelona, Spain, vbalaque@icm.csic.es

Porto de Pesca de Buenos Aires, FCEyN, EGE & Consejo Nacional de Investigación Científica y Técnica, Buenos Aires, Argentina, rominaschaifino@ege.fecn.uba.ar

Biogeography of BacterioPlankton Assemblages in a Lattitu-
dinal Gradient of Lakes from Patagonia to Antarctica

BacterioPlankton structure was analyzed in 45 freshwater environments (lakes, shal-
low lakes, ponds) across a >2,100 km transect, from Argentinean Patagonia (45°S) to Maritime Antarctica (63°S) in a gradient of increased latitude and climate severity. BacterioPlankton community composition (BCC) was assessed by a fingerprinting method (denaturing gradient gel electrophoresis-DGGE) followed by band sequenc-
ing, whereas the bacterial abundance was estimated by epifluorescence microscopy. Both lake area and latitude had a significant effect on BCC and operational taxonomic unit (OTU) richness. Lake trophic state and latitude showed a significant influence on bacterioPlankton abundance. OTU richness and total bacterioPlankton abundance declined significantly with increased latitude, and lake area was positively correlated with OTU richness. Of 76 different OTUs identified, 45 were shared between Patаго-

EPA, Gulf Breeze, USA, ppegasol@icm.csic.es

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than Antarctic water bodies. 28 were present only in Patagonian lakes and 3 were exclusive of the Antarctic lakes. Among the sequences, 54% were similar to others reported from cold habitats elsewhere on the planet. Our results indicate there are both environmental and spatial factors controlling bacterioplankton community structure and support the hypotheses of biogeographic patterns of bacterial assemblages.

Schindler, D. W., University of Alberta, Edmonton, Canada, d.schindler@ualberta.ca

NUTRIENT CONTROL STRATEGIES TO REDUCE EUTROPHICATION OF LAKES

Some claim that the “phosphorus paradigm” has been eroded, yet a review of whole-lake case histories reveals that controlling phosphorus has been very successful at decreasing eutrophication in a wide variety of lakes. In contrast, there are no case histories where nitrogen control has caused eutrophication to decrease, either alone or in combination with phosphorus. In several cases, nitrogen control has aggravat-ed the symptoms of eutrophication by favoring nitrogen-fixing Cyanobacteria. Many lakes recovered following phosphorus control, even though phytoplankton showed strong evidence of physiological nitrogen limitation. In eutrophic lakes, nitrogen limitation must be regarded as a sign that the lake has been over-fertilized with phosphorus, indicating that to reduce eutrophication, phosphorus is the element to control. Limnologists must distinguish between proximate nutrient limitation and ultimate nutrient, focusing on ultimate limiting nutrients where long-term recovery from eutrophication is the objective. Other common misinterpretations of the symptoms of eutrophication will be discussed. The results have important for reduc-ing eutrophication of lakes, because controlling nitrogen inputs is often very costly.

Schizas, N. V., University of Puerto Rico, Mayaguez, USA, nschizas@gmail.com
Lucas, M., University of Puerto Rico, Mayaguez, USA, nschizas@gmail.com

GENETIC DIVERSITY AND CONNECTIVITY OF SHALLOW AND MESO-PHOTIC REEFS

Reef environments deeper than 50 m (Mesophotic Coral Ecosystems, MCEs) are characterized by scleractinian corals and an increased abundance of sponges and algae. Because of the close proximity to shallow water reefs, it has been hypothesized that MCEs may be a “source” (or “sink”) of larvae for shallow reefs. To assess the standing genetic diversity and connectivity of representative MCE species, we have estimated the population structure of the coral Agaricia lamarcki that dominates the mesophotic reefs in Caribbean. Specimens were collected from the islands of Mona, Puerto Rico, Vieques, St. Thomas and St. Croix. Preliminary genetic comparisons were made within and between islands for mesophotic populations and between mesophotic and shallow populations, using nuclear markers. Analysis indicates that A. lamarcki in shallow waters harbours higher nucleotide diversity than mesophotic A. lamarcki. From a limited number of samples a complex pattern of genetic relationships in A. lamarcki arises within and between islands for both genes. Shared haplotypes were found between mesophotic and shallow waters indicating that there is some genetic exchange.

Schlotz, N., University of Konstanz, Konstanz, Germany, nina.schlotz@uni-konstanz.de
Martin-Creuzburg, D., University of Konstanz, Konstanz, Germany, dominik.martin-creuzburg@uni-konstanz.de

BIOCHEMICAL FOOD QUALITY MODULATES THE OUTCOME OF PARASITIC INFECTIONS IN DAPHNIA

Food quality can be determined by many factors. Regarding lipids, polyunsaturated fatty acids (PUFAs) are well known as precursors for biochemically active substances and especially those belonging to the omega3 or omega6 family are presently experiencing a real hype in, for example, nutrition marketing. Knowledge about the mode of action of PUFAs and their metabolites is mostly mammal-based as they are important in human health and disease. Concerning invertebrates, the influence of food quality and PUFAs on somatic growth and reproduction might be well acknowledged, but mechanistic data are scarce. We used Daphnia-parasite systems to investigate whether one reason for their significance in many invertebrates is partly due to their action during the course of an infection, that is if food quality in general and PUFAs in particular are able to change the results of host-parasite interactions.

Schmidt, W. F., University of Puerto Rico, Mayaguez, USA, w.f.schmidt@upr.edu

EVIDENCE OF INTERNAL WAVES AND MESOSCALE EDDIES FROM MESOPHOTIC ADCP AND TEMPERATURE MEASUREMENTS, LA PARGUERA, PUERTO RICO

A slope-situated ADCP transect measured currents, temperature, and pressure off the south coast of Puerto Rico between August 2008 and June 2010. The slope fronted a coastal platform of approximately 20 m depth and descended to over 80 m in a horizontal distance of 100 m. The 40 m, 60 m, and 80 m instrument transect was perpendicular to local bathymetry (NW-SE). Surface currents (less than 5 m depth) were dominated by the easterly Trades, except during substantial wind shifts (e.g., passing tropical systems). Sub-surface currents (greater than 5 m depth) were tidally bimodal, but exhibit distinct net south-southwest (offshore) flow, a plausible response to onshore-directed Ekman transport. A number of mesoscale eddy impacts were recorded in the time series and resulted in highly variable currents and temperatures at depths greater that 5 m. Temperature records at all three instruments showed large (up to 5 degrees C) fluctuations that are attributed to internal waves. NOAA ICON pro-vided meteorological information and the altimeter products used to image mesoscale eddies were produced and distributed by Aviso (www.aviso.oceanobs.com).

Schmidt, W., UPRM Dept. of Marine Sciences, Mayaguez, Puerto Rico, w.f.schmidt@upr.edu
Smith, M., UPRM Dept. of Marine Sciences, Mayaguez, Puerto Rico
Rodriguez, F., UPRM Dept. of Mechanical Engineering, Mayaguez, Puerto Rico
Quintero, P., UPRM Dept. of Mechanical Engineering, Mayaguez, Puerto Rico

BUILD IT AND THEY WILL COME: INTRODUCING ENGINEERING STUDENTS TO OCEANOGRAPHY

The undergraduate engineering student population represents a largely untargeted source of potential oceanography graduate students. This is especially true among the under-represented minority sectors of this group, as pressure to pursue “normal” engineering careers is often inversely proportional to socio-economic status. A novel Special Topics Mechanical Engineering course was taught during the 2009-2010 academic year at the University of Puerto Rico, Mayaguez (UPRM). This course, “Design of Oceanographic Instrumentation”, was co-taught by UPRM Marine Science and Mechanical Engineering faculty and funded as an outreach component of existing NSF projects. Students were grouped in teams and tasked with designing and building new instruments from materials purchased with the NSF funds. Several formal presenta-tions were required and modeled on an engineer-customer scenario. Enrollment was modest in the first semester (3), but increased substantially in the second semester (15). Future plans are to develop a formal interdisciplinary, inter- Departmental course offering and to include students from other Engineering disciplines.

Schmidt, R. J., University of California Santa Barbara, Santa Barbara, USA, schmittr@lifesci.ucsb.edu
Holbrook, S. J., University of California Santa Barbara, Santa Barbara, USA, holbrook@lifesci.ucsb.edu
Brooks, A. J., University of California Santa Barbara, Santa Barbara, USA, brooks@msi.ucsb.edu
Johnson, M. K., University of California Santa Barbara, Santa Barbara, USA, johnson@msi.ucsb.edu

THE ESSENTIAL ROLE OF FARMERFISH IN THE PERSISTENCE AND RECOVERY OF PACIFIC STAGHORN CORAL THICKETS

Staghorn corals provide essential habitat on tropical reefs but are highly vulner-able to disturbances. Despite the potential for rapid colony growth, the recovery of staghorn coral thickets can be exceedingly slow. In Moorea, French Polynesia, the Pacific staghorn Acropora pulchra has not recovered > two decades after destruc-tion by a cyclone. Observations and experiments revealed that persistence and re-establishment of A. pulchra thickets require the presence of gorgonian damselfish (genus Stegastes). All thickets of A. pulchra are occupied by farmerfish that protect their gardens from herbivores and living staghorn substrates from coralivores. Thickets where farmerfish were removed were rapidly consumed by coralivorous fishes. Staghorn propagules were only found within farmerfish territories on massive corals (genus Porites), and experiments revealed that only staghorn recruits in Stegastes territories survived to form large colonies. The feedback between staghorn and farmerfish enables the coral to persist where coralivorous fish are abundant but it contributes to low rates of recovery following large disturbances.

Schnetzer, A., University of Southern California, Los Angeles, USA, a.schnetzer@usc.edu
Lonsdale, D., Stony Brook University, Stony Brook, USA, dlondsdale@notes.cc.sunysb.edu
Caron, D. A., University of Southern California, Los Angeles, USA, dcaron@usc.edu

A GENE SEQUENCING APPROACH TO STUDY PROTIstan-COPEPOD FEEDING RELATIONS

Gene sequence information (ribosomal DNA) was used in combination with mi-croscopy to examine changes in microbial assemblages in response to altered grazing

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pressure. In a series of addition/exclusion experiments the number of copepods was
manipulated and changes in clone abundance and diversity within protistan popula-
tions from coastal and open ocean environments investigated. Protist sequences
were aligned and grouped into Operational Taxonomic Units (OTUs) using the Mi-
crobial Eukaryote Species Assignment (MESA) program with automatically assigns
OTUs at approximately species-level distinctions (95% sequence similarity; Caron
et al., 2009). Taxonomic affiliations for each OTU were then determined based on
sequence similarities to publicly available sequence information. Changes in the rela-
tive contribution of different taxa to the clone libraries in the absence or presence of
copepods showed that especially heterotrophic protists play a key role in crustacean
diets. This finding was further supported by copepod grazing rates derived from
microscopy which indicated selective grazing on ciliates and heterotrophic dinofla-
gellates. Unique insights that are provided by employing a clone library approach to
complement protistan-copepod trophic studies will be discussed.

Schooer, D. M., University of Connecticut Marine Science, Groton, USA, Donald.
Schooer@uconn.edu

McManus, G. B., University of Connecticut Marine Science, Groton, USA, George.
mcm anus@uconn.edu

Tomas, J., University of Connecticut Marine Science, Groton, USA, Jtomaras@uconn.edu

York, J., University of Delaware, Newark, USA, jyork@udel.edu

INORGANIC NITROGEN UPTAKE IN MIXOTROPHIC AND HETEROTRO-
PHIS CILIATES.

Mixotrophic and heterotrophic ciliates are important grazers of phytoplankton. How-
ever, mixotrophs can supplement grazing with uptake of inorganic nitrogen.
There are two possible mechanisms for ammonia incorporation: ammonia trans-
ferred to glutamic acid to make glutamine in the mitochondria, and ammonia used
to make glutamine in the chloroplast. We have shown that the mixotrophic ciliate
Strombidium rassoulzadegani is able to take up ammonium equally (p=0.13) under
light (V=0.504 d⁻¹, SD=0.075) and dark (V=0.409 d⁻¹, SD=0.125) conditions, as is its
prasinophyte food source Tetraselmis chui (light V=1.42d⁻¹, SD=0.16; dark V=1.01 d⁻¹,
SD=0.23; p=0.23). There was a significant difference (p<0.001) in uptake when S. rass-
soulzadegani were grown with saturating (V=0.53d⁻¹, SD=0.075) and subsaturating
(V=0.16d⁻¹, SD=0.009) Tetraselmis concentrations. Ammonia use in the mitochon-
dria is ATP dependent, therefore lower uptake rates when ciliate growth is food
limited may indicate that ammonia incorporation is occurring in the mitochondria.
Experiments designed to determine which of the two mechanisms, mitochondrial or
chloroplastidic, is used by the mixotroph will be discussed, including a comparison
of ammonium uptake in the mixotrophic S. rassoulzadegani, a heterotrophic chro-
oretic Strombidinopsis sp. and Tetraselmis chui.

Schoepfer, V. A., Wright State University, Dayton, USA, vaschoepfer@gmail.com

Burgin, A. J., Wright State University, Dayton, USA, amy.burgin@wright.edu

ANAEROBIC MICROBIAL METABOLISM IN A HIGHLY EUTROPHIC STRATIF-
ICATED LAKE.

Ten years of mass balance data suggest Acton Lake (OH, USA) processes and retains
36% of N loading from the landscape. Our goal was to quantify microbial activities
responsible for this retention, including denitrification. Microbial respiration was
observed weekly throughout the water column from stratification until fall turnover.
DO profiles indicated the lake hypolimnion, at 4m, was anoxic from the beginning of
the study, July 1, 2010, until turnover, September 25th. NO₃ concentrations ranged
from 0-160µm, decreasing with depth and time, and was absent in the hypolimnion
by July 30th. Measurements of N₂Ar by membrane-inlet mass spectrometry
(MIMS) indicated a substantial fraction of this loss was due to denitrification (N₂Ar
increased 37.05 to 41.27 with depth on July 30). Hypolimnion iron [Fe²⁺] increased
1.07-41.2µM July 30th and sulfate concentrations decreased (156-52µM), resulting
in a concomitant increase in sulfide (max of 28µM on August 20th). Our data illus-
trates how microbial metabolism follows a thermodynamic gradient of energy usage.

Schopneyer, S. A., University of Miami, RSMAS, Miami, USA, schopneyer@rsmas.miami.edu

Lirman, D., University of Miami, RSMAS, Miami, USA, dlirman@rsmas.miami.edu

Herlan, J., University of Miami, RSMAS, Miami, USA, herlan@rsmas.miami.edu

Thyberg, T., University of Miami, RSMAS, Miami, USA, thyberg@rsmas.miami.edu

Huntington, B., University of Miami, RSMAS, Miami, USA, bhuntington@rsmas.

miami.edu

Young-Lahff, C., University of Miami, RSMAS, Miami, USA, cryoung@rsmas.miami.edu

THE ROLE OF CORAL NURSERIES IN THE RESTORATION OF THE THREAT-
ENED STAGHORN CORAL ACROPORA CERVICORNIS.

Coral reef restoration methods are increasingly utilized to mitigate reef degradation
and enhance recovery of depleted coral populations. We describe coral gardening as
an effective tool to aid in the restoration of the threatened Caribbean coral Acropora
cervicornis. Fragmentation, propagation and transplantation techniques used in
coral nurseries in South Florida, USA and the Dominican Republic have been shown
to minimize stress on donor colonies, maximize biomass accumulation and enhance
outplanting success using several attachment methodologies. For example, pruning
enhances growth of donor colonies thus reducing damage to depleted parent stocks.
Fragment size and orientation play an important role in fragment growth and sur-
vival. When combined, the growth of coral nursery fragments and the re-growth of
fragmented branches from donor colonies produce almost 2 times more tissue than
in unfragmented colonies. Additionally, coral nurseries may serve as a repository
for local genetic material for restoration of reefs after severe mortality or bleach-
ing events. Such activities provide a framework for successful restoration strategies
of degraded or damaged reefs throughout the Caribbean in the face of increasing
climate change and anthropogenic stressors.

Schulz, J. L., Bemidji State University, Bemidji, USA, jessica.schulz@st.bemidji.edu

Koch, R. W., Bemidji State University, Bemidji, USA, rkoch@bemidji.edu

SUSCEPTIBILITIES OF NORTHERN MINNESOTA LAKES TO ACIDIC-
ATION: INFLUENCE OF WATER ALKALINITY AND MACROPHYTE PHOTOP-
YSISYSIS.

Jessica Schulz Richard W. Koch Bemidji State University Acid mine drainage is an
increasing threat to natural waters in Northern Minnesota, USA, though acidifica-
tion may be lessened in some lakes due to high buffering capacity in naturally alka-
line waters. Monocultures of 2 common submerged plant species (Ceratophyllum
demerum and Elodea canadensis) were assessed for susceptibility to acidification
using a 2x2x2 design with water alkalinity (high vs. low), plant species and acid
addition as categorical variables. Light intensity and temperature were maintained
at ambient levels typical of August/September. Preliminary results suggest that lakes
with naturally high alkalinities coupled with removal of dissolved carbon dioxide
by acid tolerant vegetation were able to buffer minor acid additions. Ceratophyllum
demerum tended to have a higher buffering capability than Elodea canadensis.

INFLUENCE OF WATER ALKALINITY AND MACROPHYTE PHOTOP-
YSISYSIS.

The effects of water alkalinity and macrophyte photosynthesis on the growth of
2 common submerged plant species (C. demerum and E. canadensis) were evalu-
atcd. Water alkalinity influenced growth, with lower alkalinity stifling growth of
both species. Macrophyte photosynthesis was effective in buffering against acid addi-
tions, but the capacity to do so varied between species. Acid addition decreased
chlorophyll a content in both species, but the extent of the decrease was greater in
E. canadensis, which also exhibited a greater decrease in growth rate. These results
suggest that the use of macrophytes in lake restoration efforts may be effective in
buffering against acid additions, but the success of such efforts will depend on the
specific species and environmental conditions present in each lake.
the residence time of water within Boston Harbor is short due to tidal flushing and zooplankton community dynamics of that area. Another factor to consider is that communities, we have been focusing on learning and understanding the particular Massachusetts Bay. Freshwater inputs into the harbor are primarily from three major riv-

INTERPRETING THEIR RESPONSE TO CHANGES IN FRESHWATER INPUTS

Urban-Rich, J., University of Massachusetts Boston, Boston, USA, juanita.urban-rich@umb.edu

Urban-richer@umb.edu reduce potential biases in the microbial community structure.

Rapid sample collection and processing play a significant role in the stability of microbial communities. We observed a decrease in microbial diversity and an increase in the abundance of certain bacterial and archaeal groups during the 300 minutes of sample collection. Our data indicates that microbial communities are highly dynamic and sensitive to changes in processing conditions.

Metatranscriptomics is an emerging technique that provides global analyses of gene expression in natural microbial communities. Rapid sample collection and processing is crucial to capture a realistic profile of transcription activity in situ. However, changes in transcription profiles after sampling have seldom been studied. We present metatranscriptomic data from the oxygen minimum zone off Peru, where replicate water samples were collected and subsequently filtered after 0, 20, 120 and 300 minutes in order to assess the importance of sample processing time on the transcription profile. More than 1 million reads were obtained from total RNA using Roche GS-FLX sequencing technology showing a rapid decrease in the transcription profile. More than 1 million reads were obtained from total RNA using Roche GS-FLX sequencing technology showing a rapid decrease in the transcription profile.

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Cáceres, C., University of Illinois, Urbana, USA, caceres@life.illinois.edu

CONSTRUCTED AND EXISTING VERNAL POOLS AS MICROCOSMS FOR INVESTIGATING ABIOTIC CONSTRAINTS ON PLANKTON COMMUNITIES

Small ephemeral wetland pools can be locally abundant (1-10 pools per km^2 in the forested northeastern U.S.), and likely were more abundant before agricultural till ing leveled regions that are now second-growth forest, eliminating pool basins. Partly because of their hydrological isolation, pools in a small geographic region can exhibit a high between-pool variability in abiotic factors (e.g., light regime, water chemistry, oxygen concentration, temperature); easily sampled, these systems provide a unique opportunity to investigate abiotic constraints on plankton communities. Recent construction in summer 2010 of 71 small pools as part of a larger study to investigate optimal pool design for amphibian conservation (Gibbs et al. 2009) provided numerous replicate systems to examine abiotic constraints on plankton community development. Here we report on a comparison of abiotic parameters in both the constructed pools and over 30 existing small pools within a 32 km radius. We compare the range of abiotic constraints in the season of pond construction with those in existing pools, and their relation to resource quantity and quality (e.g., seston stoichiometry), and zooplankton performance and diversity.

Schnuck, H., Leibniz Institute for Marine Sciences, Kiel, Germany, hschnuck@ifm-geomar.de

Metatranscriptomics is an emerging technique that provides global analyses of gene expression in natural microbial communities. Rapid sample collection and processing is considered crucial to capture a realistic profile of transcription activity in situ. However, changes in transcription profiles after sampling have seldom been documented. We present metatranscriptomic data from the oxygen minimum zone off Peru, where replicate water samples were collected and subsequently filtered after 0, 20, 120 and 300 minutes in order to assess the importance of sample processing time on the transcription profile. More than 1 million reads were obtained from total RNA using Roche GS-FLX sequencing technology showing a rapid decrease in the number of Betaproteobacteria in the microbial community starting already within a delay of 20 minutes of sample collection. After 300 minutes Betaproteobacteria had decreased to less than 5% of the initial population. In contrast, only minor changes were observed in other bacterial and archaeal classes within the same time. Our data emphasizes the importance of fast sample processing for transcriptomic studies to reduce potential biases in the microbial community structure.

Desai, D., Leibniz Institute for Marine Sciences, Kiel, Germany, ddesai@ifm-geomar.de

Logares, R., Uppsala University, Uppsala, Sweden, ramiro.logares@gmail.com

Changes in the microbial community structure during water sampling: a case study from the Peruvian oxygen minimum zone

Changes in the microbial community structure during water sampling: a case study from the Peruvian oxygen minimum zone

Urban-Rich, J., University of Massachusetts Boston, Boston, USA, juanita.urban-rich@umb.edu

IDENTIFYING ZOOPLANKTON COMMUNITIES IN BOSTON HARBOR AND INTERPRETING THEIR RESPONSE TO CHANGES IN FRESHWATER INPUTS

Boston Harbor is a semi-enclosed embayment located on the western side of Massachusetts Bay. Freshwater inputs into the harbor are primarily from three major rivers; of concern to this study is the Neponset River. In order to better understand how changes in freshwater inputs from the Neponset River are influencing zooplankton communities, we have been focusing on learning and understanding the particular zooplankton community dynamics of that area. Another factor to consider is that the residence time of water within Boston Harbor is short due to tidal flushing and advection with Massachusetts Bay. We will be presenting results that show the composition of the zooplankton community during the spring and summer of 2010; identification and population estimates for these results are derived from a digital taxonomic library that we created for the purpose of furthering contributions to the overall zooplankton data collected in Boston Harbor. Three sampling locations of varying distances from the mouth of the Neponset River are used and we will discuss our results in relationship to their location and to changes in freshwater inputs.

Schuster, T., University of Massachusetts Boston, Boston, USA, talillas@yahoo.com

Altmann, K., University of Hawaii at Manoa, Honolulu, USA, altmann@hawaii.edu

Groundwater is an important yet understudied source of nutrients to estuaries and the coastal ocean. Coastal aquifers are reaction zones where microbial processes alter the composition of groundwater as it transits from land to sea. Fringing environments such as salt marshes and beaches may be particularly important, as transformations here will have the most immediate impact on coastal water quality. To better understand microbial nitrogen cycling in coastal aquifers, potential rates of nitrification (0-15 µmol N kg^-1 day^-1) and denitrification (2-57 µmol N kg^-1 day^-1) were quantified at two sites (salt marsh and beach) on Sapelo Island, Georgia by in situ push-pull tests and ex situ slurry experiments. While there is a high degree of spatial and temporal variability in these rates, the data show that coastal aquifers are active zones of nitrogen cycling. Furthermore, these data suggest a potential coupling between nitrification and denitrification that could act as a dynamic pathway for nitrogen removal from coastal aquifers.

Schuster, C. A., University of Georgia, Athens, USA, cschutte@uga.edu

Joye, S. B., University of Georgia, Athens, USA, mjjoye@uga.edu

HIGH RATES OF NITROGEN CYCLING PROCESSES IN COASTAL AQUIFERS

Groundwater is an important yet understudied source of nutrients to estuaries and the coastal ocean. Coastal aquifers are reaction zones where microbial processes alter the composition of groundwater as it transits from land to sea. Fringing environments such as salt marshes and beaches may be particularly important, as transformations here will have the most immediate impact on coastal water quality. To better understand microbial nitrogen cycling in coastal aquifers, potential rates of nitrification (0-15 µmol N kg^-1 day^-1) and denitrification (2-57 µmol N kg^-1 day^-1) were quantified at two sites (salt marsh and beach) on Sapelo Island, Georgia by in situ push-pull tests and ex situ slurry experiments. While there is a high degree of spatial and temporal variability in these rates, the data show that coastal aquifers are active zones of nitrogen cycling. Furthermore, these data suggest a potential coupling between nitrification and denitrification that could act as a dynamic pathway for nitrogen removal from coastal aquifers.

Schuster, T., University of Massachusetts Boston, Boston, USA, talillas@yahoo.com

Urban-Rich, J., University of Massachusetts Boston, Boston, USA, juanita.urban-rich@umb.edu

IDENTIFYING ZOOPLANKTON COMMUNITIES IN BOSTON HARBOR AND INTERPRETING THEIR RESPONSE TO CHANGES IN FRESHWATER INPUTS

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Schuster, C. A., University of Georgia, Athens, USA, cschutte@uga.edu
**IC VARIATION IN DAPHNIA MAGNA TARGET GENE-EXPRESSION RESPONSE TO CYANOBACTERIAL PROTEASE INHIBITORS: INTRASPECIFIC VARIATION**

Intraspecific variation might have developed due to microevolution of the D. magna clones from different populations which differ intraspecifically in the protease inhibitors by increasing its protease gene-expression. Here we have investigated D. magna clones from different populations which differ intraspecifically in the strength of their gene-expression response to the same protease inhibitors. Such an intraspecific variation might have developed due to microevolution of the D. magna populations with or without cyanobacteria.

**Schwierzke-Wade, L.**, University of South Florida, St. Petersburg, FL, USA, lswade@mail.usf.edu

Petzel, D. L., Mote Marine Laboratory, Sarasota, FL, USA, dana@mote.org

Wells, R. S., Chicago Zoological Society, c/o Mote Marine Laboratory, Sarasota, FL, USA, rwells@mote.org

O’Corry-Crowe, G., Harbor Branch Oceanographic Institute, Fort Pierce, FL, USA, gocorryc@hbioi.fau.edu

Reynolds, J. E., Mote Marine Laboratory, Sarasota, FL, USA, reynolds@mote.org

**Schwarzenberger, E.**, University of Cologne, Köln, Germany, anke.schwarzenbergerer1@uni-koeln.de

**Von Elert, E.,** University of Cologne, Köln, Germany, eveelert@uni-koeln.de

**RESPONSE TO CYANOBACTERIAL PROTEASE INHIBITORS: INTRASPECIFIC VARIATION IN DAPHNIA MAGNA TARGET GENE-EXPRESSION**

Daphnia are the main grazers of phytoplankton and cyanobacteria in ponds and lakes. However, cyanobacteria have been shown to produce harmful grazer toxins of which the most frequently occurring are cyanobacterial protease inhibitors. These inhibitors directly affect their targets – digestive proteases of Daphnia - in situ. Recently a clone of Daphnia magna has been demonstrated to respond to digestive protease inhibitors by increasing its protease gene-expression. Here we have investigated D. magna clones from different populations which differ intraspecifically in the strength of their gene-expression response to the same protease inhibitors. Such an intraspecific variation might have developed due to microevolution of the D. magna populations with or without cyanobacteria.
LAKE SIZE-ABUNDANCE DISTRIBUTIONS: IMPLICATIONS FOR BOREAL BIOMASS CARBON CYCLING

Global limnological research has led to new findings including that lakes and reservoirs cover a much greater portion of the earth’s land surface (~3%) and that they process larger amounts of organic carbon than previously thought. These estimates rely on lake size-abundance patterns that on log scales form negative linear relationships (i.e., Pareto distributions). These relationships generate predictions of smaller lakes from extrapolations of the Pareto distribution for larger lakes. We demonstrate the considerable uncertainty that these extrapolations introduce into lake abundance estimates. Several regional lake size-abundance distributions where smaller lakes are better resolved do not conform to the Pareto and more closely resemble log-normal patterns with the prediction of many fewer small lakes. We estimate the orders of magnitude uncertainty introduced by these alternative models for boreal lake carbon cycling and argue the need for better measures of lake size distributions in concert with carbon processing studies.

Segovia, L. M., Hatfield Marine Science Center, San Diego State University, San Diego, California, USA, leah.segovia@gmail.com
Brodeur, R. D., Southwest Fisheries Science Center, NOAA Fisheries, Newport, Oregon, USA, Rick.Brodeur@noaa.gov
Suryan, R. M., Oregon State University, Newport, Oregon, USA, rob.suryan@oregonstate.edu
Gladders, A. J., Oregon State University, Newport, Oregon, USA, amanda.gladders@gmail.com

SPECIES COMPOSITION AND ENERGY DENSITY OF BLACK ROCKFISH (SEBASTES MELANOPS) DIETS OFF NEWPORT, OREGON

Variable oceanographic conditions may affect the diversity and abundance of mid-trophic level species which are subsequently reflected in the diets of higher trophic level predators. We collaborated with sport fishermen to obtain stomachs from black rockfish caught in nearshore reefs off the coast of Newport, Oregon to determine if their diets can indicate fluctuations in local prey availability. Numerical and gravimetric measurements were utilized to calculate the relative importance of each prey item, and bomb calorimetry was used to determine the changes in energy requirements or availability. We found marked variation in the species composition of S. melanops diets over short time periods (weeks), in addition to variation in the energy density of their prey. Combined, these results indicate the amount of energy acquired by S. melanops could vary greatly within a season. It is unknown, however, whether changes in diet reflect prey availability or predator selection. We will compare these results to the diets of other piscivorous seabirds and fishes to assess potential changes in forage fish availability in the Northern California Current.

Scandlender, E., Technical University of Denmark, DTU-Aqua, Charlottenlund, Denmark, erse@aquade.dk
Jakobsen, H. H., Technical University of Denmark, DTU-Aqua, Charlottenlund, Denmark, hhj@aquade.dk
Lombard, F., Technical University of Denmark, DTU-Aqua, Charlottenlund, Denmark
Kierboe, T., Technical University of Denmark, DTU-Aqua, Charlottenlund, Denmark, fs@aquade.dk

COPEPOD CUES INDUCE STEALTH MODE IN MARINE DINOFLAGELLATE

Chain formation is common among phytoplankton organisms but the underlying reasons and consequences are poorly understood. Here we show that chain formation in the dinoflagellate *Alexandrium tamarense* is strongly impaired by waterborne cues from copepod grazers. Chains of *Alexandrium* cells exposed to copepod cues responded by splitting up into single cells or shorter chains. Motion analysis revealed significantly lower swimming velocities for single cells compared to chains. Thus the dinoflagellates are able to reduce both size and velocity in response to copepod cues, and the resulting simulated predator encounter rates were 3 to 8 fold higher for two- and four-cell chains compared to single cells. Grazer induced chain length plasticity constitutes a novel mechanism to reduce encounters with grazers. We argue that dinoflagellates can use chain length plasticity to optimize the balance between motility and risk of predation to changing grazing pressure.

Semchekes, M. R., Old Dominion University, Norfolk, USA, msemchekes@odu.edu
Marshall, H. G., Old Dominion University, Norfolk, USA, hmarshall@odu.edu
Nesius, K. K., Old Dominion University, Norfolk, USA, knesius@odu.edu
Egerton, T. A., Old Dominion University, Norfolk, USA, tegerton@odu.edu
Muller, M. T., Old Dominion University, Norfolk, USA, mmull021@odu.edu
MUDFLATS EXPOSED THE UNTOLD STORY OF MICROPHYTOBENTHOS AND THEIR CONTRIBUTION TO CHESAPEAKE BAY PRIMARY PRODUCTIVITY

Primary production by microphytotbenthos (MPP) is trophically important to a variety of micro- and macroheterotrophs in marine and estuarine habitats. In Chesapeake Bay, MPP facilitate survival and development of ecologically and economically relevant vertebrate and invertebrate fauna. MPP rates have been measured in habitats from sandy bottoms to tidal mudflats worldwide. However, productivity measurements in Chesapeake Bay are lacking, with few published studies in the last 30 years. This project aims to quantify microphytotbenthic primary production rates in intertidal areas of lower Chesapeake Bay in relation to water column (phytoplankton) primary production (PPP). Eight sites throughout lower Chesapeake Bay were identified for measurements of PPP and PPP rates. Seasonal variations in community composition are examined in addition to MPP and PPP fluctuations. MPP and PPP samples were processed for productivity following a 14C-incubation protocol. After one year, MPP and PPP varied among and between stations, with MPP showing much higher production rates per volume than PPP. Phytoplankton and microphytotbenthic community composition fluctuated both seasonally and between stations, with phytoplankton production and composition consistent with historical Chesapeake Bay data.

Serrat, P., Universidad de Vigo, Vigo, Spain, pserrat@uvigo.es
Kitidis, V., Plymouth Marine Laboratory, Plymouth, United Kingdom, vakis@pml.ac.uk
Robinson, C., University East Anglia, Norwich, United Kingdom, Carol.Robinson@uea.ac.uk
Hill, P., National Oceanography Centre, Southampton, United Kingdom, polly.hill@noc.soton.ac.uk
Zubkov, M. V., National Oceanography Centre, Southampton, United Kingdom, mvz@noc.soton.ac.uk
Tarran, G., Plymouth Marine Laboratory, Plymouth, United Kingdom, Glen.Tarran@pmel.noaa.gov

LAGRANGIAN OBSERVATIONS OF PLANKTON COMMUNITY AND BACTERIAL PRODUCTIVITY AND RESPIRATION ALONG NW AFRICAN UPWELLING FILMAMENTS

The NW African shelf is characterised by an intense coastal upwelling that maintains a high biological production. Upwelling filaments transport new nutrients and biota offshore, generating intense biogeochemical and biological gradients, which are complicated by the successional patterns within the evolving filaments. Here we present measurements of plankton abundance, photosynthesis (GPP) and community respiration (CR) made at six depths in the euphtotic zone during two 8-days Lagrangian experiments following upwelling filaments offshore the NW African coast. Concurrent measurements of size fractionated (0.2-0.8 and >0.8 um) in vivo electron transport system (ETS) activity, and bacterial production rates were made near the surface to study changes in the bacterial contribution to CR and the bacterial growth efficiency associated to changes in community structure during filament progression. GPP and CR rates ranged ca. 5-50 mmolO2m-3d-1 and 2-10 mmolO2m-3d-1, respectively, with “bacterial” (>0.8um) respiration ranging 11-37% of total CR. Euphotic zone depth integrated GPP/CR balances reached > 2.2 molO2m-2d-1, and remained positive throughout the two 8-days experiments.

Sexton, M. A., University of Maryland Center for Environmental Science, Horn Point Laboratory, Cambridge, MD, USA, msexton@hpl.umces.edu
Hood, R. R., University of Maryland Center for Environmental Science, Horn Point Laboratory, Cambridge, MD, USA, rhood@hpl.umces.edu

THE USE OF VISUAL COUNTS FOR MEASURING MUDFLA ABDUNANCE Chrysaora quinquecirrhia, a seasonally abundant medusa in the mesohaline Chesapeake Bay and its tributaries, is considered a nuisance because of its painful sting and the ability of large aggregations to clog nets and water intakes. Because of the nuisance, several efforts have been made to understand what variables contribute to inter- and intra-annual variability in medusa abundance. Many of these efforts have relied at least partially on daily visual surface counts conducted by D. Cargo on the Patuxent River, described in Cargo and King (1990). Additionally, a second time series of visual surface counts and vertical net hauls has been conducted on the Choptank River since 2005. We use a comparison between the visual count and vertical net haul to determine how well the visual count represents the abundance of medusae in the water column and address the time scales over which the time series of visual counts is able to capture trends in abundance. Finally, we address the use of cameras in order to allow for frequent sampling and simultaneous sampling at multiple locations.

Sharma, L. N., Alfred Wegener Institute for Polar and Marine Research, Wadden Sea Station, List, Germany, Lisa.Sharma@awi.de
Schade, F., Leibniz Institute for Marine Sciences IFM-Geomar, Kiel, Germany, Franziska.Schade@awi.de
Wegner, K. M., Leibniz Institute for Marine Sciences IFM-Geomar, Kiel, Germany, Mathias.Wegner@awi.de

ECCENTICAL POTENTIAL AND THERMAL REACTION NORMS OF MARINE HOST-PARASITE INTERACTIONS

Many natural systems are being affected by increasing environmental temperatures. Evolutionary potential (genetic variability) and plasticity (genotype x environment interaction; GxE) of populations will ultimately determine their survival in changing environments. While plasticity can enable organisms to respond quickly and effectively to such change, adaptive evolution, i.e. evolution of reaction norms (GxE) is necessary in the long-term to cope with altered environmental conditions. Assessing the potential of thermal reaction norms to evolve is very relevant to understand how species can deal with rapid climate change. In addition, it is largely unknown how environmental change interacts with selection imposed by parasites. Here, we use a fish host-trematode parasite model system from marine coastal ecosystems to investigate evolutionary potential and plasticity of thermal reaction norms of key fitness traits, and the temperature-dependence of genetic correlations and tradeoffs among life history, condition and parasite resistance traits. Using a quantitative genetics approach, we extend the GxE interactions of single species to multiple species (GxGxE), from which we can predict infection outcomes and evolutionary dynamics depending on the genetic variability of host and parasite populations.

Shamberger, K. E., University of Washington, Seattle, USA, kedefg@uw.edu
Feely, R. A., NOAA Pacific Marine Environmental Laboratory, Seattle, USA, Richard.A.Feely@noaa.gov
Sabine, C. L., NOAA Pacific Marine Environmental Laboratory, Seattle, USA, Chris.Sabine@noaa.gov
Atkinson, M. J., University of Hawaii, Honolulu, USA, mja@hawaii.edu
DeCarlo, E. H., University of Hawaii, Honolulu, USA, edecarlo@soest.hawaii.edu
Mackenzie, F. T., University of Hawaii, Honolulu, USA, fredm@soest.hawaii.edu
Drupp, P. S., University of Hawaii, Honolulu, USA, drupp@hawaii.edu
Butterfield, D. A., University of Washington, Seattle, USA, David.A.Butterfield@noaa.gov

CALCIFICATION, PRODUCTION, AND CO2 ON A HAWAIIAN CORAL REEF

Net ecosystem calcification (G) and net community production (NCP) rates were monitored simultaneously with CO2 seawater parameters on the barrier reef of Kaneohe Bay, Oahu, Hawaii from June 2008 to February 2010. G on the barrier reef increased throughout the day and decreased at night. G remained positive at night except for 4 time periods when net dissolution was measured. The barrier reef was generally net autotrophic during the day and net heterotrophic at night. The NCP dye cycle controlled pCO2, and Ωarag which was high (low) at night and low (high) during the day. On a net basis, NCP of the barrier reef was net autotrophic and heterotrophic, ranging from -361 to 221 mmol m-2d-1. Daily G ranged from 180 to 348 mmol m-2d-1 and was strongly correlated with average daily pCO2 (R2 = 0.74). Average daily Ωarag ranged from 2.61 to 3.17 and there was not a seasonal trend in G, NCP, or Ωarag. Daily G of the Kaneohe Bay barrier reef is similar to or higher than other coral reefs despite comparatively low Ωarag.

Shank, G. C., University of Texas at Austin Marine Science Institute, Port Aransas, TX, USA, chris.shank@mail.utexas.edu
Obelez, J. B., Coastal Carolina University, Conway, SC, USA, jbobelcz@coastal.edu

SUNLIGHT-INDUCED PRODUCTION OF DISSOLVED ORGANIC MATTER

Obelcz, J. B., Coastal Carolina University, Conway, SC, USA, jbobelcz@coastal.edu

Other coral reefs despite comparatively low Ωarag.
the frequency of resuspension events in windy conditions and ample solar irradiance during summer in south Texas. Photodissolution has the potential to provide enough DOC to influence important biogeochemical processes within the Nueces Marsh and throughout the shallow bays and estuaries of the south Texas coast.

Sharp, J. H., University of Delaware, School of Marine Science and Policy, Lewes, USA, jsharp@udel.edu

UNDERSTANDING URBAN AQUATIC ECOSYSTEMS: IMPORTANCE OF AGENCY MONITORING DATA

Major water quality changes have occurred in aquatic ecosystems influenced by urban activities. Long time monitoring data, often available from various government agencies, are valuable for understanding changes. The tidal freshwater region of the Delaware River and Bay estuary has experienced major impact from the Philadelphia, PA area. Some limited water quality monitoring data are available for the Delaware River in the urban region from 1913 to the present and detailed data for the full estuary from 1967 to the present. These monitoring efforts were from municipal and regional agencies. The relatively good quality and consistent analyses along a very long time axis provide a strong signal to evaluate trends. I have conducted research in the Delaware Estuary for about three decades and have correlated the long-time agency monitoring data with our research to better understand changes in the estuarine water quality and ecosystem response. It is desirable that similar evaluation of long-time agency monitoring data from other estuaries and coastal waters be evaluated also to better understand environmental degradation and/or improvements.

Sharpe, S. C., Mount Allison University, Sackville, Canada, scharpe@mta.ca

Koester, J. A., University of Washington, Seattle, USA, koesterj@u.washington.edu

Loeb, M., NIOZ, Texel, Netherlands, Martina.Loeb@.nioz.nl

Cockshutt, A. M., Mount Allison University, Sackville, Canada, acockshutt@mta.ca

Finkel, Z. V., Mount Allison University, Sackville, Canada, zfinkel@mta.ca

TESTING THE ¾ RULE OF METABOLIC SCALING WITHIN AND ACROSS TWO POPULATIONS OF THE DIATOM DITYLUM BRIGHTWELLII

Across a broad range of organisms of different size metabolic rate tends to scale to the ¾ power of organism size. It has been hypothesized that fundamental biophysical constraints on the scaling of transportation networks are responsible for the ¾ rule. Alternate hypotheses have suggested that DNA content, not organism size may be the fundamental control on metabolic scaling and meta-analyses indicate that the metabolic rates of microbes may not follow the ¾ power scaling. We quantified the growth rates of 2 populations of the diatom *Ditylum brightwellii* characterized by 2 different genome and cell sizes. Due to the physical constraints of the rigid siliceous frustule diatoms decrease in size with asexual reproduction. We quantified the growth rates of clones of different size within each population. We find statistically significant differences in the size scaling of growth consistent with the ¾ rule across the 2 populations, but weak size-scaling associated with growth rate within each of the populations.

Sharpley, A. N., University of Arkansas, Fayetteville, USA, sharpley@uark.edu

Jarvie, H. P., Center for Ecology and Hydrology, Wallingford, United Kingdom, hpi@ceh.ac.uk

AGRICULTURAL MANAGEMENT, WATER QUALITY AND PHOSPHORUS: THE LONG AND WINDING ROAD

The fate and transport of phosphorus (P) in agricultural systems and its role in surface water eutrophication has been researched for nearly 50 years. However, there are still gaps in our understanding of how to manage P to maximize agricultural production, while minimizing water quality degradation. This results from rapidly changing agricultural, economic, and policy drivers to differing agricultural and limnological languages of P mobility, reactivity, and end points. For instance, land managers can identify, rank, and target sources areas and practices at greatest risk for P loss. We are slowly coming to terms with the fact that there is a legacy of past management that will be sources of P even in an ideal world. Although we can quantify the relationship between P concentrations and biological response of waters, we are still challenged by linking source and aquatic ecosystem response for the developing regulatory arena. We will discuss the long and winding road that has led us here, lessons learned along the way, and how to better link soil, land, and water management.

Shaw, F. C., The University of New South Wales, Sydney, Australia, e.shaw@student.unsw.edu.au

McNeil, B. I., The University of New South Wales, Sydney, Australia, b.mcneil@unsw.edu.au

Tilbrook, B., CSIRO Wealth from Oceans National Research Flagship, Hobart, Australia, Bronte.Tilbrook@csiro.au

NATURAL VARIABILITY IN CARBONATE CHEMISTRY HASTENS THE ONSET OF CORROSIVE CONDITIONS IN A CORAL REEF FLAT

Future changes to coral reef seawater chemistry and calcification rates that may result from ocean acidification have largely been derived from one-time ship-based observations that sample in deeper waters outside shallow coral reefs. We examined the diurnal and seasonal variability of carbonate chemistry on a reef flat in the Great Barrier Reef, Australia. We found extremely high natural variability in carbonate chemistry, that when coupled with continued increases in atmospheric carbon dioxide, will lead to corrosive conditions for aragonite by the latter part of this century. Community calcification was found to undergo periods of net dissolution during parts of the day as a result of increased carbon dioxide from respiration. However, we predict the total daily calcium carbonate production to remain positive. Calculations of calcium carbonate production using mean offshore observations underestimated the decline in calcification when compared with calculations that incorporate observed natural variability. Characterizing natural variability is therefore important to accurately diagnose the onset of key chemical thresholds that may be experienced as a result of ocean acidification.

Shein, K. A., NOAA National Climatic Data Center, Asheville, NC, USA, Karsten.Shein@noaa.gov

Pirhalla, D. E., NOAA Center for Coastal Monitoring and Assessment, Silver Spring, MD, USA, Doug.Pirhalla@noaa.gov

Hendee, J. C., NOAA Atlantic Oceanographic and Meteorological Laboratory, Miami, FL, USA, jim.hendee@noaa.gov

Brandon, T. B., NOAA National Oceanographic Data Center, Silver Spring, MD, USA, TESS.Brandon@noaa.gov

Marzin, C. G., NOAA Office of National Marine Sanctuaries, Silver Spring, MD, USA, Catherine.Marzin@noaa.gov

TRENDS IN EXTREME CLIMATE EVENTS IN THE FLORIDA KEYS

Periodic extreme climatic events, such as heat waves, droughts and severe storms drive some of the greatest immediate adverse impacts on coastal and marine ecosystems (e.g., physical damage, hypersalinity, inundation, bleaching). However, many aquatic ecosystems have exhibited resilience to such perturbations when given sufficient recovery time relative to the magnitude of the event. Unfortunately, changes in the strength, duration, and/or frequency of such events can result in increased vulnerability of these ecosystems to climate-induced stress. The climate record demonstrates that the behavior of extreme events is not static in either time or space, and may suggest that certain events are becoming more intense, lasting longer, or occurring more frequently. This research examines historical climate data from several locations within and around the Florida Keys to identify the rates and trends in extreme events in the recent past. Trends in extreme climatic events are identified using meteorological and biological data sets. The results of this research will help to identify climate-induced changes and improve our understanding of the degree to which these changes are influencing the behavior of extreme events in coastal and marine ecosystems.

Sheron, N. L., Dauphin Island Sea Laboratory REU, Dauphin Island, USA, naomish06@gmail.com

Condon, R. H., Dauphin Island Sea Laboratory, Dauphin Island, USA

Graham, W. M., Dauphin Island Sea Laboratory, Dauphin Island, USA

Linn, L. J., Dauphin Island Sea Laboratory, Dauphin Island, USA

SOUTHEASTERN DYNAMICS OF OIL-DERIVED CHROMOPHORIC ORGANIC MATTER IN COASTAL GULF OF MEXICO WATERS

The Deepwater Horizon oil spill introduced massive quantities of petroleum hydrocarbons into the northern Gulf of Mexico (GOM). However, the distribution and fate of oil-derived material is poorly understood. In order to better understand the source-sink dynamics of oil, we measured chromophoric dissolved organic matter (CDOM) in coastal Alabama waters under pre- and post-spill conditions using excitation-emission signatures to detect the presence and characterize relative amounts of oil-derived material. Using the distinct fluorescent fingerprint of oil relative to other CDOM components (Ex/Em range 290-340/585-685 nm), we detected sizeable amounts of dissolved and colloidal fractions of oil in surface and bottom waters.

Shelton, N. L., Dauphin Island Sea Laboratory REU, Dauphin Island, USA, naomish06@gmail.com

Condon, R. H., Dauphin Island Sea Laboratory, Dauphin Island, USA

Graham, W. M., Dauphin Island Sea Laboratory, Dauphin Island, USA

Linn, L. J., Dauphin Island Sea Laboratory, Dauphin Island, USA

SOURCE-SINK DYNAMICS OF OIL-DERIVED CHROMOPHORIC ORGANIC MATTER IN COASTAL GULF OF MEXICO WATERS

The Deepwater Horizon oil spill introduced massive quantities of petroleum hydrocarbons into the northern Gulf of Mexico (GOM). However, the distribution and fate of oil-derived material is poorly understood. In order to better understand the source-sink dynamics of oil, we measured chromophoric dissolved organic matter (CDOM) in coastal Alabama waters under pre- and post-spill conditions using excitation-emission signatures to detect the presence and characterize relative amounts of oil-derived material. Using the distinct fluorescent fingerprint of oil relative to other CDOM components (Ex/Em range 290-340/585-685 nm), we detected sizeable amounts of dissolved and colloidal fractions of oil in surface and bottom waters.
coastal waters. The addition of hexane to samples was used to extract other forms of oil, and increased CDOM intensities suggested oil was present as microparticles. Oil-mediated spikes CDOM spectra also correlated with increases in dissolved organic carbon and leucine incorporation rates, suggesting that oil was a major source of labile material in offshore coastal waters. These results suggest that CDOM matrices can be used in long-term studies to monitor the changing levels of oil and carbon in coastal waters.

Sherman, C., University of Puerto Rico at Mayaguez, Mayaguez, USA, csherman@upr.edu

Nemeth, M., University of Puerto Rico at Mayaguez, Mayaguez, USA, nemeth@upr.edu

Ruiz, H., University of Puerto Rico at Mayaguez, Mayaguez, USA, hrhu@upr.edu

Bejarano, I., University of Puerto Rico at Mayaguez, Mayaguez, USA, ibejarano@gmail.com

Appeldoorn, R., University of Puerto Rico at Mayaguez, Mayaguez, USA, rappeldoorn@gmail.com

Weil, E., University of Puerto Rico at Mayaguez, Mayaguez, USA, eweil@upr.edu

Hutchinson, Y., University of Puerto Rico at Mayaguez, Mayaguez, USA, hutchinsony@gmail.com

Rojas, M., University of Puerto Rico at Mayaguez, Mayaguez, USA, rojasm@gmail.com

GEOMORPHOLOGY AND SEDIMENT DYNAMICS IN MESOPHOTIC CORAL ECOSYSTEMS OF THE UPPER INSULAR SLOPE OF SOUTHWEST PUERTO RICO Multibeam bathymetry, ROV and diver observations and sediment trap collections provide data to characterize the interrelationships among geomorphology, sediment dynamics and mesophotic coral ecosystems (MCEs) of the insular slope of southwest Puerto Rico from ~20 to ~90 m water depth. Southeast-facing slopes, more exposed to prevailing seas, consistently have a gentler gradient and smoother, lower rugosity topography than more sheltered southwest-facing slopes, which are steep and irregular. MCEs are preferentially concentrated on topographic highs. Accordingly, MCEs are more abundant, extensive and diverse on southwest-facing slopes where the steep, irregular topography provides extensive suitable substrates and downwarp sediment transport is quickly funneled into narrow grooves. MCEs are more sporadic on southeast-facing slopes where topographic highs are more widely spaced and downslope sediment transport is spread over open, low-rugosity slopes. Though concentrated on topographic highs, in slope settings, all MCEs must still adapt to some level of downslope sediment transport. MCEs on lower rugosity slopes are exposed to higher rates of downslope bed load transport than MCEs on steep, irregular slopes affecting the character and composition of these communities.

Shi, D., Princeton University, Princeton, USA, dshi@princeton.edu

Ryan, D. E., Princeton University, Princeton, USA

Lomas, M. W., Bermuda Institute of Ocean Sciences, St. George’s, Bermuda

Morel, F. M., Princeton University, Princeton, USA

EFFECTS OF ELEVATED pCO2 ON CARBON AND NITROGEN FIXATION BY TRICHODESMIUM AT THE BERMUDA ATLANTIC TIME-SERIES STUDY (BATS) REGION

The N2-fixing cyanobacterium Trichodesmium thrives throughout the oligotrophic tropical and subtropical oceans where phosphorus and/or iron often limit its growth and nitrogen fixation. It contributes about half of all marine nitrogen fixation and, thus, can play a prominent role in the biogeochemical cycling of carbon and nitrogen. Although it remains to be further understood mechanistically, a few laboratory culture studies have shown that the rates of carbon and nitrogen fixation by Trichodesmium increase with increasing pCO2. However, there is almost no information on the response of field Trichodesmium populations to the rising CO2. Here we show that increasing pCO2 resulted in a systematic increase in carbon and nitrogen fixation rates of Trichodesmium colonies collected in the Bermuda Atlantic Time-series Study (BATS) region. Preliminary experiments showed a down-regulation of carboxysomal protein CcmM, which has a gamma-carbonic anhydrase domain, at elevated pCO2, implying an energy re-allocation from carbon acquisition to carbon and nitrogen fixation. Mechanistic studies are in progress to further elucidate physiological and biochemical responses of the organism to increasing pCO2 under both nutrient replete and Fe-limiting conditions.

Shields, J. D., VIMS, The College of William & Mary, Gloucester Point, USA, jshields@vims.edu

Li, C., VIMS, The College of William & Mary, Gloucester Point, USA, cvli@vims.edu

Reece, K. S., VIMS, The College of William & Mary, Gloucester Point, USA, kreece@vims.edu

Wang, H., VIMS, The College of William & Mary, Gloucester Point, USA, wang@vims.edu

Dolan, T. W., VIMS, The College of William & Mary, Gloucester Point, USA, tdolan@vims.edu

Butler, M. J., Old Dominion University, Dept. Biological Sciences, Norfolk, USA, mb Butler@odu.edu

THE IMPACT OF A PARASITIC DINOF Lagellate, HEMATOMDIUM SR, ON THE AMERICAN BLUE CRAB, CALLINECTES SAPIUS

We have been studying the infection dynamics of Hematomdiun in blue crabs from small embayments in Virginia. The prevalence of this parasite can approach 100% in focal outbreaks. Outbreaks occur once or twice per year shortly after the molting periods of the host. A highly sensitive quantitative PCR has been developed to detect dinospores of Hematomdiun in environmental samples. The dinospore abundance in water samples is significantly correlated with prevalence of infection in crab hosts from high salinity embayments. In several bays, crab abundance is negatively correlated with prevalence of infection. We are developing a model for the blue crab - Hematomdiun system that is intended to gage how physiographic features, fishing pressure and host factors contribute to outbreaks of disease. There is circumstantial evidence that overexploitation has contributed to the emergence of disease in several marine fisheries, but the effect of fishing pressure on disease has received little attention. We want to understand how fishing pressure and declining water quality combine with the physiography of small coastal estuaries to promote outbreaks of disease in blue crabs.

SHIN, W. S., Tohoku university, sendai, Japan, swoosuk@eco.civil.tohoku.ac.jp

FUJIBAYASHI, M., Tohoku university, sendai, Japan

NAGAHAMA, Y., Tohoku university, sendai, Japan

NOMURA, M., Tohoku university, sendai, Japan

NISHIMURA, O., Tohoku university, sendai, Japan

THE STUDY ON CONTRIBUTION OF MICROBIAL ORGANIC MATTER IN FORMATION OF TIDAL FLAT SEDIMENT

The tidal flats are the transition zone from land to ocean system and receive organic matters and nutrients transported from rivers or oceans. The dynamics of organic matter in tidal flats have been intensively studied, questions still remain regarding the origin of sources, fate and role of organic matter in the benthic ecology of estuaries. Especially, little is known about the role and contribution of microbial organic matter in sediment formation. It is quite likely that Microbial organic matter is potential food source of macro benthos and contribution of sediment formation in tidal flat. Recently, fatty acid has been used as biomarkers to trace the origin and flow of organic matter in marine ecosystem. The purpose of this study was to examine contribution of microbial organic matter in sediment formation with different tidal flat types. As a result, according to the regression models of FA concentration versus TOC, the microbial OM and LCFAs are relevant to contribution of sediment formation (p<0.05). On the other hand, the phytoplankton of marine and riverine has not contributed to the formation of sediment (p>0.05).

Shirley, T. C., Texas A&M University-Corpus Christi/Harte Research Institute, Corpus Christi, USA, Thomas.Shirley@tamucc.edu

Etnoyer, P. J., NOAA Center for Coastal Environmental Health and Biomolecular Research, Charleston, USA, Peter.Etnoyer@noaa.gov

Lavelle, K. A., Texas A&M University-Corpus Christi/Harte Research Institute, Corpus Christi, USA, Katherine.Lavelle@tamucc.edu

EPIFAUNA OF DEEP-WATER CORALS IN ROATAN, HONDURAS

Deep-water corals provide complex habitats for unique invertebrate and fish assemblages. Although poorly studied because of their depths, these corals serve as prey, feeding or reproductive sites, or refuge from predation. We examined assemblages on deep-water corals to depths of 750 m at three sites near the West End of Roatan, Honduras, using the 3-man submersible Idabel in August 2010. Transects were from deep to shallow and recorded on high-def video; still images were made with an SLR camera synchronized with external strobe lights. Unique epifaunal assemblages were associated with corals; 24 species of macroinvertebrate epifauna were observed, with the highest diversity on Plumathepas sp. and Dendrophyllia alternata. Two of the most conspicuous fauna were the brittlestar Asterochasma lavee and the crab Chirostylus sp., most common on Paramurica sp. The galatheid crab Eumunida picta was usually near or on Dendrophyllia, which did not host brittlestars. Host fidelity and constancy were obvious; some coral species had no visible epibionts, while others predictably hosted the same species assemblages.
Sieben, K., INSU-CNRS, UMR 7144 & Universite Pierre et Marie Curie, Station Biologique de Roscoff, Roscoff, France, sianosb-roscoff.fr
Alves-de-Souza, C., INSU-CNRS, UMR 7144 & Universite Pierre et Marie Curie, Station Biologique de Roscoff, Roscoff, France, cathosouza@gmail.com
Foulon, E., INSU-CNRS, UMR 7144 & Universite Pierre et Marie Curie, Station Biologique de Roscoff, Roscoff, France, foulon@sb-roscoff.fr
Bendit, E. M., INSU-CNRS, UMR 7144 & Universite Pierre et Marie Curie, Station Biologique de Roscoff, Roscoff, France, bendit@sb-roscoff.fr
Simon, N., INSU-CNRS, UMR 7144 & Universite Pierre et Marie Curie, Station Biologique de Roscoff, Roscoff, France, simon@sb-roscoff.fr
Guillou, L., INSU-CNRS, UMR 7144 & Universite Pierre et Marie Curie, Station Biologique de Roscoff, Roscoff, France, lguillou@sb-roscoff.fr
Bendif, E. M., INSU-CNRS, UMR 7144 & Universite Pierre et Marie Curie, Station Biologique de Roscoff, Roscoff, France, bendif@sb-roscoff.fr
Not, F., INSU-CNRS, UMR 7144 & Universite Pierre et Marie Curie, Station Biologique de Roscoff, Roscoff, France, not@sb-roscoff.fr

DISTRIBUTION AND HOST DIVERSITY OF AMOEBOPHRYIDAE PARASITES ACROSS OLIGOTROPHIC WATERS OF THE MEDITERRANEAN SEA

Marine Alveolates regularly dominate 18S rDNA libraries of marine ecosystems. Among them, Amoeboaphyidae (MALV group II) comprises numerous and genetically distant sequences, where Amoeboaphyra is the only formally described genus. Amoeboaphyra are virulent pathogens for a range of dinoflagellates species. Beside their regular occurrence, their quantitative distribution and the environmental factors triggering host infection are poorly known in oligotrophic waters. Here we studied the distribution and contribution to the eukaryotic community of Amoeboaphyridae dinospores (free-living stage) in the Mediterranean Sea, as well as their host diversity at three oligotrophic stations. Dinospores were more abundant at coastal station (max 1.5x10³ cells ml⁻¹) than in oligotrophic water (max 51 cells ml⁻¹) where they represented 10.3 to 34.9% and 0.4 to 3.1% of total eukaryotic community, respectively. From a total of 38 dinospore taxa identified, 15 were infected among which a majority were not recognized as Amoeboaphyridae host previously. Percentage of infected cells varied between 2% and 10%, with a notable exception for Blepharodysta paasieni for which 25% of cells were infected. The present study shows that dinospores are able to thrive, infect and most probably exert a control on host populations both in coastal and ultra-oligotrophic open waters. Our results emphasize the role of parasitism in microbial food web dynamics and ultimately on biogeochemical cycles.

Sieben, K., Department of Marine Benthic Ecology & Evolution, University of Groningen, Groningen, Netherlands, k.sieben@rug.nl
Ljunggren, L., County Administrative Board of Gävleborg, Gävle, Sweden
Bergrström, U., Swedish Board of Fisheries, Institute of Coastal Research, Oregrund, Sweden
Rippen, A. D., Department of Marine Benthic Ecology & Evolution, University of Groningen, Groningen, Netherlands
Eriksson, B. K., Department of Marine Benthic Ecology & Evolution, University of Groningen, Groningen, Netherlands

INTERACTING EFFECTS OF PREDATOR DECLINE AND RESOURCE ENRICHMENT ON DIFFERENT SPATIAL SCALES

We tested joint effects of predator loss and increased resource availability on different spatial scales in the coastal zone of the Baltic Sea. In a small-scale experiment, the combination of nutrient enrichment and excluding larger predators induced an increase in meso-predator fish (three-spined stickleback) which in turn caused a substantial shift in the grazer composition towards the dominance of gastropods by reducing amphipods by 40-60%. The shift in grazer composition generated a 23 times higher biomass, but only under nutrient enrichment. Second, we explored the consequences of a meso-predator release on a near-natural scale, by manipulating stickleback densities in four large 600 m² enclosures. Higher densities of stickleback resulted in a three times higher recruitment of filamentous macroalgae. At the same time we found higher abundances of the dominating invertebrate grazers with lower stickleback densities. Our results show that top-predator declines can substantially shift the grazer composition, but that cascading effects on producers strongly depend on resource availability. Furthermore, we show that a large-scale meso-predator release may dramatically change coastal food webs towards increased recruitment of filamentous macroalgae.

Sieg, R. D., Georgia Institute of Technology, Atlanta, USA, drew.sieg@gatech.edu
Poulson-Ellestad, K. L., Georgia Institute of Technology, Atlanta, USA, kpoulson@gatech.edu
Prince, E. K., Georgia Institute of Technology, Atlanta, USA, eprince@paine.edu
Myers, T. L., Georgia Institute of Technology, Atlanta, USA, tm192@mail.gatech.edu
Kubanek, J., Georgia Institute of Technology, Atlanta, USA, julia.kubanek@biology.gatech.edu

SPECIES-SPECIFIC EFFECTS AND PARTIAL CHARACTERIZATION OF ALLELOPATHIC COMPOUNDS PRODUCED BY THE RED TIDE DINOFLAGELATE, KARENIA BREVIS

The red tide dinoflagellate *Karenia brevis* exudes compounds that can inhibit the growth of competing phytoplankton, but the identities of these compounds are unknown. We characterized allelopathic compounds from *K. brevis* using a variety of chromatographic and spectroscopic techniques. Multiple chemical compounds produced by *K. brevis* inhibited the growth of four phytoplankton competitors, although competitors were susceptible to different combinations of these compounds. Brevetoxins, neurotoxins responsible for fish kills and neurotoxic shellfish poisoning in humans, did not effect the growth of the competitor *Asterionellopsis glacialis*. Most allelopathic compounds produced by *K. brevis* are polar, organic molecules produced at low concentrations, which are neutral or positively charged and relatively unstable. *K. brevis* also produces a suite of less polar, but more stable compounds that are moderately allelopathic towards *A. glacialis*. The ability of *K. brevis* to outcompete co-occurring phytoplankton may be facilitated by the production of multiple allelopathic compounds, which provides a broader chemical arsenal to combat taxonomically diverse phytoplankton species.

Siegel, D. A., UC Santa Barbara, Santa Barbara, USA, davey@eet.ucsb.edu

SATELLITE OCEAN COLOR ASSESSMENTS OF THE GLOBAL OCEAN BIOSPHERE: PAST, PRESENT AND FUTURE

For more than thirty years, satellite ocean color remote sensing has enabled researchers an unprecedented view into the changes of the global ocean biosphere. Along the way, we have learned much about how to do satellite ocean color remote sensing. In this talk, I will review some of the accomplishments made during the past three decades using satellite ocean color observations and address the required elements of satellite sensor design, sensor performance assessment, field validation, model building and data (re)processing that makes climate-quality, satellite ocean color data possible. In particular, focus is placed on what we have learned about making satellite ocean color remote sensing during this time and how those experiences should impact future missions.

Signorini, S. R., NASA Goddard Space Flight Center, Greenbelt, USA, sergio.signorini@nasa.gov
Olsen, A., Bjerknes Center for Climate Research, Bergen, Norway, aolsen@gfi.uib.no
Hakkinen, S., NASA Goddard Space Flight Center, Greenbelt, USA, sirpa.m.hakkinen@nasa.gov
Metzl, N., IPSL, Paris, France, nicolas.metzl@oceangr.is
Gudmundsson, K., Marine Research Institute, Reykjavik, Iceland, kristinn@hafro.is
OMAR, A., Bjerknes Center for Climate Research, Bergen, Norway, abraham.an.
omar@bjerknes.uib.no
Olafsson, J., Marine Research Institute, Reykjavik, Iceland, jon@hafro.is
Reverdin, G., IPSL, Paris, France, gilles.reverdin@oceangr.is
McClain, C., NASA Goddard Space Flight Center, Greenbelt, USA, Charles.R.McClain@nasa.gov

TRENDS IN THE SUBPOLAR NORTH ATLANTIC CARBON SINK AND OCEAN ACIDIFICATION: 1981-2008

An ecosystem model is used to investigate physical-biological interactions in Icelandic waters. The seasonality of phytoplankton blooms compares well with satellite ocean color products. The spring-summer bloom consists of a strong diatom bloom peaking in May, followed by a broader flagellate bloom ending in September and a coccolithophore bloom peaking in July. The effect of biological changes on the seasonal variability of the surface ocean pCO₂ exceeds the temperature effect by ~70%. The model reproduces the observed winter surface ocean pCO₂ growth very closely (faster than the atmospheric growth of 1.8 µatm yr⁻¹), which is a result of increasing pCO₂ in the deeper layers. The ocean is becoming more neutral as winter sea-air pCO₂ differences are reduced by 0.81 µatm yr⁻¹. Winter surface ocean trends in pCO₂, TCO₂, pH, aragonite, and calcite saturation states were estimated at +2.50 µatm yr⁻¹, +0.87 µmol kg⁻¹ yr⁻¹, -0.003 yr⁻¹, -0.008 yr⁻¹, and -0.013 yr⁻¹, respectively. Summer surface ocean trends are somewhat smaller, +1.60 µatm yr⁻¹, +0.44 µmol kg⁻¹ yr⁻¹, -0.002 yr⁻¹, -0.005 yr⁻¹, and -0.008 yr⁻¹, respectively.
Simmons, C. C., College of Marine Science, University of South Florida, St. Petersburg, FL, USA, csimmo2@gmail.com
Jaward, F. M., Department of Environmental and Occupational Health, College of Public Health, University of South F, Tampa, FL, USA, fjaward@health.usf.edu
Johnson, A., College of Marine Science, University of South Florida, St. Petersburg, FL, USA, aaytrey@marine.usf.edu

ASSESSING THE PRESENCE AND DISTRIBUTION OF POLYBROMINATED DIPHENYL ETHERS IN HILLSBOROUGH BAY A NORTHEASTERN REGION OF TAMPA BAY, FL.

Polybrominated diphenyl ethers (PBDEs) are a widely used class of flame retardants that are important sources for contamination in the marine environment. Sediments serve as a sink for PBDEs due to their large sorption capacity, and concentrations of PBDEs in sediments are related to coastal population density. Hillsborough Bay, a northeastern region of Tampa Bay, FL, is surrounded by a large urban area, supports extensive industrial activity and a major shipping port. This study examines the presence and distribution of PBDEs in Hillsborough Bay to determine the extent of pollution, identify sources, and possible management strategies. A total of 50 sediment surface samples were collected from Hillsborough Bay and two of its major tributaries to assess the presence and distribution of 8 routinely detected PBDE congeners. Samples were Soxhlet extracted, cleaned up on a Florisil alumina: silica gel column and extracts were analyzed by gas chromatography/ electron capture detector (GC-ECD). In this study we report the first attempt to present data and distributions of PBDEs in terms of sample location, grain size and organic matter content in this region.

Simmons, K., Hampton University, Hampton, USA, kayelyn.simmons@pipeline.hamptonu.edu
Walter, K., Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, USA, kwalter@rsmas.miami.edu
Sponaugle, S., Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, USA, spsponaugle@rsmas.miami.edu

SPATIAL AND TEMPORAL VARIATION IN THE EARLY LIFE OF A CORAL REEF DAMSELFISH (STEGASATES PARTITUS)

Spatial patterns in production and temporal fluctuations in temperature have the potential to influence the early life of a common damselfish (Stegastes partitus). To assess variation in early growth, newly settled juveniles were collected by SCUBA divers during two months (June and July) in 2007 from two sites in each of the upper and lower Florida Keys. Lapillar otoliths were dissected and read using image analysis software. Daily larval growth during the first 20 days of life did not vary significantly by month or location, resulting in no significant differences in size-at-stage. Pelagic larval duration (PLD) also did not vary by month, but fish that settled in July were larger immediately prior to and at settlement. As a result, these fish likely had higher early survival rates on the reef. There were inconsistent differences in juvenile growth over time and space; however, in July, juvenile growth was higher in the upper Keys, opposite to expectations. Together with additional data, these results help differentiate the biological and the environmental conditions that influence population replenishment of coral reef fish.

Simonelli, C., Gulf of Mexico Coastal Ocean Observing System, St. Petersburg, USA, simo@marine.usf.edu
Tissot, P., Conrad Blucher Institute, Texas A&M University-Corpus Christi, Corpus Christi, USA, ptissot@lighthouse.tamucc.edu
McKee, D., Fisheries and Mariculture Program, Texas A&M University-Corpus Christi, Corpus Christi, USA, david.mckee@tamucc.edu
Adams, J., Conrad Blucher Institute, Texas A&M University-Corpus Christi, Corpus Christi, USA, jashtips@me.com
Ball, R., Conrad Blucher Institute, Texas A&M University-Corpus Christi, Corpus Christi, USA, roblyn.lball@gmail.com
Butler, R., Gulf Intracoastal Canal Association, Corpus Christi, USA, wrbutler@comcast.net
Jochens, A., Texas A&M University, College Station, USA, ajochens@tamu.edu

A COOPERATIVE APPROACH TO RESOURCE MANAGEMENT: TEXAS GAMEFISH WIN

Recent record-setting cold weather in the southern U.S. put numerous recreational gamefish species at risk. Cognizant of the danger, barge traffic in Lake Cat, a section of the Intracoastal Waterway in Texas, poses to cold-stressed fishes, Gulf Intracoastal Canal Association (GICA) members sacrificed $7,000 per tow to protect the resource. Described here is the collaboration among academics, industry leaders, and conservationists which led to the pooling of resources to mitigate gamefish mortalities during the cold weather event. A water temperature forecasting tool, in development and tested in this partnership, is discussed in terms of ecosystem-based management, of which a key component is engaging multiple stakeholders in a collaborative process to define problems and find solutions. The partnership exemplifies the mission of the Gulf of Mexico Coastal Ocean Observing System Regional Association; to use data and tools to provide information, deliver that information to decision makers in a timely manner, and make and implement decisions that promote sustainable use of resources.

Sinclair, G. A., Louisiana Universities Marine Consortium, Chauvin, USA, gsinclair@lumcon.edu
Molina, M., Louisiana Universities Marine Consortium, Chauvin, USA, mmolina@gmail.com
Czubakowski, J., Louisiana Universities Marine Consortium, Chauvin, USA, jczuba1@gigers.lsu.edu
Boling, B., University of Oklahoma, Norman, USA, Wilford.B.Boling-1@ou.edu

SPATIAL AND TEMPORAL PATTERNS OF NITROGEN UPTAKE AND ENZYME ACTIVITY ON THE LOUISIANA SHELF.

The process of hypoxia formation on the Louisiana shelf is driven largely by phytoplankton responses to nutrient delivery via the Mississippi and Atchafalaya rivers and the consequent deposition and mineralization of this organic material in the sediments. To examine differences in phytoplankton responses to nutrients across the Louisiana shelf, nitrogen uptake rates (nitrate, ammonium, and urea) and enzyme activities were examined from March to June 2010. One transect extending off of Terrebonne Bay was characterized by relatively high nitrate concentrations derived from Mississippi river water. The other transect extending out of the Atchafalaya river delta was characterized by decreasing gradients of regenerated nutrients (ammonium and urea) from the delta to offshore waters. Phytoplankton community structure changed across the shelf with the ratio of dinoflagellates to diatoms decreasing from 1.3 to 0.37 from onshore to offshore waters. We will present differences in uptake rates and enzyme activities relative to changes in phytoplankton community and potential environmental controls (e.g. river discharge, light, nutrient concentrations, and temperature).

Sipler, R. E., Virginia Institute of Marine Sciences, Gloucester Point, USA, sipler@vims.edu
Bronk, D. A., Virginia Institute of Marines Sciences, Gloucester Point, USA, bronk@vims.edu

BIOGEOCHEMICAL LINK BETWEEN TRICHODESMIUM SP. AND RED TIDE KARENIA BREVIS.

The biogeochemical relationship between Karenia brevis and co-occurring cyanobacteria Trichodesmium sp. was evaluated using high resolution mass spectrometry. The dissolved organic nitrogen (DON) from cultures of Trichodesmium sp. was isolated, concentrated and supplied as a nutrient source to a natural K. brevis bloom in a 9 day bioassay experiment. Electrospray ionization mass spectrometry (ESI-MS) and Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS) were used to chemically characterize compounds produced and consumed by the K. brevis community. ESI analysis shows that approximately 60% of the mass (one or more compounds with a specific mass to charge ratio), added with the Trichodesmium exudate addition were bioavailable, based on a significant decrease in ion abundance (p<0.05). With higher resolution FT-ICR MS molecular formulas were assigned to >47% of the detected compounds. Approximately 500 nitrogen containing compounds unique to the exudate addition were identified and half of those compounds disappeared within the first 24 hours of incubation. This is the first study to identify previously uncharacterized DON compounds bioavailable to a K. brevis bloom community.

Sison-Mangus, M. P., University of California Irvine, Irvine, USA, msisonmaguci@gmail.com
Tran, K., University of California Irvine, Irvine, USA, kevinnt@uci.edu
Jiang, S., University of California Irvine, Irvine, USA, sjiang@uci.edu

GROWTH STIMULATION AND KILLING OF PSEUDO-NITZSCHIA BY NON-NATIVE EPIBIOTIC BACTERIA

Although a diverse suite of epibiotic bacteria is known to be associated with the toxigenic diatom Pseudo-nitzschia, the specific physiological interactions of these epibionts with the diatom host are not fully characterized. Previous literature have dealt on the role of epibiotic bacteria on the toxin production of Pseudo-nitzschia.
but so far, none have focused on algal growth stimulation or algicidal effect of epibiotic bacteria on this HAB species. Using culture isolation technique and metagenomic approach, we isolated and identified the bacteria that adhere to the surface of several strains of toxigenic *Pseudo-nitzschia* using 16S rDNA sequencing. We then re-introduced the isolated epibiotic bacteria on *Pseudo-nitzschia australis* and *P. pungens* whereas one epibiont can kill *P. australis* but not *P. pungens*. These results suggest that epibiotic bacteria do play an important role on the bloom dynamics of different *Pseudo-nitzschia* species and may potentially dictate the losers and the winners in a *Pseudo-nitzschia* bloom event.

Skjærassen, J. E., University of Bergen, Bergen, Norway, jon.skjærassen@bio.uib.no
Meager, J. J., Australia
Rudolfsen, G., Norwegian Polar Environmental Centre, Tromso, Norway
Karlsen, O., Institute of Marine Research, Bergen, Norway
Mayer, L., Norwegian Veterinary School, Bergen, Norway
Moberg, O., University of Bergen, Bergen, Norway
Staby, A., University of Bergen, Bergen, Norway
Dahle, G., Institute of Marine Research, Bergen, Norway
Fernø, Å., University of Bergen, Bergen, Norway

**SPERM TRAITS AND REPRODUCTIVE ROLES IN A MARINE BROADCAST SPawner**

Mating systems can, in terms of male reproductive success, vary from systems based entirely on female choice to communal spawning where interactions at the gamete level decide male reproductive success. In between these extremes, males may act as either dominant or subordinate males. Dominant males tend to be large, aggressive males that court females intensively, whereas subordinates males are small, non-aggressive and achieve their reproductive success by rushing in and releasing sperm when females spawn. The reproductive success of the latter ‘sneaker’ type is therefore often associated with sperm traits. Many marine broadcast spawners, such as the Atlantic cod (*Gadus morhua L.*) were traditionally thought to be communal spawners. We therefore examined the association between male reproductive success and sperm traits in cod. Using data from individual female batches we examined three hypotheses: i) all males release sperm when females spawn, and male reproductive success is decided by male sperm traits, ii) not all males release sperm, but the success of males siring eggs in a given batch is decided by sperm traits and iii) the success of the dominant male is decided by another attribute, e.g. morphology/behaviour, whereas the secondary males’ success is influenced by sperm traits.

Skrabal, S. A., UNC Wilmington, Wilmington, USA, skrabals@uncw.edu
Larson, L. A., UNC Wilmington, Wilmington, USA, lal8295@uncw.edu
Thompson, L. E., UNC Wilmington, Wilmington, USA, let1780@uncw.edu
Avery, G. B., UNC Wilmington, Wilmington, USA, averyy@uncw.edu
Kieber, R. J., UNC Wilmington, Wilmington, USA, kieberr@uncw.edu
Mead, R. N., UNC Wilmington, Wilmington, USA, meadr@uncw.edu

**PHOTOCHEMICAL RELEASE OF DISSOLVED COPPER FROM RESUSPENDED SEDIMENTS**

Understanding mobilization processes of copper in natural waters is important because it is a required nutrient at low concentrations but potentially toxic at elevated levels. Studies in our laboratory have demonstrated that exposure of resuspended estuarine sediments to simulated sunlight releases total dissolved Cu (TDCu) to seawater. Using environmentally relevant concentrations (300-400 mg/L) of fine-grained (<10 um) suspended sediments, significant releases of total dissolved Cu (TDCu) occurred in most samples exposed to 6 hours of light, relative to dark controls. TDCu concentrations were typically >50% larger in light vs. dark samples with net increases ranging from 0.5 to 10 nM. Photorelease of TDCu occurred in diverse sediment types, including oligo- to polyhaline estuarine and tidal creek environments, and impacted and relatively unimpacted sites. Some highly anoxic sediments showed no or small levels of photo release, possibly due to sequestration of Cu in sulfide phases which only slowly oxidize to release TDCu, and/or to subsequent resuscavenging of Cu onto oxidized iron and manganese oxyhydroxides. These results indicate that photo-release from suspended sediments is a previously unrecognized source of metals to natural waters.

Small, G. E., University of Minnesota, St. Paul, USA, gesmall@umn.edu
Ardon, M., Duke University, Durham, USA, mlmal@duke.edu
Ellis, E. E., University of Washington, Seattle, USA, ellise@uwashington.edu
Genereux, D. P, North Carolina State University, Raleigh, USA, genereux@ncsu.edu
Hernes, P. J., University of California Davis, Davis, USA, pjhernes@ucdavis.edu
Johnson, M. S., University of British Columbia, Vancouver, Canada, mark.johnson@ubc.edu
Mayorga, E., University of Washington, Seattle, USA, mayorga@apl.washington.edu
McDowell, W. H., University of New Hampshire, Durham, USA, Bill.McDowell@unh.edu
Pringle, C. M., University of Georgia, Athens, USA, cpringle@uga.edu
Six, J. W., University of California Davis, Davis, USA, jwsix@ucdavis.edu
Spencer, R. G., University of California Davis. Davis, CA, USA, rgs@ucdavis.edu
Townsend-Small, A., University of California Irvine. Irvine, CA, USA, atownsen@uci.edu
Wihl, E. E., Colorado State University. Fort Collins, CO, USA, ellen.wohl@colostate.edu

A SYNTHESIS OF CARBON TRANSPORT AND PROCESSING IN TROPICAL STREAMS AND RIVERS: EFFECTS OF GLOBAL CHANGE

Tropical rivers and streams are considered biogeochemical hot spots, but these ecosystems are poorly studied relative to their temperate counterparts. Moreover, as many tropical rivers are rapidly developing, anthropogenic stressors coupled with climate-driven shifts in precipitation regimes are likely to alter rates of C transport and processing. Here, we report the results of a synthesis effort using C flux data from streams and rivers across the tropics. Carbon lost from the landscape is best predicted by annual runoff, suggesting that linkages between the C and water cycles are paramount and that changes in precipitation could combine with land use changes to have important effects on C flux. Dam construction is likely to alter C transport and processing in large rivers and montane streams, while changes in precipitation regimes and species extinctions could influence C flux in lowland wet forests and dry forests. To fill the extensive gaps in our understanding of these ecosystems, we recommend standardization of methodology among studies, continuation of long-term monitoring of relatively pristine reference sites, and emphasizing studies of stressed streams and rivers in the tropics.

Smrčka, T. J., Grad. School Oceanography, Univ. Rhode Island, Narragansett, RI, USA, tsmayda@gso.uri.edu

IN HOMAGE TO PETER G. VERITY: THE CONTRASTING ECOLOGY OF DIATOMS AND DINOFLAGELLATES

IN HOMAGE TO PETER G. VERITY: THE CONTRASTING ECOLOGY OF DIATOMS AND DINOFLAGELLATES

*Improved mechanistic understanding of ocean dynamics and the ability to predict future changes . . . must identify the forces (specifically) structuring the marine pelagial, i.e. organism-organism and organism-environmental interactions ‘ (Verity and Smethie, 1996). In response to that directive and in honor of Peter Verity’s seminal studies, the contrasting ecologies of the diatoms and dinoflagellates are described and the relevance of their ecophysiological differences to contemporary notions on blooms, succession and primary production discussed. Diatoms employ a sink strategy, whereas dinoflagellates rely on swim and rover strategies; diatoms generally behave as perennial species and as members of a guild, dinoflagellates behave as annual species and solitists. The contrasting bloom behavior, species succession, habitat specialization, phenology and differing primary producer status of the diatoms and dinoflagellates are demonstrated. Different conceptual approaches consistent with their different ecologies are required in efforts to model diatom and dinoflagellate community assembly as bloom units that vary along time/space scales. The differences in their phylogenetically-based behavior impact their derived roles as energy transfer assemblers to higher trophic compartments, including the predator-prey pathways formed and type of nutrient regulation.

Smith, E. M., University of South Carolina, Georgetown, USA, erick@belle/baruch.sc.edu
Buck, T. L., University of South Carolina, Georgetown, USA, tracy@belle.baruch.sc.edu
Koepfler, E. T., Coastal Carolina University, Conway, USA, erick@coastal.edu

RESOURCE REGULATION OF PELAGIC HETEROTROPHIC METABOLISM IN THE FORMATION OF HYPOXIA IN LONG BAY, SOUTH CAROLINA, USA

As part of a larger study investigating the occurrence of episodic hypoxia in Long Bay, South Carolina, USA, pelagic respiration rates were quantified during summer (Jul-Aug) of 2006-2008. Water temperature was relatively constant across all sampling events (26-28°C), allowing for a test of the effects of in situ substrate avail-
ability on respiration rates. Variability in respiration rate (5.5 to 73.6 μg O₂ L⁻¹ h⁻¹) was strongly correlated with organic matter (especially particulate organic matter) and inorganic nutrient concentrations. Effects of inorganic nutrient availability were further tested in a series of short-term (1h) enrichment bioassays using bacterial production (¹⁴C-leucine incorporation) as the response variable. Significant enrichment effects were observed in 15 of 25 experiments, with enrichment effects ranging from 22-275% over controls. Nutrient addition, especially phosphate addition, more often (80%) resulted in greater increases over controls than did simple carbon addition (added as glucose). Results of this study and others suggest that conventional models of coastal eutrophication and hypoxia formation may need to be revised to account for the direct effects of nutrient availability on microbial heterotrophy in coastal waters.

Smith, E. G., National Oceanography Centre, Southampton, United Kingdom, e.smith@soton.ac.uk
D’Angelo, C., National Oceanography Centre, Southampton, United Kingdom, C.D’angelo@soton.ac.uk
Tchernov, D., Interuniversity Institute for Marine Sciences, Eliat, Israel, dani@vms.hui.ac.il
Wiedenmann, J., National Oceanography Centre, Southampton, United Kingdom, joerg.wiedenmann@noc.soton.ac.uk

ADAPTATION TO LOW LIGHT: EXPLORING THE ROLE OF HOST PIGMENTS IN MESOPHOTIC CORALS
Changes in the chromaticity and intensity of light with depth are the primary controls on the vertical extent of symbiotic corals. Corals from mesophotic depths experience a light environment that is distinctly different from their shallow water counterparts. Therefore, characterising the adaptations of the holobiont to the mesophotic light regime is fundamental to our understanding of the ecology of these important species. This study set out to investigate the role of the host, and in particular, fluorescent host pigments, in the adaptive response of mesophotic corals to depth. A suite of spectroscopic, physiological and biochemical analyses were performed on mesophotic species to identify internal light modification by the host and explore its effects on symbiont photosynthesis. Our new “coral window” technique provides an unprecedented insight into the internal light climate by enabling measurements of light transmission to be performed in combination with other spectroscopic analyses. Our results shed new light on the complex photobiology of these important species. This study set out to investigate the role of the host, and in particular, fluorescent host pigments, in the adaptive response of mesophotic corals to depth. A suite of spectroscopic, physiological and biochemical analyses were performed on mesophotic species to identify internal light modification by the host and explore its effects on symbiont photosynthesis.

Smith, M. R., URI Graduate School of Oceanography, Narragansett, USA, Leslie. smith@geo.uri.edu
Oviatt, C. A., URI Graduate School of Oceanography, Narragansett, USA, coviatt@geo.uri.edu

THE INFLUENCE OF WATER COLUMN METABOLISM ON HYPOXIA IN NARRAGANSETT BAY, RI, USA
Hypoxia in Narragansett Bay is episodic, occurring during summer. We examined production (¹⁴C incubations) and respiration (dark-bottle oxygen incubations) for three summers (2007, 2008, 2009) and six stations, in comparison with continuous benthic oxygen measurements. Light hypoxia occurred in summer 2007; summer 2008 had several short hypoxic episodes; and summer 2009 had hypoxia continuously through the latter half of summer. Summers with the most severe hypoxia (2008 & 2009 vs. 2007) concomitantly had the highest baywide volume weighted production (216 & 229 vs. 108 μgC m⁻³ summer⁻¹); this was not true for respiration (112 & 108 vs. 122 μgC m⁻³ summer⁻¹). Spatially, whereas production decreased exponentially through the latter half of summer. Summers with the most severe hypoxia (2008 & 2009 vs. 2007) concomitantly had the highest baywide volume weighted production (216 & 229 vs. 108 μgC m⁻³ summer⁻¹); this was not true for respiration (112 & 108 vs. 122 μgC m⁻³ summer⁻¹). Spatially, whereas production decreased exponentially through the latter half of summer. Summers with the most severe hypoxia (2008 & 2009 vs. 2007) concomitantly had the highest baywide volume weighted production (216 & 229 vs. 108 μgC m⁻³ summer⁻¹); this was not true for respiration (112 & 108 vs. 122 μgC m⁻³ summer⁻¹). Spatially, whereas production decreased exponentially through the latter half of summer.

Smith, S. L., JAMSTEC, Yokohama, Japan, lanimal@jamstec.go.jp

TOWARDS A CONSISTENT MODEL OF THE COMBINED EFFECTS OF TEMPERATURE AND CONCENTRATION ON NUTRIENT UPTAKE RATES IN THE OCEAN
I re-examine data from an extensive set of field experiments covering the North Atlantic Ocean and compare two different assumptions about the functional relationship between nutrient uptake rate and concentration: 1. The widely applied Michaelis-Menten (MM) kinetics, and 2. the recently developed Optimal Uptake (OU) kinetics (Smith et al. Mar. Ecol. Prog. Ser. 384, 2010). Using a Bayesian fitting method (Adaptive Monte Carlo) I fit the coupled OU equations for affinity, A, and maximum uptake rate, Vmax, and the corresponding uncoupled affinity-based equations (equivalent to MM kinetics) to the observations. This provides consistent estimates of the temperature sensitivity for each parameter, respectively, and reveals no evidence that the temperature sensitivities of A and Vmax differ within either model, respectively. Compared to MM kinetics, OU kinetics agrees better with the data (higher likelihood) and implies that both A and Vmax are more sensitive to temperature (the factor by which rates change for a 10 degree C increase in temperature, Q10 = 3 for OU, versus Q10 = 2 for MM), which will yield different results in predictive modeling.

Smith, T. B., University of the Virgin Islands, St. Thomas, U.S. Virgin Isles, tsmith@uvi.edu
Blondeau, J. E., University of the Virgin Islands, St. Thomas, U.S. Virgin Isles, jblonde@uvi.edu
Nemeth, R. S., University of the Virgin Islands, St. Thomas, U.S. Virgin Isles, rne-meth@uvi.edu
Pittman, S. J., NOAA, Silver Springs, USA, Simon.Pittman@noaa.gov
Calnan, J. M., University of the Virgin Islands, St. Thomas, U.S. Virgin Isles, jcalnan@uvi.edu
Kadison, E. K., University of the Virgin Islands, St. Thomas, U.S. Virgin Isles, ekadison@uvi.edu
Brandt, M. E., University of the Virgin Islands, St. Thomas, U.S. Virgin Isles, mbrandt@uvi.edu

SUSCEPTIBILITY TO MORTALITY LIMITS REFUGE POTENTIAL WITHIN MESOPHOTIC CORAL ECOSYSTEM HABITATS
Processes shaping the characteristics of Mesophotic Coral Ecosystems (MCE) are likely to vary within regions and habitats, with implications for growth and degradation. We explore this variability by showing habitat specific physical processes, habitat structure, and coral health in distinct MCE environments of the Puerto Rican Shelf south of St. Thomas-St. John, US Virgin Islands. Relates to shallow reefs, all MCE habitats were influenced by distinct physical processes; however, as compared to adjacent MCE bank habitats, MCE basin habitats had a reduced influence of currents and internal waves, while temperatures were consistently higher and less variable. Basins habitats also exhibited signs of extreme degradation due to a novel disease etiology, intercalary mortality syndrome. This disease was active across the large area between 2007 and 2010, and was uncoupled from the health of shallow water reefs and adjacent MCE habitats. This disease may be controlling the structure of basin MCE habitats, limiting their potential to serve as refuges in changing ocean environments. Habitat variability is an important consideration for understanding the role MCE will play in the future of coral reefs.

Smith, V. H., University of Kansas, Lawrence, USA, vsmith@ku.edu
Boyer, J. N., Florida International University, Miami, USA, boyerj@fiu.edu
Briceno, H. O., Florida International University, Miami, USA, hbriceno@fiu.edu

THE Vollenweider Eutrophication Model Successfully Predicts Water Quality in Four Phosphorus-Limited Florida Estuaries
Significant advances have occurred in the global management and control of eutrophication-related water quality in freshwater lakes and reservoirs. In contrast, however, coastal water quality is in decline, and excessive exports of nutrients from the landscape into the world’s coastal zones will almost certainly continue. Coastal Florida waters are biogeochemically predisposed to P-limitation, and differences in the water quality of these systems thus are likely to be driven primarily by differences in their external phosphorus supplies. We analyzed four Florida estuaries for which we could obtain annual records of total phosphorus, chlorophyll a, total phosphorus loading, and hydraulic residence time (calculated as the ratio between total estuary volume and the annual volume of inflowing freshwater). The unmodified Vollenweider model was a strong predictor of water column TP concentrations, although some under-prediction was evident for three of the four estuaries. Moreover, the unmodified Vollenweider model was a strong predictor of annual mean concentrations of chlor in these four systems.
Smyth, A. R. — The University of North Carolina at Chapel Hill, Institute of Marine Sciences, Morehead City, NC, USA, arsmyth@email.unc.edu
Pfeiler, M. F., University of North Carolina at Chapel Hill, Institute of Marine Sciences, Morehead City, NC, USA, mpfeiler@email.unc.edu
Grabowski, J. H., Gulf of Maine Research Institute, Portland, ME, USA, jgrabowski@gmi.org

LOCATION, LOCATION, LOCATION: LANDSCAPE POSITION INFLUENCES OYSTER REEF NITROGEN DYNAMICS

Coastal ecosystems are a complex mosaic of benthic habitats, and the arrangement of these habitats strongly influences community structure and population dynamics. However, little is known about the influence habitat configuration has on ecosystem processes such as nitrogen biogeochemistry. We investigated whether the habitat setting of intertidal oyster reefs enhanced nitrogen removal via denitrification (membrane inlet mass spectrometry). Sediment cores were collected from oyster reefs adjacent to salt marshes, in between seagrass beds and salt marshes, and mudflats, as well as corresponding control landscapes without reefs in Middle Marsh, NC, USA. Reefs enhanced sediment denitrification by 25-65% over the controls, with the largest increase occurring in the reef-mudflat landscape. Reef sediments responded to experimental nitrogen loading by increasing denitrification at least 96% over unamended reef sediments, while controls showed an increase of 16-59%. Reefs located in mudflat landscapes had the highest rates of denitrification likely due to increased availability of carbon and dissolved inorganic nitrogen. Assessing how habitat structure and landscape context influence biogeochemical processes is critical to understanding ecosystem function and evaluating ecosystem services.

Soares, M. G. — National Institute of Amazonian Research / INPA, Manaus, Brazil, gerciilliunas@yahoo.com.br
Prestes, L., National Institute of Amazonian Research / INPA, Manaus, Brazil, liliPRESTES@gmaiL.com

LENGTH STRUCTURE OF FISHES FROM A CENTRAL AMAZONIAN FLOODPLAIN LAKE, AMAZON, BRAZIL

In the floodplain of the Solimões-Amazonas river, in its central portion is dominated by two types of geomorphic units formed by the pattern of differential sedimentation: bar-and-meander, and flood deposit. The structure of fish length for Potamorhina latior (Cirrhitidae) Hemiodus immaculatus, Anoidus orniservices (Hemiodontidiodite) Triportheus albicus and T. angularus (Characidae) collected in lakes located in these units indicate significant differences. In the lakes of the unit bar-and-meander these species, that are migratory, were more abundant and smaller than the flood deposit. This result might be explained on the bar-and-meander, the lakes studied have a high connection with the river, and in some lakes there is a direct connection, which facilitates the entry of fish. In rising and high water periods the sediment-rich waters of the Solimões-Amazonas river carrying larvae and young fish, spread along the floodplains where there are extensive areas occupied by floating vegetation. In these areas the fish can find a suitable habitat that provides food and shelter and feeding. In this case, the length structure that provides indicative of conditions in which they live fish, to suggest that the lakes in the unit bar-and-meander, are places of growth for the migratory fish

Sobek, S., Uppsala University, Uppsala, Sweden, sebastian.sobek@ebc.uu.se
Gudasz, C., Uppsala University, Uppsala, Sweden, cristian.gudasz@ebc.uu.se
Bastviken, D., Linköping University, Linköping, Sweden, david.bastviken@liu.se
Tranvik, L. J., Uppsala University, Uppsala, Sweden, lars.tranvik@ebc.uu.se

INTERACTIVE EFFECTS OF TEMPERATURE AND OXYGEN PENETRATION DEPTH ON CARBON MINERALIZATION IN BOREAL LAKE SEDIMENTS

The sediments of boreal lakes constitute a vast stock of organic carbon (OC), and they simultaneously act as OC sinks and as sources of CO2 and CH4. Recent studies have illustrated the importance of oxygen availability and temperature for the fate of OC in lake sediments, with OC mineralization being promoted at high temperature and deep oxygen penetration into the sediment. However, even though these two factors are not independent of each other, the degree to which temperature influences oxygen penetration has so far not been determined for lake sediments. Hence, we performed an incubation experiment on aerated sediment cores of one humic and one eutrophic boreal lake across a gradient in temperature. Oxygen consumption in both sediment types was highly dependent on temperature, and the oxygen penetration depth decreased with increasing temperature. Further, the share of oxygen being consumed by the oxidation of reduced compounds, originating from anaerobic degradation pathways, was also affected by temperature. These interactive effects between oxygen and temperature need to be accounted for in models of OC mineralization in boreal lake sediments.

Soffer, N. — Florida International University, north miami, USA, nsoff001@fiu.edu
Brandt, M. E., University of Virgin Islands, St. Thomas, U.S. Virgin Islands, mbbrandt@uvi.edu
Smith, T., University of Virgin Islands, St. Thomas, U.S. Virgin Islands, tsmith@uvi.edu
Correa, A. S., Florida International University, north miami, USA, adymscorrea@gmail.com

VIRAL METAGENOMIC COMPARISONS OF WHITE PLAGUE INFECTED, BLEACHED, AND HEALTHY MONTASTREA ANNULARIS CORALS FROM THE US VIRGIN ISLANDS

Coral reefs in the Caribbean have declined for the last few decades, and much of this decline is attributed to microbial diseases that infect corals. White plague II (WP II) is of particular interest since it affects at least 20 Caribbean scleractinian coral species. Currently there is no known etiological agent for WP II, but researchers have excluded viruses from previous investigations. We analyzed several viral metagenomes from the following Montastrea annularis tissues: 1) WP II apparently infected tissue, 2) apparently non-infected tissue from the same colony 3) bleached tissue from neighboring colonies with no signs of WP II, and 4) healthy tissue from neighboring colonies with no signs of disease or bleaching. Based on bioinformatic similarity analysis to known eukaryotic viruses, we found that each coral tissue type contains a unique diversity of viruses, indicating that viruses play a role in white plague II infections.

Sohm, J. A. — University of Southern California, Los Angeles, USA, sohm@usc.edu
Webb, E. A., University of Southern California, Los Angeles, USA, eawebb@usc.edu
Ahlgren, N. A., University of Washington, Seattle, USA, nahlgren@uw.edu
Thomson, Z., University of Washington, Seattle, USA
Williams, C., University of Washington, Seattle, USA
Rocap, G., University of Washington, Seattle, USA, rocap@ocean.washington.edu

SYNECHOCOCCUS DIVERSITY IN THE OCEAN AND PHOTOSYNTHETIC PARAMETERS OF DIVERSE CLADES

Synechococcus is a widespread and abundant cyanobacterium that can contribute significantly to primary productivity in the euphotic zone. This genus contains a large amount of diversity, with 18 potential clades identified, but it is unclear what the biogeochemical consequences are of the distribution of different clades with regards to carbon fixation. Using clade specific qPCR primers, we have found that Synechococcus in the ocean appears to be dominated by five clades, with clades I and IV found in colder and coastal waters, and II, III, and X found in the warmer open ocean. Photosynthesis vs. irradiance curves were then generated with laboratory culture strains to assess differences in adaptation to light and potential for carbon fixation in coastal vs. open ocean. These differences will be discussed in the context of global clade distribution and the potential for distributions to respond to a changing world.

Soler-Figueras, B. M. — University of Puerto Rico, Mayaguez, Mayaguez, Puerto Rico, anaibabaena@gmail.com
Otero-Morales, E., University of Puerto Rico, Mayaguez, Puerto Rico, ernesto.oterom@upr.edu

DAILY, SPATIAL AND SEASONAL VARIABILITY OF PYRODINIUM BAHA- MENSE AND CERATIUM FURCA AT BAHIA FOSFORESCENTE, LA PAR- GUERA, PUERTO RICO

Bioluminescent Bays in Puerto Rico have intrigued researchers due to the high and almost complete dominance of the bioluminescent dinoflagellate Pyrodinium bahamense var. bahamense. Recent declines in abundance of this species in one of the bays, Bahia Fosforecente, La Parguera, Puerto Rico, have been observed to be accompanied by increments of the non-bioluminescent dinoflagellate Ceratium furca. The objective of this study is to determine the daily, as well as spatial and seasonal variability of both species in Bahia Fosforecente and their possible relationship with physicochemical parameters (i.e., temperature, salinity, nutrient concentrations, wind, and rainfall). During March 2010, water samples were collected at six stations during five consecutive days. Results up to date demonstrate variations of P. bahamense cell densities from 60 to 65,000 cells L-1 while those for C. furca were from 200 to 48,000 cells L-1. Variations on phosphate concentration were also found, ranging from 0.11 to 0.40 µM. Finally, a contrast of population densities between dry and wet seasons will be presented, also.
With more than 30 coastal lagoons, Puerto Rico provides a unique tropical setting for the study of coastal ecosystems. Coastal lagoons may play a substantial role as efficient carbon sinks, with significant net organic matter transfer to the ocean. The importance of these ecosystems for the global budget of carbon dioxide deserves further attention.

Soler-Lopez, L. U.S Geological Survey, San Juan, Puerto Rico, lsoler@usgs.gov

THE ROLE OF COASTAL LAGOONS ON THE CARBON CYCLE IN PUERTO RICO

With more than 30 coastal lagoons, Puerto Rico provides a unique tropical setting within the US territories to understand their role in coastal trophic interactions and the carbon cycle. Coastal lagoons may play a fundamental role in the carbon cycle and carbon dioxide removal because of terrestrial vegetation loss to development. Limnologic studies conducted by the USGS at Laguna Las Salinas in Ponce and Laguna Grande in Fajardo revealed that they are vigorous food factories with a yearly production of 400 and 500 metric tons respectively, representing a Lagun Grande in Fajardo revealed that they are vigorous food factories with a yearly production of 400 and 500 metric tons respectively, representing a yearly carbon dioxide uptake rate of about 1,200 metric tons per lagoon (Soler-López and others, 2005, and Soler-López, and Santos, C. R., 2010). Similar results were obtained in 1977 at Laguna Tortuguero in Vega Baja (Quiñones and Fusté, 1977). With increased coral reefs mortality, coastal lagoons may play a substantial role as efficient filters and in the transfer of matter between land and sea, and as such within the terrestrial-marine link of the global carbon cycle. Water budgets for these lagoons determined their net organic matter transfer to the ocean. The importance of these ecosystems for the global budget of carbon dioxide deserves further attention.

Solo-Gabriele, H. M. University of Miami, Coral Gables, FL, USA, hmsolo@miami.edu
Perez, A. L. CDM Inc., Miami, FL, USA, PerezAL@CDM.com

STATUS OF WASTEWATER AND POTABLE WATER SYSTEMS IN HAVANA, CUBA

The primary source of drinking water for the City of Havana, Cuba, the Vento Aquifer, is in need of protection from contamination, by providing improved wastewater collection and treatment. The Vento Aquifer is hydraulically connected to the Almendares River including the Ejército Rebelde Reservoir, which receives untreated industrial and domestic wastewater from the Town of Cotorro. This study provides some estimated costs for upgrades to the Town of Cotorro’s wastewater treatment system. Additional investments are needed to improve water quality in downstream reaches of interior rivers (e.g., the Almendares River and the Luyano River) which discharge to coastal areas. The bulk of the costs needed for infrastructure upgrades is associated with improvements to the wastewater collection and treatment system, and there are also substantial costs associated with improvements to the potable water distribution system. Refinements of cost estimates for various improvement projects, and prioritization of these projects should be conducted in coordination with local Cuban water professionals, in light of the intricacies associated with watershed and infrastructure management in the country.

Sommier, S., Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany, ssommier@ifm-geomar.de
Schorsch, T., Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany, tschorsh@ifm-geomar.de
McGinnis, D. F., Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany, dmcginnis@ifm-geomar.de
Bertics, V., Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany, vbertics@ifm-geomar.de
Dale, A. W., Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany, adalea@ifm-geomar.de
Pfannkuche, O., Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany, opfannkuche@ifm-geomar.de

IN SITU FLUXES OF MAJOR NITROGEN SPECIES, PHOSPHORUS, OXYGEN AND SILICATE ACROSS THE BENTHIC BOUNDARY LAYER OF THEoxic TO ANOXIC GOTLAND BASIN (BALTIC SEA)

The Baltic Sea suffers from an increased temperature, eutrophication and hypoxia which severely affects the fluxes of major elements (N, P, O, Si, S) across the benthic boundary layer. When N and P are transported into the euphotic zone they stimulate primary production including nitrogen-fixing cyanobacteria. Benthic turnover rates and data on the magnitude of internal loading of the Gotland Basin with reactive nitrogen and phosphorus from the sea floor are largely lacking. To address this question, we studied benthic nitrogen cycling and fluxes of P, O2, silicate, and sulfide under different bottom water oxygen concentrations along a depth-gradient traversing the Gotland Basin in the Baltic Sea using benthic landers in conjunction with pore water gradients and bottom water measurements. Results indicate that nitrogen cycling and phosphorus and silicate effluxes are tightly linked to the occurrence of conspicuous microbial mats that were omnipresent at depths between ~70 to 130 m. An additional major release site for NH4+ and P of the modeled gene set. A total of 319 genes were differentially regulated with a false discovery rate <0.05. Roughly 600 proteins were detected, with regulation patterns showing choreography between the transcriptome and proteome. The molecular data were paired with physiological assays which suggest that diatom P deficiency drives changes in cellular P allocation, increased P transport, a switch to utilization of dissolved organic P and a remodeling of the cell surface. The results highlight novel aspects of the diatom P stress response and the utility of using next-generation transcriptome sequencing with proteomics to identify cellular responses in phytoplankton.

Sorokin, V. V., Southern Scientific Centre of Russian Academy of Sciences / Southern Federal University, Rostov-on-Don, Russian Federation, sorokin@ssc-ras.ru
Berndnikov, S. V., Southern Scientific Centre of Russian Academy of Sciences, Rostov-on-Don, Russian Federation, berndnikov@ssc-ras.ru

RECENT CHANGES IN SEDIMENTATION AND ORGANIC CARBON FLUXES AND POOLS IN THE AZOV SEA, SOUTH RUSSIA

Contemporary sedimentation processes and reasons in growth of carbon in the ecosystem of the Azov Sea, South Russia, are analyzed using simulations and observations. Four periods of sedimentation dynamics are identified in the last 65 years, following climate variations and anthropogenic regulation of major rivers run-off. Thirty percent increase in organic carbon in the bottom sediments was found for the 1992-2006 in comparison with the 1971-1987. Our study demonstrates that the main reason of this increase may be a decrease in sedimentation rate of terrigenous origin (from 1000 to 400 g/m2/year) caused by 2.5 drop in the total matter influx from land during 1940-2005, in contrast with an increase in the primary production in the sea suggested as the main reason in previous studies. We also discuss the hypothesis of impact of processes of production and decomposition in the marine ecosystem and external fluxes to the sea as main drivers in a driving of a two-fold increase in dissolved organic carbon concentration in the sea for the 2006-2010 in comparison with the 1950-1980.

Soosik, H. M. Woods Hole Oceanographic Institution, Woods Hole, USA, hsoosik@whoi.edu
Olson, R. J. Woods Hole Oceanographic Institution, Woods Hole, USA, rolson@whoi.edu

AUTOMATED SUBMERSIBLE FLOW CYTOMETRY FOR CHARACTERIZING PHYTOPLANKTON COMMUNITY COMPOSITION®

Many aspects of how natural phytoplankton communities are regulated remain poorly understood, in large part because traditional organism-level sampling strategies are not amenable to high frequency, long duration application. To overcome aspects of this limitation, we developed the FlowCytobot series of automated submersible flow cytometers capable of rapid, unattended analysis of individual plankton cells for long periods of time. Two separate instruments are required to monitor community composition from pico- to microplankton; both use chlorophyll fluorescence triggering to optimize sampling of phytoplankton. Light scattered and
Soto-Feliciano, K. M., University of Puerto Rico at Mayaguez, Mayaguez, Puerto Rico, ksotofeliciano@gmail.com
De Jesus-Cruz, M., University of Puerto Rico at Mayaguez, Mayaguez, Puerto Rico, moises.del1@upr.edu
Casillas-Martinez, L., University of Puerto Rico at Humacao, Humacao, Puerto Rico, lcasillasgm@gmail.com
Visscher, P. T., University of Connecticut, Storrs, Storrs, USA, pieter.visscher@uconn.edu
Rios-Velazquez, C., University of Puerto Rico at Mayaguez, Mayaguez, Puerto Rico, crioslab@gmail.com

DIVERSITY OF PURPLE NON SULFUR ANOXOPHOTOTROPHIC BACTERIA FROM TROPICAL HYPERLALINE MICROBIAL MATS IN THE CABO ROJO SALT BARS
Purple non-sulfur anoxyphototrophic bacteria (PNSAB) are a diverse group of microorganisms with versatile physiological traits. As part of the organo-sedimentary laminar layer (reddish) present in tropical Hypersaline Microbial Mats, the communities are exposed to seasonal changes, such as pluvial precipitation, as well as oxygen and sulfur variations. In this study, we have isolated and characterized the PNSAB present in microbial mats from ephemeral and benthic sites at the Cabo Rojo Salt Barts. A total of 23 cultivable candidates were isolated: 15 from benthic and 8 from the ephemeral sites. All of them showed red pigmented colonies and gram-negative straight and spiral rods of variable sizes microscopically. Spectral analysis showed the presence of α-bacteriochlorophyll and the photosynthetic apparatus was detected in all the samples by amplifying and sequencing the pufM gene. The 16S rDNA analysis suggests the presence of members of the genera Rhodopseudomonas, Rhodospirillum, and Rhodobacter in both sites. Rhodobasidium and Rhodovulum were found only in benthic and ephemeral sites, respectively. The phylogenetic analysis using 16S rDNA placed the isolates in 4 phylotypes, in contrast the pufM analysis suggest 5.

Sotomayor, D. R., University of Puerto Rico - Mayaguez, Mayaguez, Puerto Rico, david.sotomayor@upr.edu
Martinez, G., University of Puerto Rico - Mayaguez, Mayaguez, Puerto Rico, tavomart@gmail.com
Perez-Alegria, L. R., University of Puerto Rico - Mayaguez, Mayaguez, Puerto Rico, luisperez11@upr.edu
Santos, C., University of Puerto Rico - Mayaguez, Mayaguez, Puerto Rico, charliejo-sesantos@yahoo.com

NUMERICAL NUTRIENT CRITERIA FOR RIVERS OF PUERTO RICO
Numerous nutrient reference conditions in rivers and streams are needed for protecting ecosystems from the effects of nutrient over-enrichment. Historical data from US Geological Survey water quality records, streams minimally impacted by anthropogenic activities (reference streams), and impacted streams (a segment of the PREQB waters quality monitoring network) was used to determine reference conditions in Puerto Rico. Numeric nutrient reference criteria using the three approaches ranged from 0.346 to 0.847 mg/L for total nitrogen (N), 0.248 to 0.435 mg/L for NO3-N, and from 30 to 40 µg/L for total phosphorus (P). The median stream seston chlorophyll-a was 0.125 µg/L in reference streams and 0.693 µg/L in impacted streams. The suggested response criteria for seston chlorophyll-a was 0.173 µg/L for reference sites and 0.390 µg/L for impacted streams. The disparity in suggested critical values between reference sites and impacted streams suggests that other variables may need to be included before considering seston chlorophyll-a as the response variable. Benthic chlorophyll-a (periphyton), ash free dry weight (AFDW) and autotrophic biomass (reference streams), and impacted streams (a segment of the PREQB waters quality monitoring network) was used to determine reference conditions in Puerto Rico. Numeric nutrient reference criteria using the three approaches ranged from 0.346 to 0.847 mg/L for total nitrogen (N), 0.248 to 0.435 mg/L for NO3-N, and from 30 to 40 µg/L for total phosphorus (P). The median stream seston chlorophyll-a was 0.125 µg/L in reference streams and 0.693 µg/L in impacted streams. The suggested response criteria for seston chlorophyll-a was 0.173 µg/L for reference sites and 0.390 µg/L for impacted streams. The disparity in suggested critical values between reference sites and impacted streams suggests that other variables may need to be included before considering seston chlorophyll-a as the response variable.

Spalding, H. L., University of Hawaii at Manoa, Honolulu, USA, hspsaldin@hawaii.edu
Padilla-Gamiño, J. L., University of Hawaii at Manoa, Honolulu, USA, hpstradley@gmail.com
Smith, C. M., University of Hawaii at Manoa, Honolulu, USA, clmsmith@hawaii.edu

ECOPHYSIOLOGY OF MESOPHOTIC CORAL AND MACROALGAE IN HAWAII: HIGH PRIMARY PRODUCTION IN LOW LIGHT CONDITIONS
Mesophotic corals and macroalgae occur at depths with relatively low irradiances, and are generally characterized by physiological traits similar to shade-adapted plants. Understanding photosynthesis is key to determining their possible distribution and abundance, and sensitivity to changing water clarity. The zooxanthellate coral Leptoseris hawaiiensis and various macroalgae form extensive mesophotic reefs in the Hawaiian Archipelago and provide significant habitat for other organisms. We used fluorescence measurements, pigment analyses, and coral symbiont size and densities to understand the ecophysiology of Leptoseris and macroalgae over a gradient of depths from 77 to 123 meters. Both coral symbiont and macroalgal fluorescence approximated sun shade relationships as individuals at increasing depths (with decreasing irradiance) had lower electron transport rates and saturation irradiances. Mean coral symbiont rETRmax (42 to 14 µmol photons m^-2 s^-1) and
Spence Cheruvelil, K., University of Michigan, Ann Arbor, Michigan, spence@umich.edu

A TRICHODESMIUM BLOOM IN THE MEDITERRANEAN SEA: A RESULT OF CLIMATE CHANGE?

Trichodesmium erythraeum is a species of marine cyanobacteria that tends to form extensive blooms in tropical and subtropical areas, predominantly in the Indian and Pacific oceans. This species is important to the global ecosystem contributing up to 40% of all nitrogen fixation occurring in the ocean and playing an important role in the “biological carbon pump”. An extensive bloom of this species is recorded for the first time at latitude greater than 30°N in the Eastern Mediterranean Sea. The bloom occurred in September 2010 following an extended period of high surface temperatures and windless days. These conditions, rarely encountered in the area, are considered amongst the main factors leading to high densities of T. erythraeum. These findings seem to be directly linked to climate change already reported for the Mediterranean Sea, and provide further evidence of the “tropicalization” of the area. Expansion of Trichodesmium blooms to greater latitudes possibly due to increased temperatures and water column stratification may lead to changes in the productivity of areas such as the oligotrophic Eastern Mediterranean. Moreover, this may act as a negative feedback mechanism to climate change through increased CO2 pumping.

Spence Cheruvelil, K., Michigan State University, East Lansing, USA, ksc@msu.edu

LOCAL LAKE AND REGIONAL LANDSCAPE FACTORS DRIVE ZOOPLANKTON COMMUNITIES

Aquatic metaecosystems are structured by both local and regional factors, but the relative importance of these factors are not clear. The conversation about zooplankton community structure has so far defined regional factors as the spatial configuration of lakes and the related dispersal limitation of individuals. Here, we expand the definition to include landscape features such as land use and watershed attributes. Using data from 54 Michigan lakes, we examined the relative contribution of local lake features (e.g., water chemistry, phytoplankton biomass, macrophyte cover) and regional landscape features (e.g., agriculture in catchment, number of upstream connected lakes) to the variation in lake zooplankton community structure. This study incorporates features at different spatial scales in order to learn more about how local aquatic communities are maintained within a connected landscape and has implications for catchment- and landscape-based management and conservation.

Spencer, R. G., University of California, Davis, USA, rgs@ucdavis.edu

HERMES, P. J., University of California, Davis, USA, pjhermes@ucdavis.edu

Daisy, R. Y., University of California, Davis, USA, rydyda@ucdavis.edu

Stubbins, A., Old Dominion University, Norfolk, USA, aron.stubbins@gmail.com

Six, J., University of California, Davis, USA, jsix@ucdavis.edu

TEMPORAL CONTROLS ON DISSOLVED ORGANIC MATTER AND LIGNIN BIOGEOCHEMISTRY IN A PRISTINE TROPICAL RIVER

Dissolved organic carbon (DOC), lignin biomarkers, and optical properties were measured in the Epulu River (northeast Democratic Republic of Congo) during three different hydrologic regimes, including a dry period, an intermediary period of small storms during transition out of the dry period, then a flushing period of high precipitation immediately following the dry period. Temporal variability in DOC quantity and quality was observed with highest DOC, lignin concentrations, and carbon-normalized lignin yields during the flushing period attributed to greater surface runoff and leaching of organic-rich horizons. The lowest measurements occurred in the dry period once source materials were well-leached. This demonstrates that although tropical rivers do not experience the seasonal climatic extremes of temperate or arctic rivers, they exhibit similar effects due to changing water inputs. Thus, flushing periods in tropical rivers are critical toward ecosystem biogeochemistry as maximal export of freshly leached plant material occur during this time period. Any changes in precipitation patterns due to climate change will have a direct impact on timing, delivery, composition, and magnitude of DOC fluxes from the landscape into tropical rivers.

Sperfeld, E., University of Potsdam, Potsdam, Germany, erik.sperfeld@gmail.com

Martin-Creuzburg, D., University of Constance, Konstanz, Germany

Wacker, A., University of Potsdam, Potsdam, Germany

SIMULTANEOUS LIMITATION OF DAPHNIA BY TWO ESSENTIAL LIPIDS: DIFFERENT TYPES OF CO-LIMITATION

Growth of aquatic herbivorous consumers can be limited by essential dietary resources, in the case of arthropods by sterols and polyunsaturated fatty acids (PUFA). Although some knowledge exists on the importance of sterols and PUFA for the growth of herbivorous crustaceans, little is known about interactive effects of both biochemicals. We examined the simultaneous growth limitation of Daphnia magna by cholesterol (the principal sterol in animals) and the PUFA eicosapentaenoic acid (EPA). The availability of the two compounds in a base food lacking sterols and PUFA was varied via cholesterol and EPA containing liposomes. Growth of D. magna increased with increasing availability of both cholesterol and EPA. Different types of co-limitation models were fitted through these growth responses and compared using model selection criteria. From this comparison we found evidence that cholesterol and EPA are interactive-essential rather than strict-essential dietary resources for D. magna. That indicates that growth of the consumer was not strictly limited by the dietary resource in shortest supply to relative demand according to Liebig’s law of the minimum as previously assumed.

Spiller, A., Friedrich Schiller University, Jena, Germany, astrid.spiller@uni-jena.de

Gebser, B., Friedrich Schiller University, Jena, Germany, bjorng.gebser@uni-jena.de

POHNERT, G., Friedrich Schiller University, Jena, Germany, georg.pohnert@uni-jena.de

DIMETHYLSULFONIOPROPIONATE (DMSP): HOW TO UNRAVEL ROLES OF A MULTIFUNCTIONAL MOLECULE

Dimethylsulfoniopropionate (DMSP) is produced by many marine micro and macro algae as an antioxidant, osmoregulate and/or cryoprotectant. Released into seawater DMSP is an important carbon and sulfur source for heterotrophic organisms. Its volatile cleavage product, dimethylsulfide (DMS), is involved in algal defense against grazers and serves as an infochemical. Here, we apply a newly developed method to determine DMSP and other osmolytes directly from phytoplankton samples using LC/MS techniques. We report the influence of external parameters like daytime, growth phase and nitrate availability on the regulation of the cellular DMSP content and other potential DMS precursors. We found a highly dynamic pattern of DMSP during the circadian cycle and influences of N-availability. We also apply mass spectrometric methods to investigate the mode of uptake of DMSP by phytoplankton and bacteria using stable isotope labeled DMSP.

Spyropoulou, A., AEGEAN UNIVERSITY, MYTILENE, Greece, spyropoulo@marine.aegean.gr

SPATHARIS, S., AEGEAN UNIVERSITY, MYTILENE, Greece, spathari@marine.aegean.gr

TSIRTIS, G., AEGEAN UNIVERSITY, MYTILENE, Greece, gtsir@aegean.gr

POTENTIAL RESPONSE OF A SEMI-ARID COASTAL ECOSYSTEM TO CLIMATE CHANGE

Eastern Mediterranean gulfs, surrounded by small semi-arid watersheds, could be particularly susceptible to climate change resulting in variations of the hydrological status of water bodies and affecting ecosystem productivity. In the present study, climatic trends in a semi-enclosed system were estimated for the period 1955-2008. Analysis revealed an overall decrease in rainfall height and a temperature increase during summer. For a typical wet and a dry year, results from a watershed model showed a threefold decrease in the amount of run-off. Results from a water budget model showed that during both years, the lagoon is functioning as a dilution basin; however, in the dry year, water residence time increased during mixing and stratification period. Overall, a trend towards dry conditions is observed for the islands of Northern Aegean, Eastern Mediterranean which may considerably affect water budgets of river basins and receiving water bodies. This is expected to have significant impacts on the productivity of these systems with further ecological implications. These changes need to be taken into consideration in the framework of integrated coastal zone management.
A strong trend was observed in community structure, with dominance by a macrofaunal abundance versus sea-ice gradient, with station B (64°S) exhibiting the highest. A recently described polychaete species, A. foodbancsia, with abundance from 29-45% of total macrofauna from the north to south ends of our transect. This species appears to be the most abundant macrofaunal species on the Antarctic shelf.

Stadmark, J., Lund University, Lund, Sweden, johanna.stadmark@geol.lu.se
Conley, D. J., Lund University, Lund, Sweden, daniel.conley@geol.lu.se

INFORMING THE PUBLIC, POLICY MAKERS, MANAGERS AND STAKEHOLDERS ON MITIGATION MEASURES TO RELIEVE THE DETERIMENTAL EFFECTS OF EUTROPHICATION IN THE BALTIC SEA
During the latest decades the impact of anthropogenic inputs of nutrients to the Baltic Sea has been communicated on television and in newspapers in Sweden. Public awareness of the problems associated with eutrophication has increased. Therefore mitigation measures have been and are still being implemented to improve the water quality and thereby the ecological status of the eutrophic Baltic Sea. In Sweden municipalities as well as public networks are involved in a number of projects aiming at nutrient reductions, e.g. wetland construction, mussel farming, reed and algae harvest. But what mitigation measures are effective in terms of nutrient reductions and costs? On a small scale, and on the scale of the Baltic Sea? In this project (IN-FORM) we will evaluate measures for nutrient reduction on land and in coastal waters, i.e. estimate the amount of nitrogen and phosphorus possibly reduced and the associated costs and disseminate the results to the public, policy makers, managers and stakeholders. We will present our approach to evaluate the measures and how we plan to reach out.

Stanish, L., University of Colorado, Boulder, USA, lee.stanish@colorado.edu
McKnight, D. M., University of Colorado, Boulder, USA, diane.mcknight@colorado.edu
Nemergut, D., University of Colorado, Boulder, USA, diana.nemergut@colorado.edu

HYDROLOGIC PROCESSES CONTROL THE PATTERNS OF DIATOM COMMUNITIES IN DRY VALLEY STREAMS
This study describes ecological controls on diatom communities in the dynamic stream ecosystems of the McMurdo Dry Valleys in Antarctica. We examined a long-term dataset spanning a 15-year cooling period and a discrete flood event. Algal mat diatom community compositions were characterized in five streams within Taylor Valley. The diatom community includes cosmopolitan taxa and taxa which have only been found in the Antarctic and are from a few genera. Two hydrologic parameters, total annual discharge and historical variation in discharge, gave the most parsimonious model of among-stream and inter-annual variation in diatom communities. Diatom sample bio-volume was negatively correlated with stream flow, such that higher discharge streams have greater relative abundances of smaller diatoms. A discrete flood event occurring during the warm 2001/2 summer season lowered mat biomass and chlorophyll-a content and caused moderate, short-term increases in diatom diversity. Most diatom communities recovered quickly after the flood event; however, Green Creek experienced a persistent diatom community shift toward small, cosmopolitan species. Thus the resilience of diatom communities following disturbance may be linked to larger scale habitat characteristics. This study demonstrates the importance of understanding factors affecting ecosystem resilience, particularly in polar regions, which are experiencing rapid climate changes.

Stasny, E. R., University of Regina, Regina, Canada, starks2e@uregina.ca
Chow, S., University of Saskatchewan, Saskatoon, Canada
Wilson, C. C., Ontario Ministry of Natural Resources, Peterborough, Canada, chriswilson@ontario.ca
Wissel, B., University of Regina, Regina, Canada, bjornen.wissel@uregina.ca

EFFECTS OF CLIMATE, LAND-USE AND FISHERIES ON TOP-PREDATOR PERSISTENCE IN NORTHERN PRAIRIE LAKES
Empirical observation and theoretical models demonstrate that disturbed ecosystems are particularly vulnerable to top-down trophic collapse. Prediction of reductions in ecosystem functioning and identification of its causes remains challenging and controversial due to the importance of both intra- and inter-specific responses. Here, we combined intraspecific biological indicators of a top predator (growth, condition and genetic diversity of Sander vitreus) with metrics of overall food-web structure (diversity and trophic complexity) to evaluate potential anthropogenic causes of reductions in ecosystem functioning across 22 prairie lakes. In this study, food webs spanned a range from two to five trophic levels and anthropogenic disturbances included climate variability, land-use and fisheries activity. Both food-web structure and top predator health were primarily influenced by salinity, eutrophication and stocking regime. Higher trophic levels declined above 3 g/L TDS or 90 ug/L P and showed physical and genetic stress below these levels. Ongoing attempts to maintain desired ecosystem functioning through population supplementation were sometimes successful but often ecologically costly. Future declines in sustainability are expected with climate change and new farming practices.

Statham, P. J., University of Southampton, School of Ocean and Earth Science, National Oceanography Centre, Southampton, United Kingdom, pjs@noc.soton.ac.uk
Couceiro, F., School of Earth & Environmental Sciences, University of Portsmouth, Portsmouth, United Kingdom, Fay.Couceiro@port.ac.uk
Fones, G. R., School of Earth & Environmental Sciences, University of Portsmouth, Portsmouth, United Kingdom, Gary.Fones@port.ac.uk
Thompson, C., University of Southampton, School of Ocean and Earth Science, National Oceanography Centre, Southampton, United Kingdom, ccl1@noc.soton.ac.uk
Parker, E. R., Centre for Environment, Fisheries and Aquaculture Science, Lowestoft, United Kingdom, Ruth.Parker@cefas.co.uk
Sivyer, D. S., Centre for Environment, Fisheries and Aquaculture Science, Lowestoft, United Kingdom, d.s.sivyer@cefas.co.uk
Greenwood, N., Centre for Environment, Fisheries and Aquaculture Science, Lowestoft, United Kingdom, naomi.greenwood@cefas.co.uk

IMPACTS OF RESUSPENSION ON NUTRIENT FLUXES ACROSS THE SEDIMENT-WATER INTERFACE IN THE NORTH SEA, UK
Exchanges of nutrients across the sediment-water interface have typically focused on diffusion and bio-irrigation. However, southern North Sea near bed velocities...
STAUWASSER, M., University of Cologne, Cologne, Germany, m.staubwasser@uni-koeln.de
Schoenberg, R., University of Tuebingen, Tuebingen, Germany, ronny.schoenberg@ifg.uni-tuebingen.de
von Blanckenburg, F., GeoForschungsZentrum Potsdam, Potsdam, Germany, frb@gfz-potsdam.de
Krüger, S., Institute of Baltic Sea Research, Rostock, Germany, siegfried.krueger@io-warnemuende.de
Pohl, C., Institute of Baltic Sea Research, Rostock, Germany, christa.pohl@io-warnemuende.de

FE ISOTOPE REDOX CYCLING IN THE ANOXIC GOTALAND DEEP BALTIC SEA
Fe isotope ratios measured on soluble and suspended Fe from a depth profile into the euxinic Gotland Basin, Baltic Sea, show preferential sequestration of light Fe isotopes into suspended particulate Fe oxides (FOH) during oxidation and precipitation. For the two-step oxidation precipitation reaction, \( \Delta^6 \text{Fe}_{\text{FOH}} > 0 \). This is in contrast to previous experimental and observational data, including from estuarine and hydrothermal environments, where \( \Delta^6 \text{Fe}_{\text{FOH}} < 0 \). This difference between dissolved redox species. In the marine anoxic environment of the Baltic Sea the isotopic recycling is apparently dominated by kinetic effects. A possible explanation is the fast oxidizing Fe(II)-carbonate and Fe(II)-hydroxide species in the alkaline, high dissolved inorganic carbon Baltic Sea environment, or organic Fe(II)-L. This and faster Fe hydroxide precipitation at alkaline pH may promote oxidation, inhibit back-reduction and change the overall reaction toward kinetic control. Relatively high \( \delta^6 \text{Fe} \) of dissolved Fe in the ocic layer suggests that diagenetic efflux of Fe, typically with low \( ^{65} \text{Fe} \), from the seafloor around the Gotland Deep is not an important Fe source to the Baltic Sea.

STAUWasser, B. A., University of Southern California, Los Angeles, USA, stauffer@usc.edu
Gellene, A. G., University of Southern California, Los Angeles, USA, gellene@usc.edu
Oberg, C., University of Southern California, Los Angeles, USA, oberg@usc.edu
Sukhatme, G. S., University of Southern California, Los Angeles, USA, gaurav@usc.edu
Caron, D. A., University of Southern California, Los Angeles, USA, dcaron@usc.edu

TIMESERIES ANALYSIS OF COASTAL MARINE ECOSYSTEM REVEALS STRONG PHYSICAL FORCING OF PHYTOPLANKTON BIOMASS AND DIVERSITY
Harmful microalgal blooms pose significant problems to coastal communities throughout the United States and worldwide. While the effects of blooms are often highly visible, the underlying causes of such blooms remain poorly understood. Coastal ocean observing allow for better documentation of environmental conditions throughout the time-course of blooms, but the analyses of such datasets have relied primarily on approaches that are inappropriate for such time-dependent, non-stationary natural phenomena. King Harbor is a near-shore marine system in the greater Los Angeles region with a history of red tides that has been outfitted with sensors since 2008. We probed a nearly year-long dataset from King Harbor in Redondo Beach, CA using timeseries analysis methods, including wavelet and synchronization approaches. Combining sensor data and timeseries methods, we were able to determine meaningful, temporarily-localized relationships between physical forces (tidal and solar cycles, temperature, salinity) and more biologically-relevant constituents (chlorophyll, dissolved oxygen, turbidity). These relationships and their temporal dynamics were in turn used to inform multivariate analyses of phytoplankton community composition and diversity, providing a more temporally robust view of near-shore microalgal bloom dynamics.

STEEN, A. D., Aarhus University, Aarhus, Denmark, andrew.steen@biology.au.dk
Zierovogel, K., University of North Carolina at Chapel Hill, Chapel Hill, USA, zier- voge@email.unc.edu
Arnosti, C., University of North Carolina at Chapel Hill, Chapel Hill, USA, arnosti@email.unc.edu

ORGANIC MATTER LABILITY IS A FUNCTION OF MICROBIAL COMMUNITY METABOLIC CAPABILITIES
Lability of organic matter is often thought of as an inherent property of organic matter, i.e., a function of the chemical structure and physical state of organic molecules. However, efficient mineralization of organic matter also requires the metabolic capabilities of the local community of heterotrophic microbes to match the suite of chemical structures present. Since remineralization of complex organic matter begins with extracellular hydrolysis, we investigated the range of substrates susceptible to extracellular hydrolysis in pelagic microbial communities around the world, with a focus on communities in the Gulf of Mexico and in the Arctic. During incubations of up to 40 days, Arctic and mesopelagic microbial communities accessed a more limited range of substrates than subtropical and surface water communities, indicating spatial variation in microbial community function with respect to organic matter degradation. Experimental evidence suggests that the Arctic and mesopelagic communities may lack genes or inducers required to metabolize specific substrates which are rapidly metabolized elsewhere. Experiments addressing the microbial carbon pump should therefore consider the functional diversity of the microbial community responsible for organic matter remineralization.

STEENBEEK, A. K., Netherlands Institute of Ecology, Wageningen, Netherlands, a.steenbeek@nioo.knaw.nl
Bodelier, P. L., Netherlands Institute of Ecology, Wageningen, Netherlands, p.bodelier@nioo.knaw.nl
Heldal, M., University of Bergen, Bergen, Norway, Mikal.Heldal@bio.uib.no
Slomp, C. P., Utrecht University, Utrecht, Netherlands, slomp@geo.uu.nl
Laanbroek, H. J., Netherlands Institute of Ecology, Wageningen, Netherlands, r.laanbroek@nioo.knaw.nl

CNP RATIOS OF INDIVIDUAL BACTERIA: AN EXPLANATION FOR ENHANCED REGENERATION OF P RELATIVE TO CARBON FROM MARINE SEDIMENTS?
Bacteria play a key role in the mineralization of organic matter in marine sediments. The stoichiometry of microbial biomass is therefore of crucial importance in determining the release of carbon and nutrients from the sediment. However, little is known about the elemental composition of benthic bacteria because direct measurements of bacterial C:N:P ratios are generally hampered by the low abundance of bacteria when compared to other sediment particles. In this study, we used X-ray Micro-Analysis (XMA) to directly measure C:N:P ratios of individual sediment bacteria. Sediments from the Baltic Sea in which the microbial activity was limited by carbon availability were incubated in slurries under oxic or anoxic conditions and with or without the addition of C, N, and P. While bacterial C:N ratios were on average 6:4:1, and thus were close to the Redfield ratio for marine organic matter, bacterial C:P ratios were significantly higher at 40:1. We postulate that the low P content of bacterial carbon relative to carbon explains the enhanced regeneration of P during organic matter mineralization observed in marine sediments.

STEFFEN, M. M., University of Tennessee, Knoxville, USA, m.steffen@gmail.com
Farnsley, S. E., University of Tennessee, Knoxville, USA
Li, Z., University of Tennessee, Knoxville, USA
Kutovaya, O. A., Bowling Green State University,
Bullerjahn, G. S., Bowling Green State University,
Boyer, G. L., SUNY-ESF,
Hauer, L. J., Oak Ridge National Lab,
Ver Berkmoes, N. C., Oak Ridge National Lab,
Wilhelm, S. W., University of Tennessee,

COMPARATIVE TARGETED AND SHOTGUN METAGENOMICS OF GLOBALLY DISTRIBUTED TOXIC MICROCYSTIS SPECIES
Freshwater cyanobacterial blooms deteriorate aquatic ecosystems by affecting water quality, food web structure and through the production of harmful toxins. We have employed targeted metagenomics, using genetic markers such as the mcyD gene, to detect and characterize potential microcystin-producing populations in a globally distributed series of lakes. This method has allowed for the resolution of potentially
toxic cyanobacterial populations (and sub-populations), including Microcystis and Planktothrix, as well as shifts in community structure. We have further used shotgun metagenomics (by 454 titanium-pyrosequencing) to compare toxic Microcystis blooms in North America and China. Using this method we have begun to gain insight on the core metagenomes of Microcystis populations during bloom events. Moreover, our results are now providing insight regarding other members of microbial community that are associated with bloom events, suggesting a core population of bacteria may be involved.

Steichen, J. L., Texas A&M University, College Station, USA, jsteichen@gmail.com
Quigg, A. S., Texas A&M University, Galveston, USA, quigg@tamu.edu
Denby, A. M., Texas A&M University, Galveston, USA, a.m.denby@gmail.com
Brinkmeyer, R. L., Texas A&M University, Galveston, USA, brinkmer@tamu.edu

A TALE OF TWO PORTS: DINOFLAGELLATE COMMUNITIES WITHIN THE PORT OF HOUSTON AND THE PORT OF GALVESTON, TEXAS (USA)

The occurrence of coastal harmful algal blooms (HABs) appears to be rising globally over the last few decades. Within Galveston Bay (Texas) HABs have led to large fish kills, shutting down productive oyster hatcheries on multiple occasions, most recently December 2009 through March 2010. The culprits in these incidents were identified as Akashiwo sanguinea and Dinophysis sp. The high volume of foreign vessel traffic thru the Houston Ship channel, traversing Galveston Bay, escalates risk of invasion by a non-indigenous species. In 2009, over 7,400 vessels traveled through Galveston Bay; up 11% from 2008 and set to rise further with growing global commerce. We have identified at least 25 dinoflagellates in the Port of Houston and the Port of Galveston between May 2008 and June 2009. Targeting 18S rDNA, dinoflagellates were identified by sequencing the end product of DGGE analysis.

Microscopy was conducted to verify the molecular results. Increasing propague pressure enhances the economic and environmental vulnerability of this region to bioinvasion, emphasizing the need to determine if harmful algal species are being delivered to these port waters via ballast water.

Steinegger, S., University of Southampton, National Oceanography Centre, Southampton, United Kingdom, ss2p07@noc.soton.ac.uk
Klar, J, University of Southampton, National Oceanography Centre, Southampton, United Kingdom, jkl2o9@noc.soton.ac.uk
Moore, C. M., University of Southampton, National Oceanography Centre, Southampton, United Kingdom, c.moore@noc.soton.ac.uk
Achterberg, E. P., University of Southampton, National Oceanography Centre, Southampton, United Kingdom, eric@noc.soton.ac.uk

THE EFFECT OF THE EYAFJALLAJÖKULL VOLCANIC ERUPTION ON THE IRON AND ALUMINIUM DISTRIBUTION IN THE HIGH LATITUDE NORTH ATLANTIC

It has been shown that phytoplankton community growth is iron-limited and high nutrient, low chlorophyll (HNL) conditions develop in the Iceland basin after the intense spring blooms. The mixed layer iron (Fe) concentration in the high latitude north Atlantic (HLNA) is generally low (~ 100-200 pM) and atmospheric dust cannot provide sufficient iron for further phytoplankton growth, resulting in the reduced efficiency of the biological carbon pump. During this study, four cruises were undertaken in the HLNA between June 2009 and August 2010. Two of these cruises coincided with the last recent eruption phase of the Icelandic Eyafjallajökull volcano in May 2010. We had the rare opportunity to examine the distribution of dissolved Fe and Aluminium (Al), a tracer for atmospheric dust deposition, in the Irminger Basin, the Iceland Basin as well as in the fallout zone directly below the volcanic ash cloud. The analysis was carried out onboard the ship via a Luminol-Fe(III) and Lumogallion-Al flow injection technique. We will present these results and compare them to results from the pre- and post-eruption cruises.

Steinhoff, T., IFM-GEOMAR, Kiel, Germany, tsteinhoff@ifm-geomar.de
Bange, H. W., IFM-GEOMAR, Kiel, Germany, hbange@ifm-geomar.de
Körting, A., IFM-GEOMAR, Kiel, Germany, akoertzing@ifm-geomar.de

NET COMMUNITY PRODUCTION IN THE MAURITIAN UPWELLING ESTIMATED WITH A DUAL TRACE GAS APPROACH USING CO2 AND N2O

We present surface ocean data for CO2 and N2O from four cruises to the Mauritania upwelling region (Northwest Africa, 16°N – 21°N) that were conducted in different seasons. The region is known as a region of strong biological productivity and high supersaturation (with respect to atmosphere) of CO2 and N2O in the fresh upwelled water masses. A rapid decay of this supersaturation is observed towards the open ocean. N2O decreases only due to air-sea gas exchange (ASE) while decay of CO2 is driven by air-sea gas exchange (ASE) and biological production (net community production, NCP) which are hard to separate quantitatively. Through combination of the saturation patterns of CO2 and N2O these two processes can be separated and NCP was estimated for all cruises. NCP values ranges from 0.4 ± 0.1 g C m⁻² d⁻¹ during times of weak upwelling to 2.8 ± 0.9 g C m⁻² d⁻¹ during a strong upwelling situation. The estimated NCP values show a strong relationship with a wind derived upwelling index. We used this relationship to estimate annual NCP, which is characterized by high interannual variability.

Stephanos Haskins, L. E., University of Waterloo/WHOI, Waterloo, Canada, Laurelesh@gmail.com
Karnauskas, K., WHOI, Woods Hole, USA

SENSITIVITY OF ENSO TO ANTHROPOGENIC SST PATTERN FORMATIONS

As the global climate changes in response to anthropogenic effects on radiative forcing, the sea surface temperature (SST) of the tropical Pacific ocean will undoubtedly change, but studies disagree on the resulting spatial and seasonal patterns, and subsequent changes in the El Niño-Southern Oscillation (ENSO). With the Zebiak-Cane intermediate coupled ocean-atmosphere model of the tropical Pacific, the mean state may be treated as an input and altered directly. This facilitates a study of the response of ENSO to various projected future mean states. Results support a correlation of mean state heating in the eastern Pacific with dominance of the high-amplitude Niño 3 regime, regardless of changes to the mean state SST in the rest of the ocean. The results are inconclusive as to the sensitivity of ENSO’s preferred period to mean state changes. Results for a “La Niña-like” mean state experiment suggest a potential improvement of the model’s ability to simulate ENSO, particularly its irregular periodicity.

Sterner, R. W., U. Minnesota, St. Paul, USA, stern007@umn.edu
Haustein, M. D., U. Minnesota, St. Paul, USA, hau0126@umn.edu
Krosgaard, A. M., U. Minnesota, St. Paul, USA, halba029@umn.edu

LANDSCAPE-LEVEL BIOGEOCHEMICAL CONTROLS ON URBAN LAKES AND PONDS: DOC AND PHOSPHORUS

A randomly selected set of 100 lakes and ponds in the Twin Cities, MN region affords an opportunity to assess limnological patterns over an entire metropolitan region. Previous work on these sites identified a negative relationship between [DOC] and impervious surface extent. As a follow up, we selected a subset of sites and performed chemical characterization of the DOC. Results indicate that DOC within urban lakes is dominated by autochthonous sources, while DOC in forested and agricultural lakes is dominated by allochthonous sources. As a second follow up, we contrasted the linkages between the extent of lawn in the immediate surroundings and [TP] in the years 2002 and 2010. A phosphorus fertilizer ban was put into effect in the region in 2004. Regression trees found that the extent of lawn 10 m from shore was an important variable pre-P ban, but not after. However, other trends in P concentration are somewhat contradictory, with higher average levels in 2010 than in 2002. Landowner awareness of the P ban and their rankings of limnological issues of greatest concern were assessed via a mail survey.

Steward, G. F., University of Hawaii at Manoa, Honolulu, USA, grieg@hawaii.edu
Powell, B. S., University of Hawaii at Manoa, Honolulu, USA, powellb@hawaii.edu
Steward, G. F., University of Hawaii at Manoa, Honolulu, USA, grieg@hawaii.edu

PREDICTING THE ABUNDANCE OF PATHOGENIC VIBRIO: A CASE FOR TIME-RESOLVED, MECHANISTIC MODELS

Pathogenic vibrios thrive in coastal waters and predicting their abundance requires an understanding of their physiological and ecological responses to the environment. Most models to predict in situ vibrio abundances have relied on correlations between species abundances and environmental variables. With multiple linear regression analysis, up to 80% of the variability can sometimes be explained, but often the results are less satisfying and the models are not portable to other systems. A number of deficiencies in the current correlative approach are apparent: 1) models typically focus on predicting species, but virulence and ecology vary at the strain level and 2) the models are not time-resolved and fail to account for time lags and differing biological responses to positive vs. negative trends in environmental variables. In this presentation, we illustrate the problem and the improvements that can be made.
be gained with a mechanistic, time-resolved model, and discuss our current efforts to couple a physical model of coastal circulation with a population model of Vibrio vulnificus in order to better predict the abundance of virulent strains of this pathogen in coastal tropical waters.

Stewart, J. J., University of Delaware, College of Earth, Ocean, and Environment, Lewes, USA, jen@udel.edu

Salvitti, L. R., University of Delaware, College of Earth, Ocean, and Environment, Lewes, USA, lsalvitti@udel.edu

Warner, M. E., University of Delaware, College of Earth, Ocean, and Environment, Lewes, USA, mwerner@udel.edu

Coyne, K. J., University of Delaware, College of Earth, Ocean, and Environment, Lewes, USA, kcoyne@udel.edu

ADAPTATION OF HARMFUL RAPHIDOPHYTTES TO GLOBAL CLIMATE CHANGE: EXPRESSION OF KEY ENZYMES IN CARBON, NITROGEN, AND FATTY ACID METABOLISM

Harmful raphidophyte species Heterosigma akashiwo and Chattonella subsalsa were examined to evaluate the effects of global climate change (increased temperature and CO$_2$) on expression of key enzymes in the carbon, nitrogen and lipid metabolic pathways. Batch cultures were acclimated to treatment conditions for 30 days, and then grown semi-continuously for 10 days before sampling. Treatments were as follows: 25°C, 375 ppm CO$_2$ (control); 25°C, 750 ppm CO$_2$; 30°C, 375 ppm CO$_2$; 30°C, 750 ppm CO$_2$. Strains of H. akashiwo isolated from the east coast (CCMP2393) and the west coast (CCMP 2280) responded differently to treatments. For example, rubisco expression in H. akashiwo strain CCMP 2283 was affected by temperature with a significant decrease in expression at elevated temperature, but was not affected by increased CO$_2$. Conversely, rubisco expression in strain CCMP 2280 was not affected by temperature, but increased with elevated CO$_2$. Comparison of these two strains and C. subsalsa with respect to rubisco, nitrate reductase, and acetyl-CoA carboxylase expression will be discussed.

Stock, C. A., NOAA/GFDL, Princeton, NJ, USA, Charles.Stock@noaa.gov

Alexander, M. A., NOAA/ESRL, Boulder, CO, USA, Micheal.Alexander@noaa.gov

Bond, N. A., JISAO, Seattle, WA, USA, Nicholas.Bond@noaa.gov

Brander, K. M., DTU Aqua, Charlottenlund, Denmark, kb@aqu.dtu.dk

Cheung, W. L., University of East Anglia, Norwich, United Kingdom, william.cheung@uea.ac.uk

Curchitser, E. N., Rutgers University IMCS, New Brunswick, NJ, USA, enrique@marine.rutgers.edu

Delworth, T. L., NOAA/GFDL, Princeton, NJ, USA, Tom.Delworth@noaa.gov

Dunne, J. P., NOAA/GFDL, Princeton, NJ, USA, John.Dunne@noaa.gov

Griffies, S. M., NOAA/GFDL, Princeton, NJ, USA, Stephen.Griffies@noaa.gov

Haltuch, M. A., NOAA/NMFS Northwest Fisheries Science Center, Seattle, WA, USA, Melissa.Haltuch@noaa.gov

Hare, J. A., NOAA Northeast Fisheries Science Center, Narraganset, USA, Jon.Hare@noaa.gov

Hollowed, A. B., NOAA Alaska Fisheries Science Center, Seattle, USA, Anne.Hollowed@noaa.gov

Lehodey, P., CLS, Ramonville, France, p.lehodey@cls.fr

Levin, S. A., Dept. of Ecology and Evolutionary Biology, Princeton University, Princeton, USA, slevin@princeton.edu

Link, J. S., NOAA Northeast Fisheries Science Center, Woods Hole, USA, Jason.Link@noaa.gov

Rose, K. A., Dept. of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, USA, karose@lsu.edu

Ryackiewski, R. R., NOAA, GFDL, Princeton, USA, Ryan.Ryackiewski@noaa.gov

Sarmiento, J. L., Atmospheric and Oceanic Sciences Program, Princeton University, Princeton, USA, js@princeton.edu

Stouffer, R. J., NOAA, GFDL, Princeton, USA, Ronald.Stouffer@noaa.gov

Schwing, F. B., NOAA Southwest Fisheries Science Center, Pacific Grove, USA, Franklin.Schwing@noaa.gov

Vecchi, G. A., NOAA, GFDL, Princeton, USA, Gabriel.Vecchi@noaa.gov

Werner, F. E., Rutgers University, IMCS, New Brunswick, USA, cisco@marine.rutgers.edu

ON THE USE OF IPCC-CLASS MODELS TO ASSESS THE IMPACT OF CLIMATE ON LIVING MARINE RESOURCES

Climate models have progressed to a point where they can now be used to make Living Marine Resource (LMR) projections over multi-decadal time horizons. However, uncertainty in climate model projections, coarse climate model resolution, and uncertainty in the mechanisms underlying LMR responses to climate limit the precision and reliability of LMR projections. Multi-model ensembles, bias corrections, and downscaling can ameliorate some limitations, but the assumptions underlying these approaches must be critically assessed for each application. Development of LMR science that could improve projections include better understanding of the multi-scale mechanisms that link climate and LMRs, and incorporation of these mechanisms within LMR models. These developments require a strong baseline of field and laboratory observations including long time-series and measurements over a broad range of spatial and temporal scales. Priority climate model developments for LMR projections include improved model accuracy at regional scales, inter-annual to decadal-scale predictions, and continued development of earth system models that include the biosphere. Efforts to address these issues should occur in parallel and be informed by the continued application of existing climate and LMR models.

Stockenreiter, M., Ludwig-Maximilians-Universität (LMU), Munich, Germany, stockenreiter@bio.lmu.de

Graber, A., Ludwig-Maximilians-Universität (LMU), Munich, Germany, akgrabere@gmail.com

Hautp, F., Ludwig-Maximilians-Universität (LMU), Munich, Germany, haupt@biologie.uni-muenchen.de

Stibor, H., European Institute for Marine Studies, EUPOLE MER, Brest, France, herwig.stibor@univ-brest.fr

THE EFFECT OF SPECIES DIVERSITY ON THE LIPID PRODUCTION OF MICRO-ALGAL COMMUNITIES

The diversity of primary producer communities is currently not considered as an important parameter for the design of industrial pelagic food webs. However, evidence about a positive link between diversity and productivity within terrestrial and aquatic primary producer communities is increasing. Based on the findings of recent studies dealing with diversity-productivity-relationships in aquatic primary producer communities we investigated experimentally whether diversity also can affect lipid production of micro-algae. We investigated the growth and lipid production of micro-algae using species from all major algal groups. Algae were grown in a large number of treatments differing in their diversity level. Additionally, we compared the growth and lipid production of laboratory communities to natural lake and pond phytoplankton communities of different diversity. The main goal of our study was to investigate how diverse multi species micro-algal communities perform in their growth and lipid production compared to highly selected strains of monocultures. Our results show, that lipid production increased with increasing diversity in both, natural and laboratory micro-algal communities. The underlying reason for the observed diversity-productivity-relationship was obviously resource complementarity.

St-Pierre. A., Université du Québec à Montréal, Montréal, Canada, st-pierre.anick@uqam.ca

Del Giorgio, P. A., Université du Québec à Montréal, Montréal, Canada, del_giorgio@uqam.ca

Thibodeau, G., Université du Québec à Montréal, Montréal, Canada, genevieve.thibodeau@courrier.uqam.ca

Lapierre, J. F., Université du Québec à Montréal, Montréal, Canada, lapierre.jean-francois@courrier.uqam.ca

Désindes, J. P., Université du Québec à Montréal, Montréal, Canada, desindes.jean-philippe@courrier.uqam.ca

PATTERNS IN METABOLISM AND CARBON BIOGEOCHEMISTRY IN BEAVER PONDS IN THE BOREAL REGION OF QUEBEC

Beavers are an important component of the boreal landscapes in North America, and have increased dramatically in recent decades. In a companion presentation, we show that beaver ponds emit large amounts of CO2 and CH4 to the atmosphere and that they may play a key role in the boreal carbon balance. Here we explore the factors underlying these extremely high fluxes. Beaver ponds are very diverse systems in terms of size, age, level of occupancy by beavers, type of flooded territory and growing vegetation. These characteristics in turn result in a wide range in water chemistry and system metabolism. We show that beaver ponds have highly elevated
concentrations of DOC and nutrients relative to rivers and lakes in the region, which in turn sustain extremely high rates of respiration and of carbon consumption. Moreover, we show that beaver ponds are extremely variable temporally, with some shifting from hypertrophy to extreme dystrophy within short periods. This heterogeneity in chemical and biological properties complicates extrapolation and needs to be considered when scaling beaver ponds processes at the landscape level.

Strass, J., University of East Anglia, Norwich, United Kingdom, J.Strass@uea.ac.uk
Martinez-Perez, C., University of East Anglia, Norwich, United Kingdom, C.Martinez-Perez@uea.ac.uk
Mock, T., University of East Anglia, Norwich, United Kingdom, T.Mock@uea.ac.uk

THE ROLE OF BACTERIA-LIKE RHODOPSINS IN MARINE EUKARIOTIC PHYTOPLANKTON

A rhodopsin gene was identified from the whole genome sequence of the polar diatom Fragilariopsis cylindrus and homologous sequences were found abundant in metatranscriptome data sets from the Southern Ocean and the Equatorial Pacific Ocean, indicating its ecological importance. Sequence analysis suggests that the protein is similar to Globo bacter rhodopsin (GR), a fast-cycling rhodopsin capable of light-driven proton transport and most probably obtained by lateral gene transfer. The physiological role of a proton-pumping rhodopsin in the presence of the proton gradient-generating chlorophyll-based photosynthetic apparatus remains puzzling. To further analyse its function, the rhodopsin from F. cylindrus (FR) was cloned from cDNA, fused to GFP and heterologously expressed in the diatom Phaeodactylum tricornutum. The FR-GFP fusion protein is associated to the plastid, suggesting targeting to the periplastidic or inter-envelope space. Further characterisation of the FR protein by expression in other heterologous systems (e.g. Escherichia coli) is in progress and promises to give insights into its physiological role and implications on the evolutionary success of rhodopsin-containing marine phytoplankton.

Strom, S. L., Western Washington University/Shannon Point Marine Center, Anacortes, USA, Suzanne.Strom@wwu.edu
NEITHER THE GARDEN OF EDEN NOR THE KILLING FIELDS: A GOVERNING ROLE FOR SUBLETHAL INTERACTIONS AMONG AQUATIC MICROBIAL EUKARYOTES*

For a combination of practical and societal reasons, much of what we know about predator – prey interactions between aquatic microbial eukaryotes is derived from research in two broad areas: work on acutely toxic prey (e.g. harmful algal bloom species), and work in laboratory systems that are optimized for predator growth. Conditions in natural waters must often fall between these two extremes. In this talk I will argue that natural selection should favor the evolution of sublethal interactions between microbes under many circumstances. Examples of such sublethal interactions and their ecological consequences will be presented. These include both generation of and response to chemical signals by predators and prey, as well as use of avoidance behaviors of various types.

Stryker, S. A., Department of Oceanography, Texas A&M University, College Station, USA, sastryker10@tamu.edu
DilMarco, S. F., Department of Oceanography, Texas A&M University, College Station, USA, sdimarco@ocean.tamu.edu
Stoessel, M., Department of Oceanography, Texas A&M University, College Station, USA, mstoessel@ocean.tamu.edu
Belabbasi, L., Lighthouse R&D Enterprises, Inc., Houston, USA, leila@lighthouse-houston.com

HYDROGRAPHY IN THE ARABIAN SEA AND OMAN SEA FROM SATELLITE, ARGO, SURFACE DRIFTER AND MOORING OBSERVATIONS

Complex circulation and atmospheric influence contribute to the water mass properties and distribution in the northwest Indian Ocean. The seasonal monsoon is the largest atmospheric influence in the region. Observations made from oceanographic Langrangian platforms, i.e., Argo floats (UCSD/COMPPOLS) and surface drifters (AOURL), and from sea surface temperature satellite (MODIS) data during January 2002–December 2009 are used to identify water mass distribution of the northwestern Indian Ocean (0°N–35°N,40°E–80°E). Six regions were chosen based on the known current structure and variability. Hydrographic observations of the Oman and Arabian Sea are compared to coastal and deep moored observations on a cabled ocean observing system during 2005–2009. The cable seabed observatory reports in real-time in the Oman Sea. The independent moorings are stationed off Cape Ras Al Hadd and Murray Ridge. Measurements range in depth from surface to 3000 m. The Lighthouse Ocean Research Initiative project in the Oman and Arabian Sea was developed and constructed by Lighthouse R&D Enterprises, Inc. In country, the project is coordinated with the Oman Ministry of Fisheries Wealth through the Marine Science and Fisheries Centre.

Stuart, R. K., Scripps Institution of Oceanography, UC San Diego, La Jolla, USA, rkstuart@ucsd.edu
Busby, K. N., University of California, San Diego, La Jolla, USA, knbusby@ucsd.edu
Brahamsha, B., Scripps Institution of Oceanography, UC San Diego, La Jolla, USA, bbrahamsha@ucsd.edu
Paulsen, I. T., Macquarie University, Sydney, Australia, ipaulsen@hcms.mq.edu.au
Palek, B., Scripps Institution of Oceanography, UC San Diego, La Jolla, USA, bpalenik@ucsd.edu

DIVERSE RESPONSE TO COPPER SHOCK BETWEEN MARINE SYNECHOCOSCUS CLADES

Marine cyanobacteria are known to be the most sensitive of the phytoplankton groups to copper toxicity and thus the most likely to be affected by environmentally relevant levels of copper. Although copper ion concentration is low (10^4 M) in the surface waters of the open ocean, it can increase by orders of magnitude below the euphotic zone, and copper levels can affect cyanobacterial distribution. Additionally, in coastal environments copper can be detected at relatively high levels due to anthropogenic inputs. We are studying the effects of copper toxicity on marine Synechococcus species, a globally distributed marine cyanobacterial group which has genetically diverse clades that can co-exist in the same water mass. From copper shock expression studies using whole genome microarrays and qRT-PCR we identified several putative copper response mechanisms, including oxidative and osmoregulatory responses as well as some possible copper specific response genes. Comparison of response to copper toxicity between the different clades has revealed differences that could potentially help explain clade or even strain distribution and seasonality.

Stubbins, A., Skidaway Institute of Oceanography, Savannah, USA, aron.stubbins@skio.usga.edu
Spencer, R. G., Woods Hole Research Center, Woods Hole, USA
Chen, H., Old Dominion University, Norfolk, USA
Hatcher, P. G., Old Dominion University, Norfolk, USA
Mopper, K., Old Dominion University, Norfolk, USA
Six, J., University California Davis, Davis, USA
Mwamba, V., Congo Atomic Energy Commission, Kinshasa, DRC
Mangangu, A., Congo Atomic Energy Commission, Kinshasa, DRC
Mwamba, V., Congo Atomic Energy Commission, Kinshasa, DRC
Hernes, P. J., University California Davis, Davis, USA

MOLECULAR SIGNATURES OF RIVER WATER ORGANIC MATTER PHOTO-DEGRADATION*

The dissolved organic matter (DOM) pool contains a diverse suite of molecules, each carrying the signature of their source organism and subsequent processing in
the environment. Deciphering these molecular messages offers unrivalled insight into biogeochemical processes. Many advances in DOM characterization are underway, each providing new perspectives upon DOM. Here we present fresh insight gained by the application of high resolution mass spectrometry to the characterization of tropical river DOM before and after solar irradiation. By comparison of Fourier transform ion cyclotron mass spectrometry data before and after 2 months irradiation in a solar simulator 3 pools of DOM were identified: 1) Photo-resistant DOM, which survived irradiation; 2) Photo-labile DOM, which was lost during irradiation; and 3) Photo-produced DOM, which was present only after irradiation. The photo-labile DOM was highly aromatic, photo-resistant DOM contained aliphatic and alicyclic compounds, and the photo-products were predominantly aliphatic. The fate of these three pools in the environment is discussed, along with the future application of high resolution techniques to DOM studies and the role of photochemistry in small mountain rivers.

Sturdivant, S. K., College of William and Mary, Virginia Institute of Marine Science, Gloucester Point, USA, kelsey@vims.edu

Brush, M. J., College of William and Mary, Virginia Institute of Marine Science, Gloucester Point, USA, brush@vims.edu

Diaz, R. J., College of William and Mary, Virginia Institute of Marine Science, Gloucester Point, USA, diaz@vims.edu

MODELING THE EFFECT OF HYPOXIA ON MACROBENTHIC PRODUCTION IN THE LOWER RAPPAHANNOCK RIVER, CHESAPEAKE BAY, USA

Hypoxia, DO concentrations of ≤ 2 ml/l, in Chesapeake Bay has substantially increased over the past few decades, with detrimental effects on macrobenthic production. The production of benthic invertebrates is important, as these fauna link energy transfer from primary consumers to epibenthic predators and demersal fish. As such, the development of accurate predictive models that determine the impact of hypoxia on macrobenthic production are valuable. A continuous-time, biomass-based model was developed for the macrobenthic community in the Rappahannock River, a tributary of Chesapeake Bay prone to seasonal hypoxia, based on the benthic submodel in the 2002 Chesapeake Bay Eutrophication Model. The primary focus was to accurately model the effect of hypoxia on macrobenthic production in the lower Rappahannock. The model was successfully calibrated and validated, using independent data, to accurately predict macrobenthic production annually, applying a functional response to hypoxia developed from macrobenthic production data collected over a two-year field experiment in 2007-2008. Simulation analysis of the DO formulation showed macrobenthic production strongly linked to DO concentration, with fluctuations in production strongly correlated with the duration and severity of hypoxia.

Sturm, P. E., Center for Watershed Protection, Ellicott City, USA, pes@cpw.org

Viqueira-Rios, R. V., Center for Watershed Protection, Taunao, Puerto Rico, rvriqueira@hotmail.com

GUANICA AS AN EMBLEMATIC WATERSHED FACING LAND BASED SOURCES OF POLLUTION

Coral Reefs have experienced an unprecedented decline over the past 30-40 years in the Caribbean, some estimates put the loss greater than 50% of live coral and over 90% of sensitive and federally listed staghorn and elkhorn Acropora species. In many areas the proliferation of land based sources of pollution (LBSP) has far exceeded the magnitude of change for other stressors. Nutrient and sediment contaminants have increased by 5-10 times pre-colonial levels and several times in the last 40-50 years (Ortiz-Zayas et al., 2006) (Larsen and Webb, 2009). Nearshore reefs in La Parguera and Guanica often harbor nutrient concentrations 10 times the threshold suggested by Lapointe (1997) for non-algal dominated reefs. The sources of increases in the Guanica watershed will be discussed as well as counter measures and the restoration of ecosystems services being implemented. More concerted efforts are needed to reduce controllable LBSP stressors due to the economic value of coral reefs coupled with research that suggests an increased capacity of coral reefs to withstand SST increases with reduced Chlorophyll A and reduced inorganic nitrogen (Woolbridge, 2009).

Sauerz-Bosche, N. E., National Oceanography Centre, University of Southampton, Southampton, United Kingdom, nesubo@noc.soton.ac.uk

Lebrato, M., IFM-GEOMAR, Department of Marine Biogeochemistry, Leibniz Institute of Marine Science, Kiel, Germany, mlebrato@ifm-geomar.de

Iglesias-Rodriquez, M. D., National Oceanography Centre, University of Southampton, Southampton, United Kingdom, dir@noc.soton.ac.uk

NATURAL ADAPTATION TO A CHANGING OCEAN: A CASE STUDY OF SEA URCHIN LARVAE

Oceanic uptake of anthropogenic CO2 increases partial pressure in seawater with an associated decrease in pH and the saturation state of carbonate bio-minerals (Omega). In most parts of the ocean, CO2 and temperature co-vary, making it difficult and irrelevant to isolate effects of any one variable. Chemical “perturbations” in the water column (ocean acidification) affect individual organisms and/or marine communities, but studies targeting multifactorial experiments are scarce. We combined experimental and field work to assess the physiological and biogeochemical response of sea urchin (Paracentrotus lividus) larvae to changes in water carbonate chemistry. We a) incubated larvae with naturally CO2-enriched deep-sea water, and b) studied the effect of ocean warming and ocean acidification in the laboratory. We report that there is no effect of in situ naturally CO2 enriched seawater on physiology or morphology but a decrease in fertilization and calcification. Developmental stages of sea urchins are likely to adapt to predicted ocean acidification and increasing temperature scenarios, which represent an advantage in maintaining stability and survival of populations under environmental selection pressure.

Subramaniam, A., Columbia University, New York, USA, ajit@ldeo.columbia.edu

BIDIRECTIONAL FLUXES OF MATERIAL BETWEEN OCEAN, ATMOSPHERE, AND ADJACENT COASTAL AREAS

The phenomena of the atmosphere as a vector for terrigenous dust, modeling of cloud processing of this dust, and the effects of deposition of biogeochemically critical macro and micro nutrients on the oceans have been reasonably well described. However, less is known about the oceans as a source of material to the atmosphere and adjacent coastal regions. This presentation will review the role of ocean atmosphere interactions in altering water quality as well as air quality in coastal regions, especially in the vicinity of large metropolitan regions. In particular, the role of concentration effects at the surface microlayer of the air water interface and the types of high spatial and temporal resolution studies required to understand the bidirectional flux of material between coastal waters, the atmosphere, and adjacent land areas will be reviewed. Case studies on the role of log water in the distribution of nutrients, the effect of harmful algal blooms on coastal air quality, and the contribution of wet and dry deposition of nitrogen to coastal eutrophication will be presented.

Sudduth, F. B., Duke University, Durham, USA, esudduth@duke.edu

Hassett, B. A., Duke University, Durham, USA, bhassett@duke.edu

Bernhardt, E. S., Duke University, Durham, USA, ebernhar@duke.edu

EFFECTS OF URBANIZATION ON STREAM Ecosystem METABOLISM

Stream ecosystem primary production, respiration, and ecosystem metabolism are holistically sensitive to the presence of urban development. More than 1 in 5 of the total stream length in the USA is developed; urban development can cause dramatic changes in stream ecosystem metabolism. Urban development can reduce stream flows and increase stream temperatures, impact water quality, and increase nutrient loads. The impacts of urban development are felt from urban streams to adjacent coastal ecosystems. A case study of the Stony Brook river on Long Island will be used to illustrate the impacts of urban development on stream metabolism and adjacent ecosystems.

Sugeno, M., Stony Brook University, Stony Brook, USA, msugeno@ic.sunysb.edu

Munch, S. B., Stony Brook University, Stony Brook, USA, smunch@notes.cc.sunysb.edu

ASSESSING THE PREVALENCE OF ALLEE EFFECTS IN FISH POPULATIONS: A NONPARAMETRIC APPROACH

Allee effects have long been recognized in theoretical studies of population dynamics and hypothesized as potential contributors to population extinction. Indeed, the necessary conditions for Allee effects to occur (e.g., difficulty finding mates at low density, mortality driven by generalist predators, etc.) would seem to apply to many species. However, the evidence for Allee effects in natural populations is equivocal at best. For instance, previous studies of recruitment in fishes found Allee effects in only 3% of stocks analyzed. However, previous approaches to identifying Allee effects have relied on parametric models, leaving open the possibility that their scarcity is an artifact of model formulation. Here we adopt a nonparametric Bayesian approach which circumvents this problem. Taking this new approach, we analyzed 262 stock recruitment data sets. Of these, 11 populations showed strong evidence
of an Allee effect and another 18 populations showed some support for their presence. These results suggest that Allee effects are far more common than previously concluded.

Sugett, D. J., University of Essex, Colchester, United Kingdom, dsugett@essex.ac.uk
Campbell, S. J., Wildlife Conservation Society Indonesia Program, Bogor, Indonesia, s.campbell@wcsip.org
Wilson, J., The Nature Conservancy Indonesia Marine Program, Bali, Indonesia, joanne_wilson@tnc.org
Mangubhai, S., The Nature Conservancy Indonesia Marine Program, Bali, Indonesia, smangubhai@tnc.org

Smith, D. J., University of Essex, Colchester, United Kingdom, dsmitc@essex.ac.uk

INTRINSIC ENVIRONMENTAL HISTORY DETERMINES CORALS SUSCEPTIBILITY TO STRESS ACROSS THE INDONESIAN ARCHIPELAGO

Indonesia’s coral reefs are some of the most important worldwide given their immense biodiversity and geographic expanse. We present research spanning local (within the Wakatobi Marine National Park, WMNP) and regional (archipelago-wide) scales to demonstrate how intrinsic environmental variability determines corals’ tolerance to environmental stress, in particular temperature anomalies: (1) local environmental gradients increasingly select for massive corals where waters shallow and short term environmental variability (= standard deviation, SD) of light and temperature increases. Colonies of species from these high SD environments were more tolerant to transient thermal stress than colonies of the same species from lower SD environments (but of comparable mean optical depth and temperature). (2) Recent analysis from four sites across the archipelago (Ache, Bali, WMNP and Kofiau), following the major 2010 El Niño-La Niña regional thermal anomaly, lower SD environments (but of comparable mean optical depth and temperature). Such knowledge may enable managers and conservations to classify other key reef systems throughout the preceding intra-annual thermal history (SD, 2001-2008). Such knowledge may enable managers and conservations to classify other key reef systems throughout the preceding intra-annual thermal history (SD, 2001-2008).

Sugett, D. J., University of Essex, Colchester, United Kingdom, dsugett@essex.ac.uk
Campbell, S. J., Wildlife Conservation Society Indonesia Program, Bogor, Indonesia, s.campbell@wcsip.org
Wilson, J., The Nature Conservancy Indonesia Marine Program, Bali, Indonesia, joanne_wilson@tnc.org
Mangubhai, S., The Nature Conservancy Indonesia Marine Program, Bali, Indonesia, smangubhai@tnc.org

Smith, D. J., University of Essex, Colchester, United Kingdom, dsmitc@essex.ac.uk

PHYTOPLANKTON PROVINCES AND FUNCTIONAL GROUPS IN CHINA SEAS

The biogeographic partition of China Sea Water (CSW) is according to Alan Longhurst’s primary partition of biomes and secondary compartments of provinces. Further partition was deeper into Sub-province mainly based on phytoplankton functional groups, geographical location and biochemical aspects, and Assemblages which mainly be classified by phytoplankton species composition. In CSW, there are two provinces, Western Pacific Warm Pool Province (WARM) and China Sea Coastal Province (CHIN). WARM is Trade Biome showing the small-amplitude response to trade-wind seasonality, evenly distributed in most part of South China Sea, mainly composed by picophytoplankton and coccolithophorids with some cyanobacteria,big-celled diatom and dinoflagellates. CHIN covers most of the China coastal zones with a feature of nutrient-limited Winter-spring production, much modified by the effects of seasonal river discharge. It is spatial heterogenic, with 10 Sub-provinces. CHIN is mainly dominated by nanoplanckton, forming blooms in selective locations and form predominant species in special seasons. Future climate change factors such as CO₂ enrichment, increase of sea surface temperature, and change of mixing of waters will have significant effects on the functional groups in the CSW.

Sugett, D. J., University of Essex, Colchester, United Kingdom, dsugett@essex.ac.uk
Campbell, S. J., Wildlife Conservation Society Indonesia Program, Bogor, Indonesia, s.campbell@wcsip.org
Wilson, J., The Nature Conservancy Indonesia Marine Program, Bali, Indonesia, joanne_wilson@tnc.org
Mangubhai, S., The Nature Conservancy Indonesia Marine Program, Bali, Indonesia, smangubhai@tnc.org

Smith, D. J., University of Essex, Colchester, United Kingdom, dsmitc@essex.ac.uk

PROTEOMIC PROFILES OF “TEXAS BROWN TIDE ALGA”-AUREOUMBRA LAGUNENSIS IN RESPONSE TO P AND N DEPLETION STRESS

The persistent bloom of A. lagunensis in south Texas lagoon raises the question how it can thrive in such low phosphorus environments. In order to reveal its adaptation mechanism, proteomic study, together with other physiological parameters, such as chlorophyll content and alkaline phosphatase activity (APA), were conducted for A. lagunensis growing in P depleted, P and N depleted and normal (P and N sufficient) cultures. In the proteomics analysis, protein from three conditions was subjected to the two-dimensional electrophoresis and tandem mass spectrometry. Because of the paucity of genome sequences of this species, the de novo cross species protein identification method was used to identify the changed proteins. Several biological processes, such as chlorophyll synthesis, oxidative stress protection, and protein recycling were found in the differentially expressed proteomic profiles. Additionally, one putative novel alkaline phosphatase was found apparently 20 fold accumulated in phosphate depletive culture, which is also consistent with the cellular APA results. The results indicate that A. lagunensis adopts several strategies of enhancing intracellular recycling of P and N and uses the ambient organic matters to survive under nutrient depletion environment.

Sunagawa, S., EMBL- European Molecular Biology Laboratory, Heidelberg, Germany, shinichi.sunagawa@gmail.com
Bayer, T., King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, tlibayer@kaust.edu.sa
Ali, S., King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, shahabhan.ali@kaust.edu.sa
Aranda, M., King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, manuel.aranda@kaust.edu.sa
Daniel, L. D., University of South Florida, Florida, USA, mdaniel@marine.usf.edu
Young, E. C., University of South Florida, Florida, USA, ecyoung@mail.usf.edu

Young, E. C., University of South Florida, Florida, USA, ecyoung@mail.usf.edu
among marine species in general. For predicting relative rates of evolution among
tative to population turnover rates, which are likely high in mussels and may vary greatly
faster in the sea urchin compared to the mussel. Evolutionary rates were further sensi-
to phenotypic variation. Based on these estimates, rates of simulated evolution were

Sunday, J. M.

Morris, J. T., University of South Carolina, Baruch Marine Lab, Georgetown,
USA, jtmorris@biol.sc.edu
Abessa, M., South Dakota School of Mines and Technology, Rapid City, USA,
mebratu.abeessa@min
Gautam, S., South Dakota School of Mines and Technology, Rapid City, USA
Morris, J. T., University of South Carolina, Columbia, USA, morris@biol.sc.edu
Koepfle, E. T., Coastal Carolina University, Conway, USA, eric@coastal.edu

DIFFERENTIAL NUTRIENT LIMITATION: DEVELOPING A THEORETICAL
FRAMEWORK FOR AN EMERGING ECOLOGICAL PARADIGM

The nutritional status of autotrophs and heterotrophs influence the structure, function,
and health of ecosystems. This presentation focuses on differential nutrient limitation
(DNL), which occurs when primary producers and microbial heterotrophs are limited
by different nutrients. We present a theoretical basis for the occurrence of DNL and
a conceptual model to illustrate the implications of DNL for the flow of fixed carbon
in ecosystems. It is postulated that DNL is a function of biotic and abiotic interactions
within the ecosystem that results in maximization of resource utilization within the
autotrophic and heterotrophic communities. Thus, the theoretical underpinnings for
the occurrence of DNL lie in the emerging theories of stoichiometry and in those of
ecosystem development. When DNL occurs in an ecosystem, we suggest that the neces-
sary result is an increase in carbon throughput because reduced carbon compounds
represent the currency of biological energy. At a broader scale, these ideas also raise
questions about the relationship between DNL and stages of ecosystem development
such as -- “Do systems develop DNL as they age?”

Sundareswar, P. V.

South Dakota School of Mines and Technology, Rapid City, USA,
pvswsdnt.edu
Richardson, C. J., Duke University, Durham, USA, curt@duke.edu
Neubauer, S. C., University of South Carolina, Baruch Marine Lab, Georgetown,
USA, scott@belle.baruch.sc.edu
Abessa, M., South Dakota School of Mines and Technology, Rapid City, USA,
mebratu.abeessa@min
Gautam, S., South Dakota School of Mines and Technology, Rapid City, USA

BOTTOM-UP AND TOP-DOWN DYNAMICS OF ZOOPLANKTON PARTICLE
SIZE SPECTRA OVER 27 YEARS IN THE BAY OF FUNDY

Zooplankton collections made with a standard bongo net (0.3 and 0.5 mm mesh)
were made across a standardised grid from 1972 to 1998 off southwestern Nova Scotia.
Zooplankton samples from eight stations were analysed for size frequency composition
with a lab-based optical plankton counter, and converted to a normalised biomass
size distribution (NBSS, or “size-spectrum”). Multivariate analysis of ten taxonomic
categories correlated with an identical analysis of the biomass of size categories. After
accounting for within year, between day-night and among station variation, we found
the slopes of the normalised size spectra – an index of secondary production – fluctuat-
between -2 and -1 in relation to the interannual abundance of chlorophyll and
copepods. The NBSS slope was significantly correlated with year class estimates at
year 1 of differing Clupea harengus (shallow water, greater year class).

Suttor, M.

Louisiana State University, Baton Rouge, USA, msuttor1@lsu.edu

Fluid Imaging Technologies, Yarmouth, USA, harrv@fluidimaging.com
Chapler, L., Laboratoire du Oceanologie de Villefranche, Villefrance, France, marc.
picheral@sobs-vlf.fr
MacLeod, N., Natural History Museum, Cromwell, United Kingdom, n.macleod@
nhm.ac.uk

Culverhouse, P., University of Plymouth, Plymouth, United Kingdom,
p.culverhouse@plymouth.ac.uk
Beneke, M., Louisiana State University, Baton Rouge, USA, mbenfie@lsu.e

APPLICATION OF IMAGING INSTRUMENT AND SEMI-AUTOMATED CLAS-
IFICATION TECHNIQUES FOR PLANKTON ANALYSIS: AN OVERVIEW-

This session will focus on the use of imaging instruments, semi- automated classifi-
cation software, and the protocols that have been developed to apply these tools to
the analysis of plankton samples. A great deal of time and effort has been expended
by many individuals to make the task of analyzing plankton samples faster, less
costly, and more accurate. Great strides have been made and there have been major
achievements in the field. There is still work to be done and results to date demon-
strate that the increased investment of time and resources in further advancing these
technologies will be beneficial. This session will aim to showcase the successes of the
past several decades, to point out the limitations of the different technologies as they
stand today, and ask the question: Where are we now, and where do we want to go?
Sutton, A. E., Howard University, Washington, DC, USA, lexasutton@gmail.com
Yankson, K., University of Cape Coast, Ghana, Cape Coast, Ghana, kyankson201@yahoo.com
Wubah, D. A., Virginia Polytechnic Institute and State University, Blacksburg, VA, USA, wubah@vt.edu

THE EFFECT OF SALINITY ON PARTICLE FILTRATION RATES OF THE WEST AFRICAN MANGROVE OYSTER, CRASSOSTREA TULIPA

The potential for developing a fisheries industry based on the West African mangrove oyster is high in Ghana. The oyster, Crassostrea tulipa, is a euryhaline organism that thrives in the coastal lagoons of the Ghanaian shoreline. The organism is commonly known, yet further research should be done in preparation for fishery development. Subsequently, this experiment focused on exploring the precise relationship between salinity and filtration rates of the oyster. Oysters gathered from two types of coastal lagoons (closed/open) were exposed to salinities (parts per thousand: ‰) varying from 0‰ to 35‰ and filtration rates were measured based on one-hour intervals. Data showed that salinity had no significant effect on particle filtration rate (measured in parts per million per minute) of a given oyster type. However, significant differences did exist between the filtration rates of oysters collected from the two different types of lagoon; oysters collected from the closed lagoon had a significantly greater mean filtration rate across all salinity levels than oysters collected from the open lagoon (3.485 ppm/min, open lagoon; 6.567 ppm/min, closed lagoon). This may indicate the presence of two distinct sub-types of C. tulipa.

Sutton, T. T., Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, VA, USA, tsutton@vims.edu
Hudson, J. M., Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, VA, USA, jeanna@vims.edu
Hoffman, J. C., Mid-Continent Ecology Division, National Health and Environmental Effects Research Laboratory, Duluth, MN, USA, hoffman.joel@epa.gov
Falkenhaug, T., Institute of Marine Research, Fledøvigen Marine Station, Fledøvigen, Norway, tone.falkenhaug@imr.no
Bergstad, O. A., Institute of Marine Research, Fledøvigen Marine Station, Fledøviggen, Norway, oddaksel@imr.no
Heino, M., Department of Biology, University of Bergen, Bergen, Norway, miidko@imr.no

ALTERNATE TROPHIC PATHWAYS SUPPORT ENHANCED BATHYPELAGIC BIOMASS OVER A MID-OCEAN RIDGE SYSTEM

A classic paradigm of oceanic ecology is that pelagic animal biomass decreases exponentially with depth. Results of a multi-year study of the distribution and ecology of the pelagic fauna over the northern Mid-Atlantic Ridge (MAR), from Iceland to the Azores, revealed that water column biomass maxima can occur at deep meso- and bathypelagic depths (~750 m). Further, topographic association of the deep-pelagic fauna occurs at some locations. For example, bathypelagic fish abundance and biomass maxima were observed within the benthic boundary layer (~200 m above the bottom) during the 2004 G.O. Sars MAR-ECO expedition. Results of a pelagic food-web model over the MAR suggest that alternate trophic pathways contribute significantly to this deep biomass maxima. Consumption of decapod crustacea and gelatinous zooplankton represented major portions of the total consumption by pelagic fishes. Stable isotope analysis of 63 species, from zooplankton to large benthic predators, suggest short food chains and high trophic efficiency may account for enhanced deep-pelagic biomass.

Suursaar, U., Estonian Marine Institute, University of Tartu, Tallinn, Estonia, ulo.suursaar@ut.ee
Kullas, T., Estonian Marine Institute, University of Tartu, Tallinn, Estonia, tiit.kullas@ut.ee

REGIME SHIFTS IN LOCAL STORMINESS, SEA LEVEL VARIATIONS, CURRENTS AND WAVE CONDITIONS IN THE EASTERN BALTIC SEA

The paper presents a statistical analysis of sea level data obtained from the Estonian tide gauges over the period 1842-2009, the results of hydrodynamic modelling experiments with a 2D model, an analysis of wind data from coastal stations over the period 1966-2008 and a corresponding wave hindcast. After adjusting the sea level time series to take into account regional post-glacial land uplift, the mean sea level series exhibit upward trends of 1.5-2.8 mm/yr. The trend is positive both in local storminess and annual maximum sea levels (3-11 mm/yr). There are climate change induced site-dependent changes in current patterns and upwelling occurrences. The significant wave heights exhibited the last high stage in 1980-95 and a slightly decreasing overall trend. As a result of northward shifts in cyclone trajectories along the so-called North Atlantic storm track, annual maximum waves have increased along the windward coast of West Estonia, but decreased on the northern coast. The implications of hydrodynamic regime shifts may apply on biotic component via physical disturbance and turbidity effects, as well as through changes in thermohaline and nutrient regime.

Swarthout, R. E., Climate Change Research Center, University of New Hampshire, Durham, NH, USA, rfswarthout@gmail.com
Sive, B. C., Climate Change Research Center, University of New Hampshire, Durham, NH, USA, bcs@gust.sr.unh.edu
Russo, R. S., Climate Change Research Center, University of New Hampshire, Durham, NH, USA, russo@gust.sr.unh.edu
Haase, K. B., Climate Change Research Center, University of New Hampshire, Durham, NH, USA, khaase@gust.sr.unh.edu
Salisbury, J., Ocean Process Analysis Laboratory, University of New Hampshire, Durham, NH, USA, joe.salisbury@unh.edu
Vandemark, D., Ocean Process Analysis Laboratory, University of New Hampshire, Durham, NH, USA, doug.vandemark@unh.edu

QUANTIFYING THE INFLUENCE OF SEA WATER CHEMICAL AND BIOLOGICAL FACTORS ON AIR-SEA FLUXES OF TRACE GASES IN THE GULF OF MAINE, USA

Perturbations to atmospheric composition and associated radiative forcing can affect sea surface temperature, salinity, acidity, and biological productivity, and changes in sea water parameters can alter the composition of the atmosphere by influencing the exchange of trace gases between the ocean and the atmosphere. A quantitative understanding of the factors influencing air-sea exchange of trace gases is important in identifying potential climate feedback cycles and improving climate models. As part of an interdisciplinary effort to examine the changing coastal ocean, paired surface sea water equilibrator-headspace samples and ambient air samples, collected seasonally from 2005 to 2007 in the Gulf of Maine, USA, were analyzed on a GC/ECD/FID/MS system and were used to calculate air-sea fluxes of trace gases. Compounds measured included halocarbons (methyl halides, chloroform, bromofrom, sulfur compounds (OCS and DMS) and biogenic compounds (isoprene and monoterpenes). Quantitative relationships between trace gas fluxes and ocean chemical and biological parameters (CDOM, chlorophyll A, pH, pCO2, pO2) were examined. The influence of these factors on the daily, seasonal and inter-annual variability in air-sea fluxes of the investigated trace gases will be discussed.

Sweetman, C. J., Virginia Institute of Marine Science, Gloucester Point, USA, cj@vims.edu
Sutton, T. T., Virginia Institute of Marine Science, Gloucester Point, USA, tsutton@vims.edu

DISTRIBUTION AND TROPHIC ECOLOGY OF BATHYLAGUS EURYOPS (TELEOSTEI: MICROSTOMATIDAE) ALONG THE NORTHERN MID-ATLANTIC RIDGE

The distribution and trophic ecology of many deepwater fishes in the North Atlantic are well documented, particularly for commercially important species. However, few studies based on large-scale latitudinal and vertical gradients have been performed. In June 2004, the MAR-ECO (Census of Marine Life) research expedition aboard the R/V G.O. Sars sampled the deep-pelagic fauna over the northern Mid-Atlantic Ridge with the objective of quantitatively assessing the nekton associated with the ridge from Iceland to the Azores. Catch data revealed Bathylagus euryops to be the biomass dominant species and ranked 3rd in total abundance. Generally considered to be a relatively stable and homogenous environment, the deep sea contains a diversity of habitats that are often related to changes in topographic features and associated hydrography. In this paper, we explore the distribution of B. euryops as a function of depth, ridge section, and hydrographic region over a mid-ocean ridge system. Furthermore, trophic analyses revealed that gelatinous zooplankton represent a significant component of the diet of B. euryops, emphasizing that ecosystem processes of the northern MAR differ from ‘typical’ open ocean patterns.

Swinsburg, W., University of Wisconsin Center for Great Lakes Studies REU, Milwaukee, USA, ws17117@mesiah.edu
McLellan, S., University of Wisconsin School of Freshwater Sciences, Milwaukee, USA, mcelellan@uw.edu
Aguilar, C., University of Wisconsin Center for Great Lakes Studies, Milwaukee, USA, aguilar@uw.edu
Cuhel, R. L., University of Wisconsin Center for Great Lakes Studies, Milwaukee, USA, rcuhel@uwm.edu

SURVEY OF METAL-REDUCING ANAEROBIC BACTERIA IN LAKE MICHIGAN SEDIMENT.

Dissimilatory metal-reducing bacteria (DMRB) contribute to the biogeochemical cycling of carbon and metals. Bacteria of the genus *Shewanella* are facultative anaerobes, special in their ability to reduce over ten different electron acceptors. This study used molecular and culture-based methods to survey DMRB in five Lake Michigan stations near Milwaukee, WI. A primer designed to be specific for *Shewanella* amplified a broad range of aquatic and sediment bacteria, but no *Shewanella*. *Shewanella* may be present at very low levels, but other groups appeared to be more dominant in Lake Michigan sediment at the sites tested. Cloning results suggested that previously uncharacterized Gammaproteobacteria were prevalent at an offshore site, and fewer were present at the nearshore locations. Culture-based methods confirmed the presence of anaerobic Mn-reducing bacteria in 19 out of 22 sites. Molecular and culture-based methods are complementary approaches that must be used in conjunction in order to ensure a comprehensive survey. Functional work with DMRB cultures, further characterization of sediment diversity, and concurrent analysis of dissolved oxygen concentration in the sediment can lead to further areas of investigation.

Svitski, J. P., CSDMS Univ of Colorado, Boulder, USA, James.svitski@colorado.edu

Kettner, A. J., CSDMS Univ of Colorado, Boulder, USA, James.svitski@colorado.edu

Milliman, J. D., VIMS Univ of William & Mary, Gloucester, USA

SEDIMENT FLUX AND THE ANTHROPOCENE

Data and computer simulations are reviewed to help better define the timing and magnitude of human influence on sediment flux — the Anthropocene period. Impacts on earth-surface processes are not spatially or temporally homogeneous. Human impacts on this sediment flux have secondary impact on floodplain and delta-plain function and sediment dispersal into the coastal ocean. Human impact on sediment production began 3000 years ago but accelerated more widely 1000 years ago. By the 16th century, societies were already engineering their environment. Early 20th century mechanization has led to global signals of increased sediment flux in most large rivers. By the 1950’s this sediment disturbance signal reversed for many rivers due to the proliferation of dams, and sediment load reduction below pristine conditions is the dominant signal today. A delta subsidence signal began in the 1930’s and is now a dominant signal in terms of sea level for many coastal environments, overwhelming even the global warming imprint on sea level. Humans have engineered how most water and sediment is discharged into the coastal ocean. Functional work with DMRB cultures, further characterization of sediment diversity, and concurrent analysis of dissolved oxygen concentration in the sediment can lead to further areas of investigation.

Talmage, S. C., Stony Brook University, Southampton, USA, Stephanie.Talmage@stonybrook.edu

Goble, C. J., Stony Brook University, Southampton, USA, Christopher.Goble@stonybrook.edu

EFFECTS OF PAST, PRESENT, AND FUTURE CO₂ CONCENTRATIONS ON THE DEVELOPMENT AND SURVIVAL OF M. MERCENARIA, A. IRRADIANS, AND C. VIRGINICA LARVAE

We examined the response of larvae from three species of commercially and ecologically valuable bivalve shellfish (*Mercenaria mercenaria*, *A. iradians*, and *C. virginica*) exposed to (250 ppm), present (390 ppm), and future (750 ppm) levels of CO₂. *M. mercenaria* and *A. iradians* larvae grown under pre-industrial CO₂ concentrations displayed significantly faster growth and metamorphosis as well as higher survival and lipid accumulation rates compared to individuals reared under current CO₂ levels. Under pre-industrial CO₂ levels, *M. mercenaria* and *A. iradians* larvae displayed thicker shells than individuals grown at present CO₂ concentrations whereas bivalves exposed to high CO₂ levels had shells that were malformed and eroded. In contrast, *C. virginica* larvae grown under present day CO₂ concentrations displayed the higher growth and survival compared than larvae grown under both past and future CO₂ levels. Differential responses among these three species may partly reflect differing distributions of extant populations and may have important implications for future evolutionary trajectories of bivalves. The differential responses of juvenile and larval stages of these species to both ocean acidification and rising temperatures also will be presented.

Tamooh, F. L., Katholieke Universiteit Leuven, Leuven, Belgium, fredrick.tamooh@ees.kuleuven.be

Van Den Meersche, K., Vrije Universiteit Brussel, Brussel, Belgium, karelvandenmeersche@gmail.com

Borges, A., Université de Liège, Liège, Belgium, Alberto.Borges@ulg.ac.be

Meecks, R., Katholieke Universiteit Leuven, Leuven, Belgium, Roel.Meecks@ees.kuleuven.be

Debairs, F., Vrije Universiteit Brussel, Brussel, Belgium, federation@vub.ac.be

Myersman, F., 2Netherlands Institute of Ecology (NIOO-CEME), Yerseke, Netherlands, Myermsman@nioo.knaw.nl

Bouillon, S., Katholieke Universiteit Leuven, Leuven, Belgium, Steven.Bouillon@ees.kuleuven.be

DISTRIBUTION AND COMPOSITION OF ORGANIC CARBON IN THE TANA RIVER BASIN (KENYA)

Few studies have quantified carbon fluxes in African tropical rivers. We report the altitudinal and seasonal patterns in carbon pools and their stable isotope composition from the River Basin (Kenya). Data from February 2008 (end of dry season, September-November 2009 (short rains), and June-July 2010 (end of long rains) are presented. Seasonal data from January 2009-March 2010 are also presented. A consistent downstream increase in TSM was observed during all three sampling campaigns. TSM values were similar for 2008 and 2010 datasets (p>0.05), but significantly higher during the short rains in 2009. 8°C-POC increased downstream (p<0.01), and were predominantly of terrestrial origin as reflected by generally high POC/Chl a ratios. TSM and %POC followed the classical inverse relationship for all years sampled. TSM and POC were highly episodic and highest in periods with high discharge. Seasonal patterns in 8°C-POC signatures coincided closely with 8°C increasing markedly during periods of high discharge and decreasing towards predominantly C3 signatures toward the end of dry periods. This suggests high sediment mobilization during rains occurs mostly in areas with significant grassland cover (C4).

Tanabe, S., Kobe University, Kobe, Japan, syonatsu@maritime.kobe-u.ac.jp

Izuhara, Y., Kobe University, Kobe, Japan, Kobe

Hosoi, M., Fukui Prefectural University, Obama, Japan

EXAMINATION OF EFFECTIVE USE OF JELLYFISH (AURELIA AURITA) GENERATED IN LARGE QUANTITIES IN THE JAPANESE COASTAL AREA

Recently, the populations of jellyfish are increasing, being threat in the Japanese coastal area. These massive jellyfish have negative impacts on aquatic ecology, fisheries industry, and tourism. Especially, on the fisheries industry, there are several serious problems that the fishing net is often broken by a large amount of jellyfish, and these jellyfish kills the caught and cultured fishes. Moreover, on Japanese industry, these organisms clog the cooling-water intake, and it is difficult to operate the power plant. Accompany with these troubles, the disposal of the large amount of jellyfish from fishery and industry also causes the economic and environmental problems. In
this study, we explored the effective use of the massive jellyfish (Aurelia aurita) for aquaculture of some shellfishes with industrial values. Three type shellfishes, oyster, blue mussel and clam, which were cultured in the fish water tank with the crushed jellyfish, grew steadily. This result indicated the possibility that these shellfish took the jellyfish solution into the inside of the body, and use as a nutrient.

Tang, T., School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, USA, tangt@ic.sunysb.edu
Lee, C., School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, USA, cindy.lee@sunysb.edu

DEGRADATION OF GLYCOPROTEINS IN MARINE ENVIRONMENTS

Glycosylation is a common protein modification that substantially changes the 3D structure of proteins and potentially influences their bioavailability to heterotrophic microorganisms. To better understand the importance of glycosylation in preserving marine proteinaceous materials, we studied the degradation of a commercially available glycoprotein and non-glycoprotein as well as a natural marine glycoprotein. The glycoprotein and non-glycoprotein (ovalbumin and bovine serum albumin) were incubated in coastal seawater; we measured changes over time in total hydrolyzable amine acids, molecular weight patterns of Coomassie Brilliant Blue (CBB) stainable proteins, and Periodic Acid-Schiff (PAS) stainable proteins (glycoproteins). Preliminary results showed a progressive shift to lower molecular weight CBB-stainable products after 10 days incubation of both proteins. However, there were few lower molecular weight PAS-stainable glycoproteins formed during the incubation. Furthermore, a natural membrane glycoprotein, surface layer protein (S-layer), was identified as a dominant PAS-stainable glycoprotein in Synechococcus sp. CCMP 2370. Our studies of S-layer degradation are in progress using transmission electron microscopy and PAS staining techniques, with emphasis on S-layer crystalline ultrastructure and its ability to induce mineral deposition.

Tank, S. E., Marine Biological Laboratory, Woods Hole, MA, USA, setank@mbl.edu
Raymond, P. A., Yale School of Forestry and Environmental Studies, Yale University, New Haven, CT, USA, peter.raymond@yale.edu
Peterson, B. J., Marine Biological Laboratory, Woods Hole, MA, USA, bp.peterson@mbl.edu
Holmes, R. M., Woods Hole Research Center, Falmouth, MA, USA, rmholmes@whrc.org
McClelland, J. W., Marine Science Institute, University of Texas at Austin, Port Aransas, TX, USA, jimmy@mail.utexas.edu
Striegl, R. G., USGS, Boulder, USA, rstripeU@usgs.gov

DISSOLVED INORGANIC CARBON EXPORT FROM THE WORLD'S LARGEST CIRCUMPOLAR WATERSHEDS

The Arctic Ocean drainage basin lies largely within the boreal biome, and thus carbon cycling and flux within this biome significantly impacts the Arctic as a whole. We have determined the concentration and flux of dissolved inorganic carbon (DIC) from the rivers is approximately 30 Tg C yr⁻¹ at the mouths of the 6 largest circumpolar watersheds, using data collected during the PARTNERS (Pan Arctic River Transport of Nutrients, Organic Matter and Suspended Sediment; 2003-2006) and Arctic-GRO (Arctic Great Rivers Observatory; 2009-current) projects. Together, the catchments for these rivers encompass half of the Arctic Ocean basin. DIC flux from the rivers is approximately 30 Tg C yr⁻¹, indicating that DIC dominates total C export. Flow-weighted concentrations are highest in western North America, and lowest in the Russian Far East. Most DIC export occurs as bicarbonate (85%), which is largely derived from carbonate (65-75%), rather than silicate weathering. Thus, circumpolar DIC export comes disproportionately from the liberation of rock C, rather than soil respiration, when compared to the global average. This information provides an important baseline with which to assess changes in terrestrial-aquatic C cycling across vast boreal regions.

Tanner, C. A., Scripps Institution of Oceanography, La Jolla, USA, ctanner@ucsd.edu
Levin, L. A., Scripps Institution of Oceanography, La Jolla, USA, llevin@ucsd.edu

PRESENT-DAY ENVIRONMENTAL pH WINDOWS EXPERIENCED BY MARINE LARVAE

Early-life stages of marine fauna are likely exposed to variable and/or low pH, yet our knowledge of present-day pH conditions limits our prediction of future acidification impacts on marine fauna. To rectify this, we have combined continuous pH and environmental measurements with biological sampling in a kelp forest to get a holistic understanding of pH variability in a nearshore environment. We found seawater pH in a kelp forest was elevated relative to nearby offshore waters by 0.08 pH units, and fluctuated diurnally by 0.23 ± 0.06 (mean ± SD) pH units tracking the diurnal and semi-diurnal tidal cycle. Stochastic events also impacted pH. This included brief periods of upwelling (>1d) which dropped pH below 7.90 at 5m depth. Parallel biological sampling, found that settlement occurred by a variety of invertebrate taxa throughout these pH fluctuations, suggesting they are adapted to this range of pH. Through this study we have been able to identify the real-world pH conditions which marine invertebrate larvae experience in a nearshore environment. This provides a baseline of knowledge for future laboratory and field studies.

Taylor, G. T., Stony Brook University, Stony Brook, USA, gordon.taylor@stonybrook.edu
Scranton, M. L., Stony Brook University, Stony Brook, USA, mary.scranton@stonybrook.edu
Podlaski, A., Stony Brook University, Stony Brook, USA, apodlaski@ic.sunysb.edu
Cernadas-Martín, S., Stony Brook University, Stony Brook, USA, saracernadasi@hotmail.com
Li, X. N., Rutgers University, New Brunswick, USA, xiaonali@marine.rutgers.edu
Muller-Karger, F., University of South Florida, St. Petersburg, USA, carib@marine.usf.edu
Fanning, K., University of South Florida, St. Petersburg, USA, kaf@seas.marine.usf.edu
Rueda, D., University of South Florida, St. Petersburg, USA, dru009@mail.usf.edu
Thunell, R. C., University South Carolina, Columbia, USA, rthunell@geol.sc.edu
Varela, R., Fundación de la Salle de Ciencias Naturales, Punta de Piedras, Venezuela, ravela@edimar.org
Astor, Y., Fundación de la Salle de Ciencias Naturales, Punta de Piedras, Venezuela, yastor@edimar.org

PROCESSES DRIVING TEMPORAL VARIATIONS IN THE CARIACO BASIN'S MICROPOPULATION BALANCES

Time series data for the last 14 years indicate that prokaryoplankton inventories are as dynamic as phytoplankton in the mixed layer overlaying the permanently anoxic Cariaco Basin. Prokaryoplankton abundances and production are weakly correlated with phytoplankton biomass and production in the mixed layer. In deeper waters, prokaryoplankton abundances correlate poorly with any measured variables. In fact, integrated prokaryoplankton biomass in the mixed layer explain less than 18% of variance in deeper layers. Results suggest that microbial dynamics among the mixed, transitional and sulfidic waters are temporally uncoupled, possibly responding to different environmental drivers. The Basin is subject to seasonal and interannual variations in upwelling intensity, vertical biogenic flux, riverine input and intrusions of oxygenated waters. Spectral analyses of time series data revealed that bacterial inventories in transitional and sulfidic waters share a periodicity (~110 d) with variabilities in water density and inventories of phosphate and oxygen within redoxcline. Unlike phytoplankton biomass and production, strong periodicity was not evident for prokaryoplankton in the mixed layer. Paper will further explore potential drivers of temporal variability for microbes inhabiting the 3 layers.

Taylor, P. G., University of Colorado, INSTAAR and Biology, Boulder, USA, philip.taylor@colorado.edu
Townsend, A. R., University of Colorado, INSTAAR and Biology, Boulder, USA

STOICHIOMETRIC COHERENCE AMONG THE GLOBAL CARBON, NITRATE AND PHOSPHORUS CYCLES: AN EXPANDED MODEL

Interactions between carbon, nitrogen and phosphorus are central to the biogeochemistry of ecosystems along the hydrologic continuum from small streams to the open ocean. Yet, the development of biogeochemical models that aim to explain cross-system elemental interaction has been difficult because each system has unique structural (and often functional) features. However, our recent work suggests that nitrate concentrations in all of Earth’s ecosystems depends on stoichiometric controls over the relative activity of heterotrophic nitrate uptake, nitrification and denitrification. Together, these microbial processes moderate nitrate accumulation by responding acutely to shifts in resource stoichiometry (organic carbon to nitrate ratio). I will expand on this published model in two ways. First, I will discuss key uncertainties, focusing on the role of bacterial growth efficiency and biomass plasticity in regulating inverse patterns between organic carbon and nitrate. Second, I will layout a similar stoichiometric model that connects global distributions in bioavailable phosphorus abundance to the organic carbon. Our results link disparate areas of research to show that ecological stoichiometry continues to be a theoretically rich framework for exploring the major biogeochemical cycles.

Taylor, G. T., Stony Brook University, Stony Brook, USA, gordon.taylor@stonybrook.edu
Scranton, M. L., Stony Brook University, Stony Brook, USA, mary.scranton@stonybrook.edu
Podlaski, A., Stony Brook University, Stony Brook, USA, apodlaski@ic.sunysb.edu
Cernadas-Martín, S., Stony Brook University, Stony Brook, USA, saracernadasi@hotmail.com
Li, X. N., Rutgers University, New Brunswick, USA, xiaonali@marine.rutgers.edu
Muller-Karger, F., University of South Florida, St. Petersburg, USA, carib@marine.usf.edu
Fanning, K., University of South Florida, St. Petersburg, USA, kaf@seas.marine.usf.edu
Rueda, D., University of South Florida, St. Petersburg, USA, dru009@mail.usf.edu
Thunell, R. C., University South Carolina, Columbia, USA, rthunell@geol.sc.edu
Varela, R., Fundación de la Salle de Ciencias Naturales, Punta de Piedras, Venezuela, ravela@edimar.org
Astor, Y., Fundación de la Salle de Ciencias Naturales, Punta de Piedras, Venezuela, yastor@edimar.org

ASLO 2011 ASLO Aquatic Sciences Meeting
During methanogenesis causing enriched biogenic δ13C signature resulted in methane production. Fractionation factors between methane and carbon dioxide had values ranging from about -60 to -30 ‰ and about -350 to -140 ‰ respectively. Higher salinity locations contained δ2H enriched values. Bubbles contained δ13C-labeled monomethylamine, trimethylamine, acetate, methanol, and bicarbonate. In all cases, methanogenesis causing enriched biogenic δ13C values.

Hypersaline ponds in Baja California Sur and in Don Edwards National Wildlife Refuge in northern California provided diverse sampling sites with salinities ranging from 55 to 320 ppt. Maximum methane concentrations, nearly 40% of volume, were located not only within the microbial mats and underlying sediment but locked within evaporitic minerals. Bubbles contained δ13C-values ranging from -60 to -30 ‰ and about -350 to -140 ‰ respectively. Higher salinity locations yielded apparent non-biogenic methane based upon stable isotopic evidence (values greater than about -50 ‰), however incubations of crustal and sediment samples resulted in methane production. Fractionation factors between methane and carbon dioxide had δ13C values ranging from 1.01 to 1.05. To determine which methanogenic pathways were dominant these sites, samples of microbial mats and microbial communities encrusted within the gypsum were collected and incubated using 13C-labeled monomethylamine, trimethylamine, acetate, methanol, and bicarbonate. In all cases, methanogenesis caused enriched δ13C values.

TRADITIONAL BIOGENIC METHANE BOUNDARIES. ISOTOPIC METHANE DATA FROM HYPERSALINE PONDS EXTENDS THE TRADITIONAL BIOGENIC METHANE BOUNDARIES.

Hypersaline ponds in Baja California Sur and in Don Edwards National Wildlife Refuge in northern California provided diverse sampling sites with salinities ranging from 55 to 320 ppt. Maximum methane concentrations, nearly 40% of volume, were located not only within the microbial mats and underlying sediment but locked within evaporitic minerals. Bubbles contained δ13C-values ranging from -60 to -30 ‰ and about -350 to -140 ‰ respectively. Higher salinity locations yielded apparent non-biogenic methane based upon stable isotopic evidence (values greater than about -50 ‰), however incubations of crustal and sediment samples resulted in methane production. Fractionation factors between methane and carbon dioxide had δ13C values ranging from 1.01 to 1.05. To determine which methanogenic pathways were dominant these sites, samples of microbial mats and microbial communities encrusted within the gypsum were collected and incubated using 13C-labeled monomethylamine, trimethylamine, acetate, methanol, and bicarbonate. In all cases, methanogenesis caused enriched δ13C values.

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loration rates reflected a gradient in the delivery of sediment driven by latitudinal differences in ice duration and local circulation patterns, increasing from a low of 5.8 cm/ky at the southern end to 69 cm/ky at the northernmost station. Sediment concentrations of organic carbon and nitrogen were low down-core at all five stations, ranging from 0.5 - 1.0 wt. % POC and 0.05 - 0.15 wt. % PON. Average fluxes of oxygen, nitrate, ammonium, and silicate across the sediment/water interface were similar along this transect and between winter and summer sampling events. One station was occupied twice during a summer cruise, bracketing a local diatom bloom as evidenced in satellite data. Oxygen demand was higher during the second sampling period, suggesting a response in sediment oxygen demand to a phyto- detrital pulse. These data are consistent with the hypothesis that seasonally delivered phydrodetritus serves as a foodbank for benthos throughout the year.

Thomas, M. K., W K Kellogg Biological Station, Michigan State University, Hickory Corners, USA, thomasmr@msu.edu
Kremer, C. T., W K Kellogg Biological Station, Michigan State University, Hickory Corners, USA, kremerco@msu.edu
Klausmeier, C. A., W K Kellogg Biological Station, Michigan State University, Hickory Corners, USA, klausme1@msu.edu
Litchman, E., W K Kellogg Biological Station, Michigan State University, Hickory Corners, USA, litchman@msu.edu

PHYTOPLANKTON ADAPTATION TO TEMPERATURE ACROSS THE WORLD OCEANS

Marine phytoplankton are responsible for nearly half of global primary production. Global variation in production is driven in part by temperature, which strongly affects the fitness of phytoplankton species. As climate change is predicted to change thermal regimes (mean and variance) in the oceans, we need to understand patterns in adaptation to these regimes in order to predict future ocean productivity, community composition and carbon sequestration. To examine variation in phytoplankton response to temperature, we assembled a dataset of >140 published thermal tolerance curves of strains isolated from across the globe (7°N-75°S). We found a strong latitudinal gradient in optimum temperature for growth that was well explained by mean annual temperature and annual temperature range at the place of isolation ($R^2$=0.65, p<0.001). We modelled adaptation to existing global thermal regimes and found a broad agreement between the optimal strategies predicted by the model and those present in the oceans. However, the data also suggest that tropical phytoplankton are poorly adapted to their thermal environment and that increases in temperature could lead to a loss of diversity in the tropics.

Thomson, C. M., Woods Hole Oceanographic Institution, Woods Hole, USA, cmtington@whoi.edu
Hare, M. P., Cornell University, Ithaca, USA, mph75@cornell.edu
Gallager, S. M., Woods Hole Oceanographic Institution, Woods Hole, USA, sgallager@whoi.edu

AUTOMATED IMAGE-ANALYSIS FOR THE IDENTIFICATION OF BIVALVE LARVAE

Machine learning methods for identifying planktonic organisms are becoming well-established in marine science. Species-specific shell birefringence patterns allow color and texture-based features to distinguish species of bivalve larvae. Our approach uses Gabor and color angle feature selection algorithms on polarized images of bivalve larvae, and image classifications are made using a Support Vector Machine. This method showed up to 99% overall accuracy classifying four hatchery reared species. To adapt it for unknown larvae from field samples, we first used multiplex-PCR to confirm species identifications. Field classified larvae had lower correspondence to our manual classifications with 75% overall agreement and individual species agreements from 63-88%. The biggest issue with field identification accuracies was the occurrence of false-positive identifications from species not represented in the training sets. This was improved with simple correction methods. Overall, this approach represents a less expensive and time-consuming alternative to molecular-based identifications and allows for species-specific information, a rarity in studies of bivalve larvae.

Thormykke, M., Royal Swedish Academy of Sciences, Sven Loven Centre Kristineberg, Sweden, mike.thormykke@marecol.gu.se
Stumpf, M., IFM-GeoMar, Kiel, Germany
Dorey, N., University of Gothenburg, Kristineberg, Sweden
Melzner, F., IFM-GeoMar, Germany
Dupont, S., University of Gothenburg, Kristineberg, Sweden

WINNERS AND LOSERS IN LIFE-HISTORY STRATEGIES IN ECHINODERMS

Global warming and ocean acidification (OA) are believed to be major threats for near-future ecosystems and that amongst the most sensitive taxa will be calcifying organisms and the free-living larval stages produced by many benthic marine species. In this respect, echinoderms are one of the taxa potentially most at risk. In this presentation, we will demonstrate the importance of taking life-history strategy into account when assessing the impact of these stressors. For example, the impact of OA on planktotrophic larvae is globally negative while lecithotrophic larvae appear to benefit from OA. Within a species, egg size and spawning time are also of tremendous importance; for example, in the northern hemisphere, late spawners appear to be more at risk than early spawners. Our results suggest that life-history strategies should be included in any large scale predictions of the impact of OA and climate change and that some of the original paradigms (e.g. OA will negatively impact marine calcifiers) should be reconsidered.

Thyssen, M., Université Lille Nord de France, Laboratoire d’Océanologie et de Géosciences - ULCO - CNRS UMR 8187, Wimereux, France, meliot@uln.fr
Denis, M., Université de la Méditerranée, Centre d’Océanologie de Marseille, LMGEM CNRS UMR 6117, Marseille, France, michel.denis@univmed.fr
Gregori, G., Université de la Méditerranée, Centre d’Océanologie de Marseille, LMGEM CNRS UMR 6117, Marseille, France, gerald.gregori@univmed.fr
Guisein, N., Université Lille Nord de France, Laboratoire d’Océanologie et de Géosciences - ULCO - CNRS UMR 8187, Wimereux, France, natacha.guisein@univ-littoral.fr
Artigas, L. F., Université Lille Nord de France, Laboratoire d’Océanologie et de Géosciences - ULCO - CNRS UMR 8187, Wimereux, France, Felipe.Artigas@univ-littoral.fr

AUTOMATED FLOW CYTOMETRY FOR HIGH FREQUENCY SPATIO-TEMPORAL PHYTOPLANKTON MONITORING: A NEW CHALLENGE IN OCEANOLOGY.

Phytoplankton observation is a challenge in oceanology: the accurate estimation of their biomass and their dynamics will refine global climate models and will enable harmful algae bloom detections. Presently, phytoplankton monitoring is lacking in representative data sets. In order to integrate diversity and high frequency observation, flow cytometry has been adapted for phytoplankton analysis by integrating automation, large volumes and large cells observations (Cytobuoy b.v). High frequency temporal phytoplankton dynamics was studied by submerging a flow cytometer in the bay of Marseilles (France, summer 2005). Seven groups of cells sharing similar optical fingerprints behaved as independent entities after wind events and NO3/PO4 variations. Spatial phytoplankton dynamics was also investigated using automated flow cytometry in the North Atlantic Ocean. Six groups of cells made evidence of huge variability at scales of a few km. Those applications open the way to coastal monitoring of phytoplankton (recently funded European project DYNAMPHY).

By integrating also the “image in flow” component, high frequency monitoring of phytoplankton will gain in precision for the evidence of environmental changes in key species or functional groups.

Titelman, J., University of Oslo, Oslo, Norway, josefin.titelman@bio.uio.no
Takahashi, K., Tohoku National Fisheries Research Institute, Shiogama, Japan, issey@affrc.go.jp
Tönnesson, K., University of Gothenburg, Fiskebäckskil, Sweden, Kajsa.tonnesson@marecol.gu.se
Calliari, D., Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay, dcalliar@fcien.edu.uy
Møller, L. E., University of Gothenburg, Fiskebäckskil, Sweden, Lene.fritsmoller@ marecol.gu.se
Tiselius, P., University of Gothenburg, Fiskebäckskil, Sweden, Peter.tiselius@marecol.gu.se

PREDEATION AND DIEL BEHAVIORAL PATTERNS OF A CHAETOGNATH

Experimentally determined feeding rates of chaetognaths are few. Here we experimentally quantified feeding rates of the chaetognath Sagitta setosa on co-occurring copepods of varying states and species and thus with different behaviors and presumed different detectability by the predator. Feeding rates were highly variable, but mean predation rates on various prey were generally higher than published rates inferred from gut content analyses of field caught animals. Feeding rates appeared to depend on prey specific differences related to the behavior, as well as on predator and prey size. Some larger prey were killed, but not ingested. Preliminary results from video observations suggest that Sagitta changes its predation strategy between day and night time.

Tomczak, M. T., Baltic Nest Institute, STOCKHOLM RESILIENCE CENTRE, Stockholm University, Stockholm, Poland, neogobius@gmail.com

Weslawski, J. M., Institute of Oceanology PAS, Sopot, Poland, waslaw@iopan.gda.pl

Gluchowska, M., Institute of Oceanology PAS, Sopot, Poland, mgluchowska@iopan.gda.pl

Walkuszk, W., Institute of Oceanology PAS, Sopot, Poland, walwo@io.pas.gda.pl

Kwasnieski, S., Institute of Oceanology PAS, Sopot, Poland, kwas@iopan.gda.pl

Stempienwich, L., Vertebrates Ecology Department, University of Gdansk, Gdansk, Poland

“PELAGIC ENERGY TRANSFER TO TOP TROPIC LEVELS IN TWO CONTRASTING ARCTIC FJORDS”

Trophic flows in the pelagic part of two high latitude arctic fjords (Kongsfjorden 79N and Hornsund 77N) were compared on the basis of food-web mass-balanced model (Ecopath). Kongsfjorden is strongly influenced by Atlantic waters from the West Spitsbergen Current, Hornsund is of a more arctic character. The studied systems differ in the hydrological condition, determining the trophic interaction. We found that the fjord with warmer water temperature (Kongsfjorden) gets more dissipated energy flow from primary production to small carnivores, compared to the colder fjord (Hornsund) with a less complex pelagic system. Species composition of mesozooplankton community plays an important role in energy transfer to higher trophic level. Food-web properties have been described in light of the Ecological Network Analysis and Odum's ecosystem maturity attributes. Testing the scenario of possible future changes in the food web caused by warming, indicates that less energy may reach top carnivores (seals and seabirds) and small pelagic fish may benefit from the new situation. Possible regimes at the investigated fjords have been compared with the Baltic Sea food-web that has under gone a regime-shift.

Toor, G. S., University of Florida, Wimauma, USA, gstoog@ufl.edu

SPATIAL AND TEMPORAL PATTERNS OF PHOSPHORUS TRANSPORT IN A SUBTROPICAL URBAN COASTAL WATERSHED

Little is known about phosphorus (P) transport in urban watersheds. We evaluated the spatial and temporal evolution patterns of P forms in streams draining various sub-basins (19 to 350 km2) of an urban watershed in the Tampa Bay, Florida using CTD profiler provides a view of high temporal and spatial heterogeneity and provide a framework within which both physical and biological micro-environments can be contrasted with measurements obtained during two SF6 tracer experiments in spatial survey mode. Data from a shear microstructure survey mode (15 days) and in spatial survey mode. Coastal upwelling regions are characterised by large chemical and particle fluxes which significantly influence atmospheric chemistry and oceanic biogeochemistry. Upwelling filaments and Surface Ekman layer dynamics are the two main mechanisms for export which transport well mixed upper column water offshore. This view contrasts with measurements obtained during two SF6 tracer experiments in April-May 2009. During 60 days we sampled upper-ocean turbulence in Lagrangian survey mode (15 days) and in spatial survey mode. Data from a shear microstructure (MSS90), an ADCP with high rate pinging and an autonomous fast temperature CTD profiler provides a view of high temporal and spatial heterogeneity and provide a framework within which both physical and biological micro-environments can be described. Large scale surveys with CTD, VMADCP and MVP too support the view of an energetic yet patchy upper water column. Richardson W., Turner N. and Thorpe scale distributions show a large proportion of the water column to be turbulent. We will present estimates of turbulence, examples of different processes contributing to upper-ocean mixing and its significance in the upper ocean biogeochemistry during the experiment.
We analyze current and stage measurements in the Santee River, SC. The site is ~10 km long and is characterized by variable channel morphology with strong bathymetric gradients. Tides reach this area in the form of free waves and propagate in fresh water. Riverine discharge and tidal fluxes are comparable, but there is a clear indication of tidal dissipation as tides propagate upstream. Tides are asymmetric and their distortion is related with finite amplitude effects and the generation of overides. We found a phase lag between the free surface and current velocities varying between -68° and -53°. We estimated bottom stress assuming a logarithmic boundary layer and found an asymmetry in the drag coefficient between the flood and ebb currents. The drag coefficient values of flood currents range from 10^-4 to 1.8 x 10^-2 and for the ebb currents from 2.4 x 10^-3 to 1.1 x 10^-2. We hypothesize that there is a strong feedback between complicated hydrodynamics and topography resulting in the enhanced tidal dissipation and the maintenance of the observed bathymetric features.

Mock, T., UEA, Norwich, United Kingdom, t.mock@uea.ac.uk
Moulton, V., UEA, Norwich, United Kingdom, vincent.moulton@cmp.ac.uk
Marchetti, A., University of Washington, Washington, USA
Parker, M., University of Washington, Washington, USA
Moxon, S., UEA, Norwich, United Kingdom
Armbrust, E. V., University of Washington, Washington, USA
Uhlig, C., Alfred-Wegener Institute, Bremerhaven, Germany
Valentin, K., Alfred-Wegener Institute, Bremerhaven, Germany
Moulton, V., UEA, Norwich, United Kingdom, vincent.moulton@cmp.ac.uk
Mock, T., UEA, Norwich, United Kingdom, t.mock@uea.ac.uk
EUKARYOTIC METATRANSCRIPTOMICS: FROM WHOLE ENVIRONMENT TO SPECIES-SPECIFIC ANALYSIS
Taxonomic analysis of environmental metatranscriptome data can identify interesting taxa for detailed functional analysis. Sea-ice samples from the Weddell Sea (Southern Ocean), water samples from the oligotrophic Equatorial Pacific and the productive coastal system of Puget Sound (North-West Pacific) were taken during phytoplankton blooms, eukaryotic mRNA was extracted and pyrosequenced to produce ~100 Mb of sequence data. These metatranscriptome sequences were fed through a computational pipeline of quality filtering, taxonomic and functional analysis. The taxonomic structure of the data sets was provided using MEGAN with the results of BLAST comparisons against the NCBI-nr database – extended to include newly sequenced phytoplankton genomic and EST sequences. All three metatranscriptomes contain a high abundance of matches to Stramenopile sequences, in particular around 22% of sequences from the Southern Ocean set hit to Stramenopiles and 58% of these sequences match genes from the Fragilariaopsis cylindrus genome. From this analysis we can identify the in situ transcriptome of specific Stramenopile taxa in order to begin with deciphering the functional contribution of individual taxa to complex communities.

Townsend, H., NOAA - Chesapeake Bay Office - Oxford Lab, Oxford, USA, Howard.Townsend@noaa.gov
USING MODELS TO SUPPORT INTER-JURISDICTIONAL ECOSYSTEM-BASED FISHERIES MANAGEMENT IN THE CHESAPEAKE BAY
The completion of the Fisheries Ecosystem Plan for Chesapeake Bay (2006) was a milestone in the effort to develop ecosystem-based approaches to management of the estuary and its watershed. The next step in that effort was to develop an operational structure to implement ebfm. NOAA Chesapeake Bay Office and Maryland Sea Grant have been working with resource managers and regional scientists to implement this structure by convening resource managers as part of the EBFM Goal Implementation Team (GIT). Regional scientists in species teams (ST) then develop briefs discussing pertinent ecosystem issues for focal species in the Chesapeake. Quantitative Ecosystem Teams are charged with developing quantitative indicators based on the relevant ecosystem issues. These teams are to work with the GIT to develop quantitative endpoints for management. The QETs will explore the viability of using such an indicator. Ultimately, before such an endpoint would be used as a management tool, the QETs will use various types of ecosystem modeling to simulate management scenarios using such endpoints.

Townsend-Small, A., University of Cincinnati, Cincinnati, USA, amy.townsend-small@uc.edu
Owen, L. A., University of Cincinnati, Cincinnati, USA
Haneberg, W. C., University of Cincinnati, Cincinnati, USA
Dietsch, C., University of Cincinnati, Cincinnati, USA
VULNERABILITY OF SOIL AND RIVER ORGANIC CARBON TO GLOBAL CHANGE IN THE GANGES RIVER HEADWATERS, SUBTROPICAL INDIAN HIMALAYAS
The Ganges-Brahmaputra River system is a major contributor of terrestrial organic carbon to the oceans. The exact implications of global change on this flux are uncertain. A significantly strengthened Asian monsoon, such as observed in the summer of 2010, may lead to depletion of soil C stocks via erosion and landslides, which may further result in increased organic C deposition on the continental shelf. But local scale processes such as dam building and land use change for agriculture or urbanization are also expected to have a significant impact on the regional carbon cycle. We will present the results of a field survey of organic C stocks and carbon isotope (14C and
Epibiotic bacterial populations are implicated in the toxin production of the toxic Pseudo-nitzschia species. To date, several bacteria from &Alpha;proteobacteria (Roseobacter, Pseudoalteromonas, Thalassobacter, Sinanigibacter, and Paracoccus species) and Bacteroidetes (Haloarcula, Prosthecochloris, and Thalassodendron) have been isolated from the toxin-producing Pseudo-nitzschia multiseries (Kaczmarcka et al. 2005, Genbank). In this study, we isolated and identified the epibiotic bacteria associated with the non-toxic P. pungens strain by culture isolation technique and metagenomic approach to determine if their epibiont bacteria is diverse as well. The 16s rDNA was amplified and sequenced from cultured bacteria and from clonal library made from P. pungens metagenomic sample. We found that P. pungens can associate with only a few bacteria from &Alpha;/proteobacteria group; their 16s sequence identities are similar to cultured and uncultured Thalassobacter and Roseobacter. Our results suggest that bacterial diversity may be a characteristic of toxic Pseudo-nitzschia species.

LONG-TERM DEGRADATION KINETICS AND CONTINUUM OF REACTIVITY OF LAKE WATER DOC
Dissolved organic carbon (DOC) is the largest pool of reduced C in lake water. It comprises a continuum of fractions with different susceptibility to decomposition. Still, its degradation is often described by first order kinetics, assuming one homogeneous pool. Moreover, DOC decomposition is usually studied in short-term laboratory batch experiments, during which only a small fraction of the C is mineralized. We incubated water from seven boreal lakes on the time scale of typical water retention times, monitoring DOC mineralization by natural microbial communities in the dark for three years. A reactivity continuum model, which expresses DOC degradation is related to initial DOC optical properties. Specifically, k declined with decreasing DOC-specific UV absorbance, and increased with steeper slopes of the absorbance spectrum in the UV range (275-295 nm). This suggests that differing DOC quality can influence the overall extent and temporal course of mineralization even at time scales of several years, similar to the residence time in lakes.

Marine benthic ecological studies routinely use digital images for data collection. However, color information, which is important for human classification, has varying spectral shifts associated with attenuation by water and its dissolved and particulate constituents. Some studies simply ignore the color information, others attempt to color correct the images. However, simple color correction methods were not shown to provide consistent color output for the same objects under different imaging conditions. Nevertheless, having consistent output is imperative for using color as a scientific tool, e.g., for creating coral bleaching indices. Underwater color calibration charts are often used to compensate for the effects. In this work we show that even with a calibration chart, the recovered colors are inconsistent between images, in part caused by specular reflections from the calibration charts. The specular reflections add a color component that is independent of the calibration card, contributing errors to the color estimation process. We present a method that provides more reliable color correction results, demonstrated on a set of coral reef underwater images.

Net changes in the regional C balance and the dynamics of GHG emissions following the creation of theEastmain 1 Reservoir in Northern Quebec, Canada
The Eastmain 1 Net Greenhouse Gas (GHG) Emissions Project was launched in 2004 to document the net changes in the regional carbon (C) balance resulting from the construction of the Eastmain 1 reservoir (EM1). All major C sources and sinks of the pre-flood terrestrial and aquatic ecosystems were quantified for 3 years before flooding as well as those from the EM1 reservoir over 4 years after flooding.

The total, pre-flood aquatic ecosystems C budget was a net emitter (about 120t C-CO2 yr-1 km-2) and of 2.8 t C-CH4 yr-1 km-2) and of 2.8 t C-CH4 yr-1 km-2). Overall pre-flood landscape C budget was a natural source of about 7 t C-CO2 yr-1 km-2, and of 2.8 t C-CH4 yr-1 km-2. The post-flood C budget calculated for the first year indicates the EM1 reservoir was a net source of CO2 in the range of 830 t C-CO2 yr-1 km-2 but a much smaller source of CH4 (0.07 t C-CH4 yr-1 km-2). These emissions declined sharply over the following 3 years and tend to stabilize to a constant value of about 174 t C-CO2 yr-1 km-2 within 10 to 15 years.

Underwater color as a source of scientific data for coral communities
Marine benthic ecological studies routinely use digital images for data collection. However, color information, which is important for human classification, has varying spectral shifts associated with attenuation by water and its dissolved and particulate constituents. Some studies simply ignore the color information, others attempt to color correct the images. However, simple color correction methods were not shown to provide consistent color output for the same objects under different imaging conditions. Nevertheless, having consistent output is imperative for using color as a scientific tool, e.g., for creating coral bleaching indices. Underwater color calibration charts are often used to compensate for the effects. In this work we show that even with a calibration chart, the recovered colors are inconsistent between images, in part caused by specular reflections from the calibration charts. The specular reflections add a color component that is independent of the calibration card, contributing errors to the color estimation process. We present a method that provides more reliable color correction results, demonstrated on a set of coral reef underwater images.
Tripp, H. J., UC Santa Cruz, Santa Cruz, USA, hjamin.tripp@gmail.com
Hewson, I., Cornell University, Ithaca, USA, ih8@cornell.edu
Boyarsky, S., UC Santa Cruz, Santa Cruz, USA, xenison@gmail.com
Stuart, J., UC Santa Cruz, Santa Cruz, USA, julystuart@gmail.com
Zehr, J., UC Santa Cruz, Santa Cruz, USA, jzehr@gmail.com

GLOBAL OCEAN SURVEY OF MARINE METATRANSCRIPTOMES REVEALS DOMINANCE OF REDUCED NITROGEN COMPOUNDS IN BIOGEOCHEMICAL CYCLING OF NITROGEN

Marine metatranscriptomics has the potential to reveal the compounds metabolized by different microorganisms as a function of time and space. In order to gain broad insight into biogeochemical cycling of nitrogen, we obtained 9,522,746 pyrosequencing reads derived from mRNA from 15 locations in southwestern Pacific and 8 locations across the equatorial Atlantic. We found that the community transcribes two orders of magnitude more genes related to the metabolism of reduced nitrogen compounds (e.g. ammonium) vs. oxidized nitrogen compounds (nitrate and nitrite). In addition, while the tens of thousands of transcripts for acquisition and metabolism of oxidized nitrogen compounds were primarily limited to Synechococcus and Altermonas. It is well known that a few “keystone” species reduce dinitrogen gas to ammonia, and that some “streamlined” genomes lack capacity for reducing nitrate and nitrite to ammonium. However, this study suggests that “keystone species” reduce nitrate and nitrite, the dynamics of which deserve further study for consideration in biogeochemical nitrogen models.

Trocine, C., INIBIOMA-CONICET, UNComahue, San Carlos de Bariloche, Argentina, ctrocine@comahue-conicet.gob.ar
Modenutti, B. E., INIBIOMA-CONICET, UNComahue, San Carlos de Bariloche, Argentina, b modenutti@comahue-conicet.gob.ar
Balseiro, E. G., INIBIOMA-CONICET, UNComahue, San Carlos de Bariloche, Argentina, e balseiro@comahue-conicet.gob.ar

EFFECTS OF UV RADIATION ON ALLELOCHEMICALS FROM FILAMENTOUS ALGAE: DOES IT MAKE A DIFFERENCE FOR TARGET ALGAE?

North Patagonian shallow lakes can be very transparent, allowing high penetration of UV-radiations besides having very low nutrient levels. In these aquatic environments, allelopathy may provide a competitive advantage to primary producer's interaction. Particularly, allelopathy is especially effective in stress situations, e.g. under nutrient limitation, yet, UVR plays an important role in altering and degrading dissolved organic molecules. We studied the effects of UVR on allelochemicals released by filamentous green algae (FGA), to establish whether UVR affects their function and to understand the fate of these compounds in aquatic ecosystems. We measured the effect of allelochemicals obtained from FGA filtrates on natural phytoplankton performing a factorial design with 4 treatments: +FGA filtrate, –FGA filtrate, and the mentioned treatments exposed to UVR (UVA340) for 2 h. We observed a decrease in phytoplankton Chl-a in the +FGA filtrate treatment compared to the control and we found that UVR modeled the inhibition of phytoplanktonic growth. We suggest that UVR could have a negative effect on the concentration of FGA active allelochemicals in the water, which results in a positive outcome for phytoplankton.

Tsugeki/Narumi, N. K., Ehime University/Senior Research Fellow Center, Matsuyama, Japan, tsuguki.kuwae@sci.ehime-u.ac.jp
Urabe/Jotaro, U., Tokohu University/Graduate School of Life Science, Sendai, Japan
Tani/Yukinori, Y., Shizuoka University/Environmental Science, Shizuoka, Japan
Ueda/Shingo, U., Nihon University/College of Bioresource Science, Fujisawa, Japan
Aguas/Tetsuo, T., Shimane University/Faculty of Medicine, Shimane, Japan
Oda/Hirohata, O., Nagoya University/Chronological Research, Nagoya, Japan
Tanabe/Shinsuke, T., Ehime University/Center for Marine Environmental Studies, Matsuyama, Japan

DOES ATMOSPHERIC DUST TRANSPORTED FROM THE ASIAN CONTINENT INFLUENCE OLIGOTROPHIC LAKES IN JAPAN?

We examined fossil pigments and zooplankton remains from Pb-dated sediments taken from a high mountain lake of Hourai-Numa, located in the National Park of Japan, to uncover historical changes in the phyto- and zooplankton community over the past 100 years. Simultaneously, we measured the biogeochemical variables of TOC, TN, TP, d13C, d15N, and 206Pb/204Pb in the sediments to identify environmental factors causing such changes. Sedimentary analysis showed that the abundance of phytoplankton in this lake drastically increased since the 1990s when the fluxes of TN and TP rapidly increased. In parallel with this, Daphnia, a keystone herbivore, largely increased. During this period, there was no anthropogenic perturbation in the watershed and no large changes in economic, industrial activities in urban areas at the base of the mountain. However, Pb stable isotope analysis showed that air dusts with nutrient substances caused by activities such as coal combustions originated from Asian continent were increasingly transported to the lake since 1990. A mass balance estimation showed that amount of P transported from Asia are enough to explain the increase in TP since the 1990s. These results indicate that long-range transport of P (and N) has promoted eutrophication and induced large changes in plankton communities even in unproductive mountain lakes far from direct human disturbance and across geopolitical boundaries.

Tucker, J. M., Memorial University of Newfoundland and Labrador, St. John's, Canada, jane.tucker@mun.ca
Rivkin, R. B., Memorial University of Newfoundland and Labrador, St. John's, Canada, r rivkin@mun.ca
Li, W. K., Department of Fisheries and Oceans, Bedford Institute of Oceanography, Dartmouth, Canada, Bill.Li@dfo-mpo.gc.ca
Moulard, R., Memorial University of Newfoundland and Labrador, St. John's, Canada, r moulard@mun.ca

MICROBIAL PROCESSES IN THE BEAUFORT SEA

The Canadian Arctic is a climate-sensitive region and characterizing its biogeochemistry is crucial for predicting climate-mediated changes on ocean ecosystems. Heterotrophic microbes process 50-80% of ocean production, thus they influence biogeochemical cycling. Relatively little is known about marine microbes at high latitudes. As part of Canadian IPY-GEOTRACES, we measured bacterial properties during August-September 2009 in the Beaufort Sea, along a transect from the Mackenzie River to the Canada Basin. Bacterial abundance ranged from 8.9x106 cells-l-1 at 250m in the Canada Basin to 5.3x108 cells-l-1 at 5m, near the Mackenzie River. Bacterial production shows a different pattern: rates at all stations were highest between 0-20m (0.05 to 0.24 ug C l-1d-1), decreased to 500m and remained constant to 3000 m. Bacterial production ranged from undetectable to 200m in the Canada Basin to 0.93 ug C l-1d-1 at 125m near the Mackenzie River. Our results suggest that microbial activity in deep waters is significant and contributes to the biogeochemical cycling of organic matter in the Arctic Ocean and thus should be included in climate models.

Tucker, J. K., Louisiana State University, Baton Rouge, USA, j tuck 10@yahoo.com

IS THERE A CORRELATION BETWEEN CHYTRID FUNGUS AND LUNGWORMS IN RANA SYLVATICA (WOOD FROGS)

Chytridiomycosis, an aquatic fungus has been implicated in the decline of amphibian populations worldwide. In Itasca State Park, Minnesota the fungus has been identified in several frog species including Rana sylvatica (Wood frogs), as well as an anuran lungworm, Rhodias bakeri. The purpose of this project was to examine a relationship between the chytrid fungus and the lungworm, since chytrid infects the skin of amphibians and Rhodias enters the body of amphibians through the skin. To test the correlation we caught frogs from several sites in the park. After removal of the lungs we counted the total number of Rhodias in each pair of lungs. In conjunction, PCR was used to test each frog for chytrid. We found that of the 116 samples collected, 26 percent of the adults, and 29 percent of the young of the year were chytrid positive. Adults with chytrid averaged 1.46 Rhodias, while adults without chytrid averaged 2.93 Rhodias. This difference was statistically significant (P value equaled 0.026). VOY with chytrid averaged more (1.33) Rhodias than those without chytrid ( .79). This difference was not significant.

Tulka, T. E., Mount Allison University, Sackville, Canada, setulka@mta.ca
Jeans, J. A., Mount Allison University, Sackville, Canada, jaejeans@mta.ca
Cocksheart, A. M., Mount Allison University, Sackville, Canada, acocksheart@mta.ca

QUANTITATIVE ANALYSIS OF THE CYANOBACTERIAL THYLAKOID MEMBRANE DURING IRON STARVATION

We have developed an immunodiagnostics test to measure changes in the major complexes of the thylakoid membrane during iron starvation (cyanobacteria). Global antibodies which recognize conserved targets in key proteins of the complexes are used in quantitative immunoblotting experiments with calibrated recombinant standard proteins to measure changes in the absolute levels of the complexes. Synechocystis sp. PCC6803 was subjected to iron starvation over a 4 day period. The levels of Photosystem I (PSI), Photosystem II (PSII), the iron starvation induced protein (Isa), the Cytochrome B6 complex and the F1FO ATPase were measured using antibodies and standards against PsAC, PsAB & PsBb, Isa, Ptt-

15N, and 206Pb/204Pb represents Tutorial presentations

ASLO 2011 ASLO Aquatic Sciences Meeting
and AtpB, respectively. While the levels of PSI remained unchanged upon iron starvation, the levels of PSI and the B6f complex dropped over the 4-day period. The levels of ISIA increased over 100 fold. Under iron replete conditions the ratio of ISIA per PSI monomer is only 0.15, however the ratio increases to 25 after 4 days of iron starvation. The ATPase complex doubles over the period of starvation.

Tunin-Lev, A., Ifremer, France, France, alina.tunin.lev@ifremer.fr
Maurer, D., Ifremer, France
Denis, K., Numerical Ecology of Aquatic Systems, University of Mons, Belgium, France
Belin, C., Ifremer, France

Grosjean, P., Numerical Ecology of Aquatic Systems, University of Mons, Belgium, France

COUPLING OPTICAL DETECTION BY FLOWCAM TO AUTOMATIC CLASSIFICATION BY THE SOFTWARE ZOO/PHYTOIMAGE FOR AUTOMATION OF PHYTOPLANKTON COMMUNITY IDENTIFICATION

The marine micro-phytoplankton communities are characterized biweekly by Ifremer at reference sites along the French coast since 1984 (French monitoring network Rephy). This exceptionally long-term series is very time-consuming and mobilizes numerous taxonomists. In order to partly automate phytoplankton identification, an original project was developed, combining optical detection of particles by the FlowCAM technology to image analysis and automatic classification performed by the Zoo/PhytoImage software. This approach, based on the machine learning principle, shows that quantitative discrimination of the particles from a natural sample is possible at a very fine taxonomic level, very close to the manual counting by microscopic method. In addition, an image and associate measurements are available for each detected particle, allowing both manual identification and numerical preservation of the samples. This study presents the classifier tool created from Arcachon bay samples, which can discriminate between 34 groups of particles with emphasis on the micro-phytoplanktonic taxa. Global identification rate with this classifier is 77.5%. The performance and limits of this innovative tool are compared with microscopic enumeration on the same samples.

Turnbull, L., Arizona State University, Tempe, USA, Laura.Turnbull@asu.edu
Childers, D. L., Arizona State University, Tempe, USA
Grinn, N. B., Arizona State University, Tempe, USA
Earl, S., Arizona State University, Tempe, USA
Hale, R., Arizona State University, Tempe, USA
Elrod, A. K., Arizona State University, Tempe, USA
Weller, N., Arizona State University, Tempe, USA

II. MULTI-SCALAR EFFECTS OF URBAN STORMWATER INFRASTRUCTURE IN A SEMI-ARID URBAN CATCHMENT: NUTRIENT RETENTION AND TRANSPORT

Over recent years urbanization has occurred rapidly, in particular in arid and semi-arid regions. Major changes in ecosystem structure occur during urbanization, including changes in hydrological flow paths due to the construction of stormwater infrastructure. These changes have implications for nutrient transport and redistribution within the urban ecosystem. We present the effects of urban stormwater infrastructure on the hydrologically mediated transfer of dissolved and particulate nutrients with emphasis on the micro-phytoplanktonic taxa. Global identification rate with this classifier is 77.5%. The performance and limits of this innovative tool are compared with microscopic enumeration on the same samples.

Turner, K. B., University of Washington, Seattle, USA, katharinebturner@gmail.com
Sanchez, C. I., University of Washington, Seattle, USA, pixelreflex@gmail.com
Morris, R. M., University of Washington, Seattle, USA, morrismw@u.washington.edu

HEAD SHRINKERS: A SHORT FILM TO TARGET A BROAD AUDIENCE

In August 2010, graduate students from the Master of Communication in Digital Media program joined forces with oceanographers from the University of Washington to produce short films highlighting research and teaching activities onboard the R/V Thompson. Several short films (2-5 min) were produced during a 14-day cruise in the North Pacific Ocean. Here we discuss ‘Head Shrinkers’, a light-hearted film designed to excite a broad audience about life at sea. Through this film, we will explore critical aspects of effective project design. Examples of multimedia storytelling produced by Katherine Binford Turner and Carlos Javier Sanchez are available at the following link: http://morrislab.ocean.washington.edu/

Turner, R. E., Louisiana State University, Baton Rouge, LA, USA, euturne@lsu.edu
Rabalais, N. N., LUMCON, Cocodrie, LA, USA, nrabalais@lumcon.com

POTENTIAL NUTRIENT LIMITATIONS ON PHYTOPLANKTON GROWTH WITHIN AND NEAR THE LOUISIANA COASTAL CURRENT

Patterns in the concentrations and atomic ratios of dissolved nitrogen, phosphate and silicate in the Louisiana Coastal Current and nearby waters were examined to determine potential factors limiting phytoplankton production. The DIN:DIP atomic ratio on 50 cruises varied from 2 to 100 and DIN:Si atomic ratio from 0.2 to over 20 in surface waters between the 890 and 890 W. The nutrient concentrations for DIN, DIP and Si ranged from 0 to 100, 1.8 and 120 μmol, respectively, for all data. Data interpretations based on nutrient concentrations and ratios suggest that 69% of the stations appeared to be N-limited stations, 7% were P-limited stations, and only <2% Si-limited stations. There was an apparent balance of potentially limiting nutrients at the remaining stations. These data were compared to results from small-bottle addition/deletion bioassays conducted over 25 years, and without apparent systematic differences in outcomes. The spatial distribution of identified N and P limited stations is fairly even across the shelf. The results are consistent with modeling and literature syntheses showing an increase in phytoplankton nitrogen loading from the freshwater end member.

Turner, S. M., USGS- Alaska Science Center, Anchorage, USA, saraturner@usgs.gov
Nielson, J. L., USGS- Alaska Science Center, Anchorage, USA, jnielsoeng@usgs.gov
Schaeffer, J. J., Old Dominion University, Norfolk, USA, jschaff@odu.edu
Jones, C. M., Old Dominion University, Norfolk, USA, cjones@odu.edu

SPECIES IDENTIFICATION OF JUVENILE PACIFIC SALMON USING GENETIC AND OTOLITH SHAPE

North American Pacific salmon represent a highly specious group of fishes that occur in temperate waters throughout their range from Alaska to California. However, recent surveys express concern over shifting distributions and relative abundance due to a rapidly changing climate. Linking changes in the physical environment with changes in biology requires a rigorous assessment of species-specific information at different life stages. Adult Pacific salmon species are easily identified using morphology and descriptive coloration. Juvenile salmon, however, are less likely to be correctly identified to species due to ontogenetic changes in morphometric indicators and a wide range of color phenotypes from different habitats. Although many genetic techniques for species identification are well described in the literature, these methods often fail to consider within-species diversity found in samples collected across large landscapes. In this study, we performed species identification of juvenile salmon collected in the Copper River, Alaska, using two independent indicators: genetic polymorphism and otolith shape. We compare and contrast results drawn from both techniques for accuracy, analysis time, and general laboratory costs. Biological studies often have access to different tissues or analytical techniques, but not others. Our comparison of these two approaches for species identification in juvenile salmon may provide direction and confidence in protocols for future studies.

Tunin-Lev, A., Ifremer, France, France, alina.tunin.lev@ifremer.fr
Maurer, D., Ifremer, France
Denis, K., Numerical Ecology of Aquatic Systems, University of Mons, Belgium, France
Belin, C., Ifremer, France
Dissolved inorganic phosphorus trapping at a water-column redoxcline: Implications for ocean anoxic events?

Geochemical records suggest the ocean has undergone periods of at least partial deeper-water anoxia or euxinia. Two counteracting feedback loops involving redox control of the dynamics of the phytoplankton nutrient dissolved inorganic phosphorus (DIP) might co-exist, helping to stabilise the redox-state of the atmosphere and oceans. This concept implies that, during deeper-ocean anoxia, the DIP transfer from the deep anoxic into the oxic surface waters is uninhibited by processes taking place at the redoxcline. This implicit assumption requires testing because iron (Fe) and manganese (Mn) dynamics at oxic/anoxic water-column redoxclines have the place at the redoxcline. This implicit assumption requires testing because iron (Fe) and manganese (Mn) dynamics at oxic/anoxic water-column redoxclines have the potential to form a DIP trap, inhibiting DIP transport from anoxic deep into oxic and manganese (Mn) dynamics at oxic/anoxic water-column redoxclines have the potential to form a DIP trap, inhibiting DIP transport from anoxic deep into oxic surface waters. Using a time-series dataset of Fe, Mn, DIP and dissolved oxygen distributions in the Eastern Gotland Basin of the Baltic Sea we provide estimates of the efficiency of this Fe- and Mn-driven DIP trap. We find average trapping efficiencies of 38% - 63%. The transferability of these results to, and possible implications of the trapping mechanism during, ocean anoxic events are discussed.

Tzetziou, M., ESSIC, University of Maryland, College Park, USA, maria.a.tzetziou@nsu.edu
Neale, P.J., Smithsonian Environmental Research Center, Edgewater, USA, nealep@sied.edu
Meggialio, P.J., Smithsonian Environmental Research Center, Edgewater, USA, meggienalp@si.edu
Dacquistio, J., Smithsonian Environmental Research Center, Edgewater, USA, Dacquistio@Agri.edu
Rudolf, J., Florida International University, Miami, USA
Butterworth, M., Smithsonian Environmental Research Center, Edgewater, USA

Microbial and photochemical processing of dissolved organic matter exported from tidal marshes in the Chesapeake Bay

Tidal marshes have been shown to affect fluxes of carbon and nutrients in adjacent coastal ecosystems. Relative to information on the amount and direction of these tidal exchanges, much less is known about the degradability, processing and fate of the distinctive dissolved organic material (DOM) derived from marshes. We performed several experiments to determine the sensitivity of marsh-derived DOM to both microbial and photochemical degradation. Marsh and estuarine dominated samples were collected from freshwater and brackish systems in the Chesapeake Bay. Photochemical degradation was measured after a 10h exposure to filtered xenon irradiance simulating midday surface exposure. DOM bioavailability was quantified using the traditional batch incubation approach in which DOM inoculated with a microbial fraction (0.2-1 µm) was incubated in bottles for 7 days. Incubation experiments were performed using both exposed and non-exposed DOM, to examine effects of DOM photochemical transformation on its microbial availability. We measured changes in absorption and fluorescence spectra, fluorescence Emission-Excitation Matrices, molecular weight distribution, DOC, DIC, and CO2. Results provide insights on the cycling and fate of marsh-exported dissolved compounds in estuarine and coastal waters.

Ubertini, M., UMR 100 PE2M IFREMER-Université de Caen Basse-Normandie, Caen, France, martin.ubertini@unican.fr
Orvain, F., UMR 100 PE2M IFREMER-Université de Caen Basse-Normandie, Caen, France, francis.orvain@unican.fr
Gangnery, A., Station IFREMER, Laboratoire Environnement Ressources de Normandie, Port en Bessin, France, aline.gangnery@ifremer.fr
Lefebvre, S., UMR 8187 CNRS-LOG, Station Marine de Wimereux, Université Lille 1 sciences et technologies, Wimereux, France, sebastien.lefebvre@univ-lille1.fr

Spatial dynamic of microphytobenthos resuspension in a low-normandy estuary ecosystems

Microphytobenthos resuspension is controlled by a complex set of interacting processes between biological, physical, and chemical components. Moreover, these processes are space and time dependent. Understanding the sediment and associated microphytobenthos resuspension and its fate in the water column is of fundamental importance for measurements of food quantity available to benthic and pelagic food webs. In order to determine the different factors possibly implicated in this resuspension, an estuarine ecosystem, the Bay des Veys, has been sampled on the whole intertidal area at low tide and into the surrounding water column during ebb tide. A wide range of physical (hydrodynamic regime, sediment granulometry, suspended matter) and biological (flora and fauna assemblages, chlorophyll measurements) parameters have been explored to characterize the benthos-pelagos coupling at the bay scale. A mapping approach using kriging interpolation has allowed us to relate the different parameters sampled on the field. First results suggest a clear resuspension event, highlighting the role of sediment types and bioturbators like Cerastoderma edule in the spatial dynamic of microphytobenthos resuspension.

Uchimuya, M., The University of Tokyo, Chiba, Japan, uchimuya@aori.u-tokyo.ac.jp
Fukuda, H., The University of Tokyo, Chiba, Japan, hfukuda@aori.u-tokyo.ac.jp
Ogawa, H., The University of Tokyo, Chiba, Japan, hogawa@aori.u-tokyo.ac.jp
Nagata, T., The University of Tokyo, Chiba, Japan, nagata@aori.u-tokyo.ac.jp

Prokaryote production in the mesopelagic layer of the western Arctic Ocean

Heterotrophic prokaryote production in the mesopelagic layer (HPP-meso) reflects spatiotemporal variations in the magnitude of lateral and vertical transport of organic matter. One may hypothesize that variations in primary production and HPP-meso are spatially coherent when particulate organic matter sinking is the prevailing mechanism by which organic matter is delivered to the mesopelagic zone. The Arctic Ocean is one of the interesting regions to test this hypothesis because of its unique and rapidly changing oceanographic features. We examined the relationship between HPP-meso and chlorophyll a standing stock in the upper layer along a near-shore to off-shore gradient of the western Arctic Ocean (Canada basin). Results showed that the spatial coupling between the chlorophyll a distribution and HPP-meso was weak. Rather, prokaryote production was high at depths of 100 – 200 m, which corresponded to the upper halocline layer composed of Pacific Winter Water. These data are consistent with the notion that the intrusion of the Pacific-origin intermediate water mediates the lateral delivery of a large quantity of labile dissolved organic matter to the mesopelagic layer of the Canada basin.

Urban-Rich, J., University of Massachusetts Boston/ EEOS, Boston, USA, juanita.urban-rich@umb.edu
Dicker, R., University of Massachusetts Boston/ EEOS, Boston, USA, rachel.dicker001@umb.edu
Stanton, J., University of Massachusetts Boston/ EEOS, Boston, USA, jake.stanton001@umb.edu

Changes in plankton communities in a small embayment in boston harbor in relationship to freshwater inputs

Coastal plankton communities are important for the health and well being of our oceans, many commercial fish and for humans using the sea. These communities are also highly responsive to natural and man-induced changes in freshwater discharge, nutrient loadings and ocean temperatures. Seasonal and annual changes in chlorophyll and more recently zooplankton biomass have been monitored in Savin Hill Cove for the past five years. Savin Hill Cove is located adjacent to the University of Massachusetts campus and is within Massachusetts Bay and Boston Harbor. It can be influenced by off-shore waters from Massachusetts Bay, freshwater input from the Neponset River along with precipitation and land run-off. Changes in the phytoplankton community have been observed during the spring 2010 and summer 2009 seasons. These changes in phytoplankton communities and zooplankton biomass will be discussed with regards to changes in precipitation and the influx of freshwater from the Neponset River.

Uy, T. C., University of the Philippines Diliman, Quezon City, Philippines, tonileuy@gmail.com
Soriano, M. N., University of the Philippines Diliman, Quezon City, Philippines, jing.soriano@gmail.com

Determination of attenuation coefficient in coastal waters using a commercial camera

A method for determining the attenuation coefficient, k, in coastal waters with the use of a commercial underwater camera is presented in this study. A white surface was lowered at different depths in Philippine seas and its image captured. Irradiance spectra of the white surface for different depths were reconstructed from the colored images using an inversion matrix derived from the camera's spectral sensitivities and eigenspectra of Munsell chips. Attenuation coefficients in the entire visible spectrum were then solved via the Beer-Lambert Law. k measurements obtained through this method were comparable to those obtained using a spectroradiometer. In situ spectral measurements will benefit from the method proposed here, as it provides a fast and affordable method for obtaining attenuation coefficients in coastal waters.
Vahmäe, E., University of Tartu, Tallinn, Estonia. Vahmäe@sea. ee

Prairie, Y. T., Université du Québec à Montréal, Montréal, Canada, prairie.yves@ uqam.ca

GAS TRANSFER VELOCITY IN LAKES: A STEP TOWARDS UNIVERSALITY Reliable gas transfer coefficients (k) in lakes are critical when estimating gas exchange with the atmosphere. We performed a series of gas exchange measurements in 12 diverse aquatic systems, using the floating chamber method, and relate them to different meteorological, biogeochemical and physical variables. We found a strong and quasi-universal relationship with surface turbulent kinetic energy dissipation rate (ε-squared = 0.78). Consecutive measurements under different sampling configurations showed that our specific model of floating chamber can grossly overestimate flux (up to 100%), particularly in low turbulence conditions. An analysis of the relationship between k600 and wind speed (as a proxy for turbulence) in several systems showed that the parameters are largely system-specific mainly because the impact of a given wind speed on turbulence varies among systems. We developed a general multivariate model where the combined influences of lake size and wind speed are shown to provide the best predictive model of gas transfer velocity. The use of turbulence and the implication of system size in the wind-k relationship can have large impacts on estimation of gas exchange of whole landscapes.

Vahmäe, E., Estonian Marine Institute, University of Tartu, Tallinn, Estonia, Ele. vahmiae@sea.ee

Kutser, T., Estonian Marine Institute, University of Tartu, Tallinn, Estonia, Tii. kutser@sea.ee

DETECTING CHANGES IN BALTIC SEA BENTHIC ENVIRONMENT WITH REMOTE SENSING Coastal areas are greatly affected by human activity, which has significant effect on marine animal and plant communities. Quantifying the areal coverage of different benthic types at a point in time allows researchers to identify the current state of the benthic community. In addition monitoring programs need to be established in order to identify changes in species distribution and structure. Spatial and temporal dynamics of different benthic communities were studied in relatively turbid Baltic Sea coastal environment. The suitability of space-borne multispectral sensor QuickBird for change detection was estimated. Bottom types of the coastal area were classified into sets of classes representing the most typical habitats of the coastal environment. Two QuickBird images acquired over three years interval (2005 and 2008) of Western-Estonian archipelago were processed and change detection analysis applied. Major changes in general distribution of different bottom types happened in areas, which were highly affected by the hydrodynamic processes. Water quality differences caused some confusion in classification and therefore resulted in some inaccuracies in maps of change.

Vailiancourt, R. D., Millersville University of Pennsylvania, Millersville, USA, robert. vailiancourt@millersville.edu

Marra, J. F., Brooklyn College, Brooklyn, USA, jfm7780@brooklyn.cuny.edu

Lance, V., Lamont Doherty Earth Observatory, Palisades, USA, vlance@ldeo. columbia.edu

PHOTOSYNTHETIC EFFICIENCY IS CONTROLLED PRIMARILY BY ZEAXANTHIN IN THE WESTERN NORTH ATLANTIC OCEAN The goal of our project (ON DEQUE) was to test the hypothesis that the photosynthetic quantum yield in the upper layer of the ocean’s euphotic zone is controlled by irradiance, through the pigment composition of the phytoplankton, and in the lower euphotic zone by the upward flux of nutrients. Our observations support this hypothesis. Correlation max throughout the analyses show that the pigment zeaxanthin controls middle part of the euphotic zone between the 10% and 1% surface irradiance isoline (z = 32-100 m). max above and below these depths was uniformly low and exhibited lower correlations to zeaxanthin. All of the other known photoprotective carotenoids were present in significantly high quantities, yet exhibited only weak correlations to max at all depths. Nitrate + nitrite concentration and the vertical N+Np max only within narrow depth intervals showed correlations to coinciding with the upper surface of the deep chlorophyll maximum. This research provides a mechanism to understand how the processes of nutrient supply and light affect the physiology of natural populations of phytoplankton, a long-standing problem in biological oceanography.

Valdivieso-Ojeda, J. A., Universidad Autonoma de Baja California, Ensenada, Mexico, microbalmats@yahoo.com.mx

Huerta-Diaz, M. A., Universidad Autonoma de Baja California, Ensenada, Mexico, mhuertadiaz52@yahoo.com

Tellez-Duarte, M., Universidad Autonoma de Baja California, Ensenada, Mexico, mtellez@sac.edu.mx

Siqueiros-Valencia, A., Universidad Autonoma de Baja California, Ensenada, Mexico, arsiva@sacb.mx

ENRICHMENT OF MOLYBDENUM AS A BIOSIGNATURE OF MICROBIAL MATS IN MODERN AND ANCIENT SEDIMENTARY STRUCTURES Metal enrichment factors (EFs) relative to the Earth’s crust were calculated for Fe, Zn, V and Mo in microbial mat samples (MATs) from a number of sedimentary environments, including contemporary hypersaline and hydrothermal and in fossil stromatolites. Results indicate that Mo was substantially enriched in all the studied MATs, with EFMo values in the range of 5 to 463. The elements Fe, Zn and V, however, showed no substantial enrichments (values in the range 0.2s EFM ≤5). The Mo enrichments, which were prevalent in all the studied environments (including the fossil stromatolite), indicate that this metal is probably biocaccumulated by the bacterial consortia, and that the enrichment is subsequently transferred to the underlying sediments. Our results suggest that the EFs (in conjunction with the EFFe, EFZn and EFFe) could be used as biosignatures for the presence of MATs in early and ancient sedimentary structures.

Valencia, J. A., CICESE - Dept of Biological Oceanography, Ensenada, Mexico, gasteres@ci.cese.mx

Ladah, L. B., CICESE - Dept of Biological Oceanography, Ensenada, Mexico, lladah@ci.cese.mx

Lavin, M. F., CICESE - Dept of Physical Oceanography, Ensenada, Mexico, mlavin@ ci.cese.mx

Filonov, A., Universidad de Guadalajara. Departamento de Física, Guadalajara, Mexico, aflonov@prodigy.net.mx

HOW DO WINDS AND INTERNAL WAVES CONTROL THE TEMPORAL AND SPATIAL VARIABILITY OF BARNACLE SETTLEMENT IN BAJA CALIFORNIA, MEXICO? We evaluated the importance of winds and internal waves in the spatial and temporal variation in settlement of the barnacle larvae, Chthamalus fissus. Two different spatial patterns were detected in 3 sites separated by 0.5 km. For more than half of the days that had a strong settlement pulse, a homogeneous settlement rate was detected among the 3 sites. However in about a third of the days that had a strong settlement pulse, the furthest north and most wave-exposed site had a significantly greater settlement rate than the other two sites. At two of the three sites, settlement rate significantly correlated with fluctuations in stratification, temperature and onshore currents, but not with winds. At a third site, settlement rate correlated strongly with winds, but not with any of the above mentioned physical variables. Our results suggest that the physical factors that modulate onshore transport of barnacle larvae vary at small spatial (<1 km) and temporal (<12 hr) scales, and that different larval transport mechanisms may occur at very nearby sites at the same time.

Valentin Del Rio, C. R., University of Sacred Heart, Santurce, Puerto Rico, c.r.valentin@gmail.com

Meléndez, J., University of Puerto Rico, Rio Piedras, Puerto Rico, jmelendez@ prxtreme.com

Negrón, G., Catholic University Of Puerto Rico, Mayaguez, Puerto Rico

Saez, L.

PUERTO RICO LIONFISH MANAGEMENT PLAN The effects of the lionfish invasion have threatened the ecosystems of Puerto Rico and the Virgin Islands; this moved a number of organizations to action. To help coordinate activities of the various organizations, Ecotono Inc. identified the need to create a management plan that would provide a framework to coordinate activities among government and non-government agencies, businesses, and local organizations to control the invasion of lionfish in Puerto Rico. This management plan includes five main areas: Education, detection and removal, monitoring and data gathering, data analysis and reporting, and lionfish market developments. Our principal objective is to control the lionfish population around Puerto Rico and to minimize the negative impact on marine ecosystems, fish populations, and other marine organisms. Ecotono wants to encourage and support the fishermen community and water sport operators to have a direct participation in lionfish removal activities. Finally, we would like to encourage the general community to support restaurants that serve lionfish.
Dinoflagellates are responsible for much of the bioluminescence seen in surface oceanic and coastal waters. Bioluminescence occurs in several ecologically important cosmopolitan dinoflagellate genera but little is known about the distribution and ecology of these organisms. During a research cruise to the Patagonian Shelf in December 2008, novel “universal” PCR primers that amplify dinoflagellate luciferase were used to detect and map bioluminescent dinoflagellate populations, across a range of shelf and open oceanic waters. Coincidental measurements of bioluminescence were taken using a bench top photometer and the taxonomic composition was analyzed by light microscopy. Detection of luciferase enabled the mapping of bioluminescent dinoflagellate populations during the day and allowed identification of light emission originating from organisms other than dinoflagellates. Bioluminescent dinoflagellate populations during the day and allowed identification of light emission originating from organisms other than dinoflagellates. Bioluminescent dinoflagellate populations were mainly found near the shelf break and that the distribution of these populations was closely tied to the physicochemical environment.

Vallina, S. M., Massachusetts Institute of Technology, Cambridge, USA, vallina@mit.edu
LeQuere, C., University of East Anglia, Norwich, United Kingdom, lequere@uea.ac.uk

STABILITY OF COMPLEX FOOD WEBS: RESILIENCE, RESISTANCE AND THE AVERAGE INTERACTION STRENGTH

In the face of climatic perturbations, the overall stability of an ecosystem will be determined by the balance between its resilience and its resistance, but their relative importance is still unknown. Using aquatic food web models we study ecosystem stability as a function of food web complexity. We measured three dynamical stability properties: resilience, resistance, and variability. Specifically, we evaluate how a decrease in the strength of predator-prey interactions with food web complexity, reflecting a decrease in predation efficiency with the number of prey per predator, affects the overall stability of the ecosystem. We find that in mass conservative ecosystems, a lower interaction strength slows down the mass cycling rate in the system and increases its resistance to perturbations of the growth rate of primary producers. Furthermore, we show that the variability and overall stability of the food webs is mostly given by their resistance, and not by their resilience. Resilience and resistance display opposite trends, although they are shown not to be simply opposite concepts but rather independent properties. The ecological implication is that weaker predator-prey interactions in closed ecosystems can stabilize food web dynamics by increasing its resistance to climatic perturbations.

Van Colen, C., Ghent university - Marine Biology Section, Ghent, Belgium, carl.vancoelen@ugent.be
Rossi, F., CNRS - Institut d’écologie et environnement, Montpellier, France
Montserrat, F., Netherlands Institute for Ecological Research - Centre for Estuarine and Marine Ecology, Yerseke, Netherlands
Andersson, M. G., Netherlands Institute for Ecological Research - Centre for Estuarine and Marine Ecology, Yerseke, Netherlands
Grönholt, B., Aarhus University - Center for Geomicrobiology, Aarhus, Denmark
Herman, P. M., Netherlands Institute for Ecological Research - Centre for Estuarine and Marine Ecology, Yerseke, Netherlands
Degrær, S., Management Unit of the of the North Sea Mathematical Model - Marine Ecosystem Management Section, Brussels, Belgium
Ysebaert, T., Netherlands Institute for Ecological Research - Centre for Estuarine and Marine Ecology, Yerseke, Netherlands

Middelburg, J. J., Utrecht University - Faculty of Geosciences, Utrecht, Netherlands

SPECIES-ENVIRONMENT INTERACTIONS DETERMINE POST-HYPOXIA RECOVERY OF FUNCTIONING

Resulting from global warming and decreased ocean ventilation, recurrent hypoxic events followed by successional readaptation are a common feature at present. Understanding the reaction of ecosystems to such event-like disturbances requires quantification of the return time of the system to an equilibrium and insight in the governing mechanisms for this return. In this respect it is particularly important to understand how recurring hypoxia will affect biodiversity of the community, and how this biodiversity may feedback on the return time of ecosystem functioning. Here we demonstrate, using an intertidal benthic system as an example, that species interactions through the environment as a consequence of ‘ecosystem engineering’ are more important than direct trophic interactions and individual species’ reaction times to set the return time of the community and sediment functioning (carbon and nitrogen cycling, respiration, sediment irrigation, mixing and transport) from hypoxia. We argue that the slow recovery of benthic communities to hypoxia creates opportunities for the existence of alternative stable states, and that the most diverse types of benthic communities will have the longest return times after hypoxia.

Van den Meersche, K., VUB, Brussels, Belgium, karelvandenneersche@gmail.com
Tambooth, K., KUL, Leuven, Belgium
Meyssman, F., NIOO CEME, Yerseke, Netherlands
Borges, A., UL, Liege, Belgium
Bergs, R. K., LEUVEN, Belgium
Dehairs, F., VUB, Brussels, Belgium
Bouillon, S., KUL, Leuven, Belgium

INORGANIC CARBON IN THE TANA RIVER BASIN (KENYA): DISTRIBUTION, COMPOSITION AND PROCESS RATES

Studies on the biogeochemistry of East African rivers are few. We present results of intensive field campaigns on the Tana River Basin in Kenya, focusing on dissolved inorganic carbon (DIC). Sampling took place from 2008 to 2010, and over different seasons (end of dry season, short rains, end of long rains). Samples were taken in several tributaries and over the course of the main river, from headwaters to the delta. DIC concentrations ranged from 0.2 mmol L-1 in the headwaters to 1.5 mmol L-1 downstream, with peaks of 4.8 mmol L-1 in some tributaries. 813C–DIC varied between -2.4% and -20.7%, with the bulk of the measurements (-9%) between -3.8% and -12.6%. The water was generally supersaturated with CO2, making the river a CO2 source to the atmosphere. This supersaturation was more pronounced during wet season than during dry season. Measurements of pelagic respiration and primary production show a very heterotrophic system with intensive carbon processing.

Van der Ham, J. L., Louisiana State University, Baton Rouge, USA, jvdham@lsu.edu
De Mutsert, K., Louisiana State University, Baton Rouge, USA, kimdev1@lsu.edu

EFFECTS OF THE DEEPWATER HORIZON OIL SPILL ON GROWTH OF BROWN SHRIMP IN AN AFFECTED LOUISIANA ESTUARY.

The oil spill that followed the explosion on the Deepwater Horizon oilrig on April 20, 2010 affected offshore waters and estuaries. Nekton species with lifecycles that include both these environments are likely to come into contact with crude oil or its components. Brown shrimp (Farfantepenaeus aztecus) may have been exposed to crude oil offshore as eggs and/or larvae and may have suffered further exposure while maturing in affected estuaries. Crude oil contains polycyclic aromatic hydrocarbons (PAHs), which can reduce growth, impair reproductive and immunological functions, and affect larval development of crustaceans. Our objective is to study growth of brown shrimp with the contention that reduced growth rates are potential indications of PAH exposure. The ecological and economical importance of brown shrimp makes this a high priority species to monitor. To this purpose we collected shrimp using an otter trawl at control, medium, and highly impacted estuarine research sites in the Louisiana coastal area since June 2010. Growth rates are calculated using cohort analyses and linear regressions. We use an extensive collection record (1988-2009) from the same sites as baseline data.

Van Dover, C. L., Duke University, Nicholas School of the Environment, Marine Laboratory, Beaufort, USA, ch3@duke.edu
Godet, L., CNRS, Laboratoire Geolittomer - UMR 6654 LETG, Universite de Nantes, Nantes, France, gudet@univ-nantes.fr
Dunn, D., Duke University, Nicholas School of the Environment, Marine Laboratory, Beaufort, USA, daniel.dunn@duke.edu
ASSESSING LARGE RIVER RESTORATION SUCCESS

Dionisio Pires, M., Deltares, Delft, Netherlands, miguel.dionisio@deltares.nl
Troost, K., Wageningen Imarens, Yerseke, Netherlands, karin.troost@wur.nl
Troost, T., Delft, Netherlands, tineke.troost@deltares.nl

FILTRATION RATES AND BOUNDARY-LAYER MODIFICATION BY NATIVE AND INVASIVE SHELLFISH SPECIES

Dense shellfish beds can filter several cubic metres of water per hour. The Ooster-schelde in the Netherlands has large stocks of shellfish (native species, such as mussels and cockles and invasive species, such as Pacific oysters and American razor clams). The large filtration capacity of shellfish can influence the light regime as well as nutrient cycling in the system and thereby influence primary production and ultimately their own carrying capacity. Bivalves also modify the near-bed hydrodynamics, influencing transport rates to the bed. To assess the effect of different species on ecosystem functioning, we require accurate and comparable data of filtration rates of these shellfish, as well as estimates of their impact on the boundary layer. Flume experiments at two different flow velocities have been carried out to assess the individual as well as bed-average clearance rates and horizontal depletions over the bed. ADV measurements were used to characterise the boundary layer over the shellfish. These data will be used as input for a coupled hydrodynamic-ecological model calculating carrying capacity of the system for shellfish.

van Duren, L. A., Deltares, Delft, Netherlands, luca.vanduren@deltares.nl
Troost, K., Wageningen Imarens, Yerseke, Netherlands, karin.troost@wur.nl

BENTHIC RESPIRATION PARTITIONING IN CONTRASTING SUBTIDAL SEDIMENTS: SEASONALITY AND RESPONSE TO A SPRING PHYTOPLANKTON DEPOSITION

We investigated Sediment Community Oxygen Consumption (SCOC), biomass and respiration rates of bacteria, nematodes and macrofauna in relation to the sedimentation of a spring phytoplankton bloom in permeable and non-permeable sediments at the Belgian Part of the North Sea. Bacterial respiration was assessed through bacterial production estimates and nematode and macrofaunal respiration was calculated from biomass-respiration conversions. Our results indicate that sediment respiration is partitioned differently among different benthic size groups in contrasting sediments. In coarse, permeable sediments, bacteria are responsible for the bulk of the respiration throughout the year. In contrast, metazoan organisms are important oxygen consumers next to bacteria in winter and early spring. In winter, the macrobenthos is more important than the nematode communities. In spring, shortly after the arrival of phytoplankton to the seafloor when macrobenthic densities and biomass is low, the importance of nematode respiration (20%) is striking. This indicates that seasonal sampling and incorporation of all benthic size classes is needed in further research aiming at unravelling benthic responses to phytoplankton deposition.

van Oevelen, D., NIOO-CEME, Yerseke, Netherlands, D.vanOevelen@nioo.knaw.nl
Soetaert, K., NIOO-CEME, Yerseke, Netherlands, k.soetaert@nioo.knaw.nl
Vinck, M., Ghent University, Gent, Belgium, magda.vinck@ugent.be
Moens, T., Ghent University, Gent, Belgium, tom.moens@ugent.be

MACROEVOLUTIONARY TRENDS IN SILICOFLAGELLATE SKELETAL MORPHOLOGY: THE COSTS AND BENEFITS OF BIOMINERALIZATION

The silicoflagellates are a class of enigmatic eukaryotes characterized by net-like skeletons composed of opaline silica. Since other major groups of siliceous plankton exhibit evidence of decreasing size and/or silicification over the Cenozoic, we looked for similar trends in the silicoflagellate record by constructing a species level database of diversity and morphological metrics. This new database reveals a proliferation of silicoflagellate species with spined skeletons and an increase in the number of spines over the Cenozoic. There appears to be a decrease in the size of silicoflagellate species without spines similar to decreases in size observed in diatom frustules and organic-walled dinoflagellate cysts over the last 65.5 million years. In contrast, there is little change in skeleton size or silicification in spined species; however, spined species are on average more heavily silicified per unit surface area than those without spines. The observed trends indicate that increased predation pressure combined with declining surface nutrient availability, specifically silicate, may have shifted the costs and benefits of biomineralization causing divergent responses in skeletal morphology between different morphological lineages over the Cenozoic.

Vanaverbeke, J., Ghent University, Gent, Belgium, jan.vanaverbeke@ugent.be
Franco, M. A., Ghent University, Gent, Belgium

COASTAL WATERS OPTICAL CLASSIFICATION: INTEREST FOR OPTIMIZING BIO-OPTICAL INVERSION ALGORITHMS

The high optical dynamics of the coastal ocean prevent the development of general open ocean-like inverse algorithms needed to derive in-water bio-optical and biogeochemical parameters from satellite information. Local or regional algorithms are usually developed to focus on the area-specific range of optical variability. However, these algorithms comport some limitations related to their high dependency on the data set used for their development as well as to the difficulty to capture the numerous high frequency processes affecting regional bio-optical relationships. Another and more universal approach consists in classifying coastal waters according to their optical properties (independently of their location) and then apply a class-specific algorithm (empirical or semi-analytical) for improving the performance of the inversion procedure. The framework associated with the development of such classification-based algorithms is detailed, while the interest of the latter approach is

van Tol, H. M., Mount Allison University, Sackville, Canada, hmvantol@mta.ca
Irwin, A. J., Mount Allison University, Sackville, Canada, airwin@mta.ca
Finkel, Z. V., Mount Allison University, Sackville, Canada, zfinel@mta.ca
illustrated from an optical, bio-optical and biogeochemical data set gathered in con-  
tрастted coastal waters of the eastern English Channel, north Sea and French Guyana.  

**Vaqué, D.**, Institut de Ciències del Mar (CSIC), Barcelona, Spain, dolors@icm.csic.es  
Boras, J. A., Institut de Ciències del Mar (CSIC), Barcelona, Spain, boras@icm.csic.es  
Lara, E., Institut de Ciències del Mar (CSIC), Barcelona, Spain, elara@icm.csic.es  
Arrieta, J. M., Institut Mediterrani d’Estudis Avançats (CSIC), Esporles, Spain,  
txetxu@imedea.uib-csic.es  
Duartè, C., Institut Mediterrani d’Estudis Avançats (CSIC), Esporles, Spain, carlosduart@imedea.uib-csic.es  
Sala, M. M., Institut de Ciències del Mar (CSIC), Barcelona, Spain, carlosduarte@imedea.uib-csic.es  

**EFFECT OF SEA ICE MELTING ON MICROORGANISMS OF THE MICROLAYER IN THE ARCTIC OCEAN**  
One of the highest ice retreats in the Arctic Ocean was recorded in summer 2007. During this time, the cruise ATOS-1 was carried out, from 27 June to 28 July 2007, in the northern Greenland Sea and in the Arctic Ocean (78 – 80.5º N, 2.3º W – 16.5º E). Nineteen stations were visited, to explore the effect of the melting ice directly on microorganisms inhabiting the microlayer and how these changes in activity and bio-
mass could affect the underneath layers (0.01, 1, 5, and 10 - 20 m). We have measured abundances of bacteria, virus and protists as well as bacterial activity and mortality due to viruses. Our results show that bacterial activity was enhanced in the microlayer of stations containing icefloe. Finally, we discuss the consequences of these changes of bacterial activity in the microlayer on those produced through the water column, and their further implications on the carbon cycle in the Arctic Ocean.

**Vaquer-Sunyer, R.**, IMEDEA, Esporles, Spain, raquel.vaquer@uib.es  
Holding, J., IMEDEA, Esporles, Spain, johnnaholding@gmail.com  
Regaudie-de-Gioussé, A., IMEDEA, Esporles, Spain, aurore.regaudie@imedea.uib-csic.es  
Duartè, C. M., IMEDEA, Esporles, Spain, carlosduarte@imedea.uib-csic.es  
Reigstad, M., University of Tromsø, Tromsø, Norway, marit.reigstad@uit.no  
Wassmann, P., University of Tromsø, Tromsø, Norway, paul.wassmann@uit.no  

**SEASONAL PATTERNS IN ARCTIC PLANKTONIC METABOLISM (FRAM STRAIT - SVALBARD REGION) AND POSSIBLE CONSEQUENCES OF WARMING ON METABOLIC RATES**  
The metabolism of the Arctic Ocean is marked by extreme pronounced seasonality and spatial heterogeneity associated with light conditions, ice cover, water masses and nutrient availability. Here we report the metabolic rates (Net Community Production, Gross Primary Production and Community Respiration) along three different seasons of the year for a total of seven cruises along the western sector of the Arctic Ocean (Fram Strait - Svalbard region). The results show that metabolism of the western sector of the European Arctic varies throughout the year, depending mostly on the stage of bloom, which is mainly determined by availability of light and nutrient availability. Here we report metabolic rates for the different periods, including the spring bloom, summer, fall and the dark period, increasing considerably the empirical basis on metabolic rates in the Arctic Ocean, and especially in the European Arctic corridor. We also report a rough annual metabolic balance for this area of the Arctic Ocean, resulting in a Net Community Production of 130 g C m-2 year-1. The possible consequences of warming on metabolic rates are also evaluated.

**Vargas, C. A.**, Aquatic System Unit, Environmental Sciences Center EULA Chile,  
Universidad de Concepcion, Concepcion, Chile, cvargas@udec.cl  
Arriagada, N. L., Faculty of Sciences, Universidad Católica de la Santísima Concepción, Concepcion, Chile  
Cancino, S., Faculty of Sciences, Universidad Católica de la Santísima Concepción, Concepcion, Chile  
Cascales, E. K., Aquatic System Unit, Environmental Sciences Center EULA Chile,  
Universidad de Concepcion, Concepcion, Chile  
Contreras, P. Y., Aquatic System Unit, Environmental Sciences Center EULA Chile,  
Universidad de Concepcion, Concepcion, Chile  
Farias, A., Faculty of Sciences, Universidad Católica de la Santísima Concepción, Concepcion, Chile  
Manríquez, V., Aquatic System Unit, Environmental Sciences Center EULA Chile,  
Universidad de Concepcion, Concepcion, Chile  

*Placencia, J., Faculty of Sciences, Universidad Católica de la Santísima Concepción, Concepcion, Chile  
Urrutia, R., Aquatic System Unit, Environmental Sciences Center EULA Chile,  
Universidad de Concepción, Concepcion, Chile  
Sobrino, M., Department of Oceanography, Universidad de Concepción, Concepcion, Chile  

**INFLUENCES OF ALLOCHTHONOUS ORGANIC MATTER AND NUTRIENTS ON THE COASTAL OCEAN FOOD WEB AND BIOGEOCHEMISTRY IN A LAND-OCEAN CONTINUUM OFF CENTRAL CHILE**  
We evaluated the potential sources of riverine particulate organic matter (POM) across a land-ocean continuum in Central Chile by using stable isotope (d13C, d15N) and fatty-acids. d13C values of vegetation and anthropogenic sources along the river-basin ranged from -18 to -32‰, with higher differences in d15N values. Analysis of lignogenic (LSi) and biogenic (BSi) silicon showed that most particulate silicon exported corresponds to LSi fraction. At the river plume, cyanobacteria and cryptophytes were mainly associated with shallow brackish waters, where the highest values of CDOM and bacterial production were observed. Highest abundance of diatoms was concentrated downward to the fresh water plume with a maximum concentration associated to the river plume front. d13C and fatty acid data showed higher contribution of terrigenous sources to the POM pool in river plume waters. Preliminary results evidenced that terrestrial carbon may account for a significant percentage of the body carbon for zooplankton (1–63%). Despite we ignore the ter-
restrial carbon pathways to zooplankton as well as the allocation of both phytotplank-
ton- and terrestrial-derived carbon, these finding has significant implications for carbon flux models in productive coastal ecosystems. Funded by Fondecyt Project 10905009 to C.A. Vargas.

**Vecía, G. A.**, NOAA/GFDL, Princeton, USA, Gabriela.A.Vecchi@noaa.gov  
Zhao, M., NOAA/GFDL, Princeton, USA, ming.zhao@noaa.gov  
Held, I. M., NOAA/GFDL, Princeton, USA, IsaaC.Held@noaa.gov  
Villarin, G., Princeton University, Princeton, USA, gvilarr@princeton.edu  
Smith, J., Princeton University, Princeton, USA, jsmith@princeton.edu  
Knutson, T. R., NOAA/GFDL, Princeton, USA, Tom.Knutson@noaa.gov  

**PAST AND FUTURE CHANGES OF ATLANTIC HURRICAN ACTIVITY**  
We explore the issues of hurricane activity change attribution, prediction and projec-
tion using both comprehensive, high-resolution global dynamical models and simple statistical models. Dynamical predictions and projections of hurricane activity changes are found to be critically sensitive to details in the horizontal structure of SST changes and the vertical structure of atmospheric temperature changes - rather than the overall temperature change. The pattern of SST change provides a unifying statistical framework for seemingly divergent hurricane projections using dynamical models. The sensitivity of hurricane activity to details in the response of the climate system limit their predictability. Efforts are made to identify the most influential patterns of SST change, and connect these relevant patterns with forced and internal climate variations. Recent increase in Atlantic TS and hurricanes can be forced by some estimates of historical SST changes, yet hindcasts of hurricane counts using comprehensive dynamical models are limited by the observational uncertainty in SST - even over the satellite era (1982-2007). Thus, in order to make accurate decadal predictions of hurricane activity changes, we may need to predict decadal patterns of SST change better than we currently observe them.

**Vega, A. M.**, University of Puerto Rico, Río Piedras, Puerto Rico, pupacia@yahoo.com  
Strickland, B., Berry College, Georgia, USA, bradley.strickland@wiktins.erry.berry.edu  
Cotner, J. B., University of Minnesota, Minnesota, USA, cotne002@umn.edu  
Kellerman, A., Uppsala University, Uppsala, Sweden, kelle66@umu.se  

**EARTHWORM INVASION EFFECTS ON FOREST SOIL NUTRIENT AVAILABILITY**  
We evaluated the potential sources of riverine particulate organic matter (POM) across a land-ocean continuum in Central Chile by using stable isotope (d13C, d15N) and fatty-acids. d13C values of vegetation and anthropogenic sources along the river-basin ranged from -18 to -32‰, with higher differences in d15N values. Analysis of lignogenic (LSi) and biogenic (BSi) silicon showed that most particulate silicon exported corresponds to LSi fraction. At the river plume, cyanobacteria and cryptophytes were mainly associated with shallow brackish waters, where the highest values of CDOM and bacterial production were observed. Highest abundance of diatoms was concentrated downward to the fresh water plume with a maximum concentration associated to the river plume front. d13C and fatty acid data showed higher contribution of terrigenous sources to the POM pool in river plume waters. Preliminary results evidenced that terrestrial carbon may account for a significant percentage of the body carbon for zooplankton (1–63%). Despite we ignore the ter-
restrial carbon pathways to zooplankton as well as the allocation of both phytotplank-
ton- and terrestrial-derived carbon, these finding has significant implications for carbon flux models in productive coastal ecosystems. Funded by Fondecyt Project 10905009 to C.A. Vargas.
A collaborative effort between NASA, NOAA, and academia partners has been funded by NASA and NOAA to seek solutions to enhance the NOAA’s Coral Reef Watch (CRW) sea surface temperature data products. This project seeks to enhance the NOAA Coral Reef Watch’s Decision Support System by assessing the value of SST data from the MODIS and AVHRR satellites at 1 and 4 km spatial resolution; the current decision support system uses 50 km AVHRR products. The NOAA Coral Reef Watch’s Decision Support System by assessing the value of SST data from the MODIS and AVHRR satellites at 1 and 4 km spatial resolution; the current decision support system uses 50 km AVHRR products. The NOAA CRW program uses operational, near-real-time SST data to produce SST climatologies and various thermal stress indices as SST anomalies, HotSpots and Degree Heating Weeks (DHW), among other products. Similar thermal stress indices will be generated with high-resolution satellite imagery. These will help monitor and forecast coral reef bleaching events around the world. Test imagery will be developed for the Florida Keys and Caribbean regions for application and ground truthing in collaboration with regional coral reef researchers.

**Vega-Thurber, R. L.** Florida International University, Miami, USA, rvegathurber@gmail.com

**VIRUSES OF REEF-BUILDING SCLERACTINIAN CORALS**

Disease outbreaks threaten an increasing number of coral taxa and reefs globally and contribute to high regional losses of some shallow water reef-building corals. Although ~18 diseases or syndromes are described, their associated causative agent(s) and/or ecological drivers are debated. While most research effort explored bacteria as potential coral pathogens, there is growing interest in the viruses associated with corals and their role(s) in reef environments. Using viral metagenomics and microscopy, we investigated the viral consortia present in the tissues of *Porites*, *Montastraea*, and *Acropora* species of corals from the Hawaiian Archipelago, the Caribbean, and the Great Barrier Reef, respectively. We find significant evidence to support a hypothesis that viruses contribute to reduced coral fitness, including the induction of more than one disease. We also show that different members of these consortia infect different members of the holobiont including: herpesviruses that infect the coral tissue, phycodnaviruses that infect resident *Symbiodinium*, and phages that infect and potentially induce virulence in coral bacteria.

**Velázquez, A. L.** University of Puerto Rico at Cayey, Caguas, Puerto Rico, al.velazquez25@gmail.com

**CORRELATION BETWEEN BATRACHOCHYTRIUM DENDROBATIDIS AND PARASITE ABUNDANCE IN LUNGS OF LEOPARD FROGS (RANA PIPIENS).**

Massive amphibian population decline has concerned the scientific community over the past two decades. Several factors have been attributed to this decline, including the introduction of pathogens into ecosystems. These population declines can cause various ecological effects since amphibians play an important role in the ecosystem as biological engineers and indicators of environmental stress. Batrachochytrium dendrobatidis (Bd) is a pathogenic aquatic fungus that has been associated with the decline of many amphibian species. We looked for a correlation between the presence of Bd and the abundance of *Rhabdias* spp, which are parasites that enter through the amphibian’s skin and inhabit in the host’s lungs. Other studies have shown that *Rhabdias* ranae is specific to leopard frogs (Rana pipiens), as other species of *Rhabdias* are specific to other frog species. Using *R. pipiens* as our target species, we evaluate whether frogs with *Bd* have more, less or the same kind and number of parasites as frogs that are not infected with *Bd*. We collected frogs at four different sites in Itacaca State Park, Minnesota. Lungs were examined for parasite abundance. We extracted DNA from each toe sample and used Polymerase Chain Reaction (PCR) to replicate *B. dendrobatidis* DNA using its specific primers (Bd1a and Bd2a). There was no presence of *Rhabdias* in leopard frog lungs. This suggests that *Rhabdias* ranae is not present in Itacaca State Park area.

**Velez, F. J.** University of Puerto Rico, Mayagüez Campus, Mayagüez, Puerto Rico, francisco.velez1@upr.edu

**Scott, K. R.** University of Puerto Rico, Mayagüez Campus, Mayagüez, Puerto Rico, kristina.scott@upr.edu

**Canals, M. F.** University of Puerto Rico, Mayagüez Campus, Mayagüez, Puerto Rico, miguel.canals@upr.edu

**NEARSHORE HYDRODYNAMICS OF RINCÓN, PUERTO RICO: IMPLICATIONS FOR SEDIMENT TRANSPORT AND COASTAL EROSION**

Coastal areas of Rincón, PR have suffered from severe erosion problems around the past years. Previous studies by Thieler et al. (2007) show the drastic changes in Rincón’s shoreline. The shoreline has been retreating about 1 m/yr (Thieler, 2007). The response of property owners to shoreline erosion has been to construct large seawalls to protect adjacent property which has led to the disappearance of many beaches. The purpose of this study is to carry out numerical simulations and field observations of the nearshore hydrodynamics which have led to the erosion and sedimentation problems in Rincón. The numerical model used for the study is BOUSS2D, which is a fully nonlinear, phase-resolving Boussinesq wave model. The model is able to reproduce nonlinear wave transformation in the surfzone as well as unsteady wave-induced currents. The model will be validated with the use of surf zone drifters. Those drifters will track the direction of the wave induced currents that affects the area, making use of the global position system (GPS). At the end of the study we will have a validated model which will provide us with important data to try to understand and find a solution to the erosion and sedimentation problem in Rincón.

**Velez-Zuazo, X.** University of Puerto Rico, San Juan, Puerto Rico, xvelezzuazo@gmail.com

**Navarro, M.** University of Puerto Rico, San Juan, Puerto Rico, lemonycheesecake@yahoo.com

**Mege, P. C.** University of Puerto Rico, San Juan, Puerto Rico, pascal.mege@gmail.com

**Ruiz, C. P.** University of Puerto Rico, San Juan, Puerto Rico, claudiapatriciaruiz@gmail.com

**Patricio, A. R.** University of Puerto Rico, San Juan, Puerto Rico, anaritapatricio@hotmail.com

**Toledo-Hernandez, C.** University of Puerto Rico, San Juan, Puerto Rico, c_toledo_hernandez@yahoo.com

**MTDNA ANALYSIS OF EXOTIC LIONFISH IN PUERTO RICO SUPPORT ORIGIN FROM US EAST COAST INVASION**

In Puerto Rico, the invasive lionfish (*Pterois spp.*) was first reported off Vieques Island in 2008. However, beyond the growing number of sighting reports, no comprehensive work assessing their origin or ecological impact has been conducted. In this preliminary study, we addressed two fundamental questions: (1) How many species are presently invading the marine habitats of Puerto Rico? (2) What is the origin of these individuals? Using two molecular markers from the mtDNA (COI and D-loop), we analyzed 21 lionfish samples from the north coast of Puerto Rico. Analysis of COI fragments identified all individuals as *P. volitans*, contrasting with previous studies where *P. miles* was also identified. More samples from around the island are being analyzed in an effort to identify additional species. Low diversity characterized our sample and only two mtDNA D-loop haplotypes were observed, both previously reported as the most common haplotypes on the east coast of the United States. Therefore the lionfish population in Puerto Rico seems to have its origin in the invasive population from the east coast of the United States.

**Velghe, K.** McGill University, Montreal, Canada, katherine.velghe@mail.mcgill.ca

**Vermaire, J.** McGill University, Montreal, Canada, jesse.vermaire@mail.mcgill.ca

**Gregory-Eaves, I.** McGill University, Montreal, Canada, irene.gregory-eaves@mcgill.ca

**PHOSPHORUS AND FISH PREDATION AS DRIVERS OF DIATOM AND CLADOCERAN DIVERSITY ACROSS LAKES AND OVER TIME**

Aquatic ecosystems are among the most vulnerable to biodiversity declines. Eutrophication has been identified as a primary cause for the decrease in aquatic biodiversity, but it is not yet clear how increases in nutrients interact with drivers.
February. This approach may be applicable to other reef ecosystems, thus providing
platform edge to 7.8 (± 0.6) days in the lagoon. Seasonal differences in calcification
to a spatially integrated multi-tracer model to estimate net community calcification
tracers, in conjunction with observations of seawater total alkalinity, were applied
to estimate reef water residence times for the Bermuda coral reef platform. These
el approach based on distributions of beryllium-7 (7Be) and thorium-234 (234Th)
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A MULTI TRACER MODEL APPROACH TO ESTIMATE REEF WATER RESI-
Venti, A. M., University of Miami/ Rosenstiel School of Marine and Atmospheric
Sciences, Miami, USA, avent@rsmas.miami.edu
Kadko, D. C., University of Miami/ Rosenstiel School of Marine and Atmospheric
Sciences, Miami, USA, dkadko@rsmas.miami.edu
Andersson, A. J., Bermuda Institute of Ocean Sciences, St. Georges, Bermuda,
andreas.andersson@biso.edu
Langdon, C., University of Miami/ Rosenstiel School of Marine and Atmospheric
Sciences, Miami, USA, clangdon@rsmas.miami.edu
Bates, N. R., Bermuda Institute of Ocean Sciences, St. Georges, Bermuda, nick.
bates@bios.io
A MULTI TRACER MODEL APPROACH TO ESTIMATE REEF WATER RESI-
DENCE TIMES
To understand the response of coral reef ecosystems to ongoing ocean acidification
there is a need to quantify net community calcification rates. Here we present a nov-
el approach based on distributions of beryllium-7 (7Be) and thorium-234 (234Th)
to estimate reef water residence times for the Bermuda coral reef platform. These
tracers, in conjunction with observations of seawater total alkalinity, were applied to
a spatially integrated multi-tracer model to estimate net community calcification
rates. Model results yielded residence times ranging from 0.4 (± 0.1) days at the
platform edge to 7.8 (± 0.6) days in the lagoon. Seasonal differences in calcification
were observed as platform average net community calcification ranged from 22.5
(± 0.3) mmolCaCO3 m-2 d-1 in November to 4.6 (± 0.1) mmolCaCO3 m-2 d-1 in
February. This approach may be applicable to other reef ecosystems, thus providing
an opportunity to estimate net community calcification rates and how these rates
may change in the context of ocean acidification.

Victoria, I. Aanderaa Data Instruments, Inc., Atleboro, USA, ivan.victoria@aadi.no
Hovdnes, J. Aanderaa Data Instruments A.S., Bergen, Norway, jostein.hovdnes@aad.no
Tengberg, A., Aanderaa Data Instruments, A.S., Bergen, Norway, anderste@chem.
gu.se
Heltne, J., Aanderaa Data Instruments, A.S., Bergen, Norway
Apostolidis, A., PreSens - Precision Sensing GmbH, Regensburg, Germany
Kononets, M., Department of Chemistry, University of Gothenburg, Gothenburg,
Sweden
Hall, P., Department of Chemistry, University of Gothenburg, Gothenburg, Sweden
OPTODES FOR AQUATIC CO2 AND O2 MEASUREMENTS: EXPERIENCES
AND NEW DEVELOPMENTS
Commercially available oxygen optodes for oceanographic application were intro-
duced in 2002. The long-term stability (years) and reliability of these sensors have
enhanced the possibility to monitor oxygen. One part of this poster aims to dem-
strate possibilities and limitations of this technology by summarizing a wide range
of published field data. Recently compact CO2 optodes based on similar principles
have been developed and submitted to a first series of field tests. Results from these
tests will be presented and the challenges of measuring pCO2 in different aquatic
applications will be briefly described.

Vidyarathna, N. V., Linnaeus University, Kalmar, Sweden, nayan_vidyarathna@lutu.se
Granèli, E., Linnaeus University, Kalmar, Sweden, edna.graneli@lutu.se
CLIMATE CHANGE AND BLOOMS OF THE TOXIC BENTHIC DINOFLAG-
ELLATE OSTEROPIS OVATA WORLDWIDE: COMPARATIVE STUDIES ON
DIFFERENT STRAINS
Blooms of the benthic palytoxin-producing dinoflagellate Osteropis ovata are
being recorded in tropical and sub-tropical marine waters on the last 12 years. We
hypothesize that temperature increase due to climate changes is involved in the
occurrence of these blooms. A Japanese (J) and a Mediterranean (M) O. ovata strain
were exposed to temperatures between 24 – 30 °C, and their growth and toxicity
were estimated. Growth rates of strain-M were positively correlated with increasing
temperatures showing the maximum at 30 °C while strain-J had its maximum at 26
°C. On the other hand, lower temperatures (24- 25 °C) induced higher cell toxicities
in both strains. Increases in temperature significantly reduced the cell toxicities in
strain-M but not in strain-J. At 24 °C cells of strain-M were 4.4 times more toxic
than strain-J while at 30 °C the opposite was found: strain-J was 10 times more toxic
than strain-M. The present study clearly demonstrates that the effect of temperature
on the growth and toxicity of O. ovata is strain specific, but also that climate changes
seems involved in blooms of this species.

Villa, M., Universidad de Sevilla, Sevilla, Spain, mvilla@us.es
Le Moigne, F. A., National Oceanography Centre, Southampton, United Kingdom,
FLeMoigne@moc.soton.ac.uk
Sanders, R. J., National Oceanography Centre, Southampton, United Kingdom,
ric@moc.soton.ac.uk
Garcia-Tenorio, R., Universidad de Sevilla, Sevilla, Spain, gtenorio@us.es
Masque, P., Universidad Autonoma de Barcelona, Barcelona, Spain, pere.masque@uab.cat
JOINT MEASUREMENTS OF
234Th - 210Po DERIVED POC AND BIOMINERAL EXPORT AT THE PORCU-
PINE ABYSSAL PLAIN
234Th/Po210 and 210Po/238U disequilibria are commonly used to estimate POC export
but more rarely the export of PIC and BSI. 234Th is only adsorbed on particle sur-
faces, whereas 210Po is also bioaccumulated, being incorporated into the cytoplasm
of some species of phytoplankton and bacteria. Thereby, 210Po/238U better estimates
POC fluxes whereas 234Th/210Po provides particle scavenging information. Since they
also cover different timescales ranging from several weeks (234Th, T1/2=24.1d) to
several months or a year (210Po, T1/2=138.4d), their combined use provides comple-
mentary results and broadens the amount of information that can be obtained using
just one radioactive pair. We present a dataset of POC, PIC and BSI fluxes from the
Porcupine Abyssal Plain (49°N, 16°E) over the summer of 2009. Ten stations
were sampled once to obtain high resolution profiles (10-12 depths, 5-400m) and
to explore the twilight zone (up to 1000m for 210Po) and ten stations (3-5 depths, 25-
150m) were occupied in a survey over 48h around the PAP site. POC, PIC and BSI
export were calculated at two integration depths (50m and 150m) and on two size
fractions (>53µm and <1µm). Particles were collected using SAPS.
CARBENCILLIN RESISTANCE GENES FROM METAGENOMIC LIBRARIES DERIVED FROM HYPSALINE MICROBIAL MATS AT THE CABO ROJO SALTERNs

The hypersaline microbial mats from the Cabo Rojo salterns are a vast reservoir for unidentified microorganisms (i.e., Bacteria and Archaea). These ecosystems are often viewed as extreme due to fluctuating salinity, oxygen, sulfide and solar radiation. Consequently, these mats are excellent model systems for the construction of metagenomic libraries and to search for novel metabolic pathways including antibiotic-resistance mechanisms. Genomic DNA was extracted using an indirect method and a fosmid library of approximately 33,000 clones (carrying inserts of more than 25Kbp) was generated. The library was initially screened for resistance genes using Carbenicillin (100µg) and Gentamycin (10µg) plates and seven clones exhibited resistance against these two antibiotics. These clones were further tested and reconfirmed for antibiotic resistance using a Kirby and Bauer susceptibility assay. Only two of the clones showed resistance to Carbenicillin. Further Minimum Inhibitory Concentration (MIC) assays against these two clones have shown resistance to 60,000 µg/ml of Carbenicillin. Using a transposon-mediated vector we have sequenced the genes responsible for Carbenicillin resistance. The first sequence indicated a 95% similarity to a beta-lactamase inhibitor protein from Bacillus sp. Sequencing efforts are underway in the second clone to determine if hypersaline environments may host a plethora of novel and useful undiscovered metabolic pathways and biomolecules.

Visscher, P. T., UConn Marine Sciences, Groton, USA, pieter.visscher@uconn.edu
Dupraz, C., UConn Marine Sciences, Groton, USA, christophe.dupraz@uconn.edu
Casillas-Martinez, L., UPR Humacao, Humacao, USA, lcasillasm@gmail.com
Rios-Velazquez, C., UPR Mayaguez, Mayaguez, USA, crisolab@gmail.com
Marvasi, M., Pontificia Universidad Catolica de Puerto Rico, Ponce, USA, massimiliano.marvasi@gmail.com
Gallagher, K. L., UConn Marine Sciences, Groton, USA, kimberley.gallagher@uconn.edu
Stork, N., UConn Integrative Geosciences, Storrs, USA, natalie.stork@uconn.edu
Fowler, A., UConn Integrative Geosciences, Storrs, USA, alexandre.fowler@uconn.edu
Braissant, O., University of Basel, Basel, Switzerland, olivier.braissant@gmail.com
Glunk, C., University of Lausanne, Lausanne, Switzerland, christina.glunk@netplus.ch

HYPERSALINE ENVIRONMENTS ON EARTH AND BEYOND: NORMAL OR NOT?

Hypersaline environments are commonly found in all geographic regions of the world, spanning a large size range and include ponds, lakes and lagoons. Biogeochemical characteristics of hypersaline environments are the combined result of the geochemical conditions and the microbial processes that influence these. Hypersaline microbial community comprises a number of halophilic “extremophiles” with representation from Bacteria and Archaea. Eukaryotic contributions are typically limited to diatoms and hypersaline microphytes. One example ecosystem that is often found in hypersaline environments is microbial mats. These laminated organosedimentary systems are arguably the oldest ecosystems on Earth. In the absence of eukaryotes, these mats thrive in salinities up to 350 PSU. The high salinity reduces the concentration of oxygen and as a result microbial respiration is dictated by sulfate reduction and methanogenesis, with the latter dominating at the highest salinities. The “extreme” physicochemical conditions and “unusual” biochemistry make hypersaline mats the quintessential systems to study with respect to novel metabolic pathways and products (e.g. antibiotic resistance) The biosignatures that these mats produce include a variety of organominerals and biogenic gases, which are key in astrobiological investigations.

Vivas-Aguas, L. J., Instituto de Investigaciones Marinas y Costeras “José Benito Vives de Andrés” (INVENMAR), Santa Marta, Colombia, jbenito@invemar.org.co
Carvajalino-Fernández, M. A., Universidad del Magdalena, Santa Marta, Colombia, maancafe240@gmail.com
Tosic, M., Instituto de Investigaciones Marinas y Costeras “José Benito Vives de Andrés” (INVENMAR), Santa Marta, Colombia, marko_tosic@invemar.org.co

IMPACTS OF LAND-BASED SOURCES OF POLLUTION ON THE MARINE AND COASTAL WATERS OF COLOMBIA

This paper presents results from the REDCAM Project which has been monitoring 25 water quality parameters (physico-chemical, microbiological, hydrocarbons, pesticides and heavy metals) at more than 300 stations along the Caribbean and Pacific coasts of Colombia over the past 10 years. In this study, we identify the principal sources of land-based pollution impacting the coastal waters of Colombia in order to contribute to the overall national diagnostic of coastal water quality and related pollution control efforts. This analysis incorporates the use of land use coverage data in coastal watersheds and was supported by coastal water quality data. Pollutant loads from 22 rivers draining to the Colombian coasts were calculated. Estimations were also made of inputs of wastewater from 47 coastal municipalities and the biological oxygen demand caused by their decomposition. Results show that the Rivers Magdalena, Atrato, and Sinú in the Caribbean and the Rivers San Juan, Mira and Patía in the Pacific pose the greatest risk to Colombia’s coastal water quality due to their discharges of runoff and loads of inorganic nitrogen, phosphorus, and suspended solids, among other contaminants.

Vlahos, P., University of Connecticut, Groton, CT, USA, penny.vlahos@uconn.edu
Eglinton, T., Swiss Federal Institute of Technology, ETH, Zurich, Switzerland, teglinton@whoi.edu
Monthuco, D., Woods Hole Oceanographic Institute, Woods Hole, MA, USA
Fast, K., University of Connecticut, Groton, CT, USA
DISSOLVED ORGANIC CARBON ALONG THE FRONTAL ZONE OF THE NW ATLANTIC

Continental margins are important transition zones that link coastal and open oceans. The most dynamic component of this linkage is along frontal boundaries. Though the frontal zone is a critical point of exchange there remain limited observations, particularly with high depth resolution, of the reduced carbon pool. The 2010 NW Atlantic Cruise conducted high resolution sampling at over 40 stations spanning 34N, 75W to 43N, 58W with emphasis on the frontal boundaries. Dissolved organic carbon concentrations and distributions are presented. With over 800 samples of coupled dissolved organic carbon, inorganic carbon and radiocarbon measurements this sampling effort will provide critical insight to these important regions that may help broadly characterize frontal exchange dynamics in this and other regions.

Voelker, B. M., Colorado School of Mines, Golden, USA, voelker@mines.edu
Hansard, S. P., Florida Geological Survey, Tallahassee, USA, paul.hansard@dep.state.fl.us
Hansel, C. M., Harvard University, Cambridge, USA, hansel@seas.harvard.edu
Learman, D. R., Harvard University, Cambridge, USA, learman@seas.harvard.edu
OXIDATION OF Mn(II) BY SUPEROXIDE

Two lines of evidence indicate that superoxide radical (O2-·) could play an important role in the oxidation of manganese(II) in marine waters. First, oxidation of Mn(II) by cells and culture extracts of the common marine bacterium *Roseobacter* sp. Azwk-3b was inhibited by superoxide dismutase in a concentration-dependent manner. Second, the reaction of nanomolar Mn(II) with subnanomolar superoxide has an effective second-order rate constant of ~10^7 M^-1 s^-1 in seawater at 22°C. Combined with recently measured superoxide concentrations on the order of 10^9 M in surface seawater, this rate constant implies that reaction with superoxide could be a surprisingly rapid pathway of Mn(II) oxidation, with a Mn(II) half-life of less than an hour. While oxidation of Mn(II) by superoxide seems an inefficient pathway at best for oxidative precipitation of manganese, these results suggest that dissolved Mn(III) is readily formed in marine surface waters, and that its subsequent reactions bear further examination.

Voigt, R. J., University of Regina, Regina, Canada, richvogt@gmail.com
Leavitt, P. R., University of Regina, Regina, Canada, Peter.Leavitt@uregina.ca
LIMITED ECOSYSTEM RESPONSE TO A WHOLE LAKE DEEPENING: AN EXPERIMENTAL TEST OF ALTERNATIVE STABLE STATE THEORY

Previous work has demonstrated that over a wide range of nutrient concentrations shallow lakes can exhibit two alternative equilibria: a clear-water state dominated by submerged aquatic vegetation and a turbid state dominated by algae. Macrophytes help to preserve a clear-water state by sequestering nutrients, providing a refuge for herbivorous zooplankton from predators, reducing sediment re-suspension, and impeding nutrient influx from internal sources. Consequently, elimination of macrophytes should increase algal biomass and water turbidity. We evaluated this hypothesis using an 818M whole-lake experiment in which macrophyte-rich, clear-water urban Two Creeks Lake, Regina, Canada, was deepened from ~1.5 m to ~6 m, during a single winter and macrophyte habitat and populations were largely eliminated. Contrary to theoretical expectations, no significant change was observed for algal abundance (as Chlorophyll a), despite a modest increase in zooplankton
abundance and no net reduction in the availability of limiting nutrients. These findings suggest that experimental deepening can improve water quality for recreational use (e.g., boating) by eliminating macrophytes without initiating a regime shift to a turbid state with noxious algal blooms.

Volkamer, R., University of Colorado, Boulder, USA, rainer.volkamer@colorado.edu
Coburn, S., University of Colorado, Boulder, USA, sean.coburn@colorado.edu
Dix, B., University of Colorado, Boulder, USA, barbara.dx@colorado.edu
Sinreich, R., University of Colorado, Boulder, USA, roman.sinreich@colorado.edu

**A HETEROGENEOUS OPEN OCEAN SOURCE FOR IODINE OXIDE AND GLYOXAL**

The climate relevance of biologically active ocean upwelling regions has primarily been studied in terms of the air-sea partitioning of long-lived greenhouse gases (e.g., CO2, CH4, N2O etc), and the release of the reactive gas DMS, which can form aerosols as a result of atmospheric transformations. Considerably less attention has been paid to open ocean sources of other reactive gases that, like DMS, can form aerosols. Such molecules are glyoxal (CHOCHO) and IO. Glyoxal is an indicator for oxidative hydrocarbon chemistry, and a building block for secondary organic aerosol (SOA). SOA modifies the hygroscopic properties of organic aerosols, and potentially also adds to the growth of small particles to sizes that can more easily activate to form cloud droplets. Iodine oxide (IO) can nucleate new particles, and/or adds to the growth of pre-existing particles. Due to the very high solubility of the glyoxal molecule, concentrations in excess of 100ppt over the open ocean like we found over the Pacific Ocean require an airborne source mechanism (Sinreich et al., 2010). We have investigated the source mechanism further during a ship campaign in 2009, as well as a first research flight abord the NSF/NCAR GV research aircraft (HIAPER). Both campaigns give clues about the sources of both gases over the remote tropical Pacific Ocean, and reveal a surprising impact on the composition of the free troposphere.

Volkern, N., University of South Carolina, Columbia, USA, nils@biol.sc.edu
Polerecky, L., Max Planck Institute for Marine Microbiology, Bremen, Germany, lpolereck@mpim-bremen.de
Matsui, G. Y., University of South Carolina, Columbia, USA, matsui@biol.sc.edu
Wetley, D. S., University of South Carolina, Columbia, USA, wetley@biol.sc.edu
Lovell, C. R., University of South Carolina, Columbia, USA, lovell@biol.sc.edu
Woodin, S. A., University of South Carolina, Columbia, USA, wooding@biol.sc.edu

**DEEP-BURROWING ORGANISMS CAUSE DYNAMIC SPATIO-TEMPORAL PATTERNS OF FLUXES THROUGH THE SEDIMENT-WATER INTERFACE**

Though it is widely accepted that bioirrigation increases benthic-pelagic fluxes, the spatio-temporal patterns of vertical water flow through the sediment-water interface are poorly understood. The combined deployment of porewater pressure sensors and planar oxygen optodes in the presence of hydraulically active organisms (crustaceans, polychaetes, and bivalves) has revealed that most of the time (> 40%) these animals pressure the sediment, causing porewater flow out of the sediment and eventually rising the oxic-anoxic boundary several mm above the sediment surface. However, all of the so far investigated species also engage in hydraulic behaviors associated with transient (seconds to minutes) periods of under-pressurization causing a draw-down of overlying water into surface sediments. Thus, bioirrigation caused at depth induces frequent oscillations between oxic and anoxic conditions in the surficial sediment layer and above. Localized enhanced flow through hydraulically induced sedimentary crusts further increases the spatio-temporal complexity of vertical fluxes. The remarkable dynamic nature of water flow through the sediment-water interface has potentially important implications for a variety of biogeochemical and ecological processes, including organic mineralization, benthic fluxes, recruitment and productivity.

von Einem, J., Lund University, Lund, Sweden, jessica.von.einem@liumn.lux.se
Grandel, W., Lund University, Lund, Sweden, wilhelm.grandel@liumn.lux.se

**EFFECTS OF FETCH AND DOC ON LIGHT CLIMATE IN SMALL FOREST LAKES - IMPLICATIONS FOR LAKE CARBON BALANCE**

We sampled small forest lakes in southern Sweden to investigate how DOC concentration and lake size influence light conditions in the epilimnion, which regulates lake ecosystem production and thus the balance between production and respiration. Epilimnion depth increased with increasing fetch, but did not decrease with increasing DOC concentration. This suggests that wind induced epilimnion-deepening overrides the tendency for epilimnion depth to decrease with increasing DOC concentration. Extinction of photosynthetically active radiation was mainly caused by DOC, which led to low mean epilimnion irradiance in large lakes with deep epilimnion and high DOC. Field incubation experiments with defined light and nutrient availability confirmed that light limitation is an important factor regulating phytoplankton biomass at light intensities similar to typical mean epilimnion irradiance in brown-water lakes. Browning of lakes in southern Sweden, and a predicted increase in the number of storm events, may lead to more severe light limitation of phytoplankton. In combination with a predicted decrease in benthic primary production with increasing DOC, lake ecosystems will become more heterotrophic and CO2-evasion to the atmosphere will increase.

Von Elert, E., University of Cologne, Köln, Germany, evon.elert@uni-koeln.de
Schwarzenberger, A., University of Cologne, Köln, Germany, schwar@uni-koeln.de

**PROTEASE INHIBITORS IN CYANOBACTERIA: IDENTIFYING THEIR TARGETS IN DAPHNIA**

Protease inhibitors are frequently encountered in natural blooms of freshwater cyanobacteria. Here we investigate if these inhibitors specifically interact with digestive proteases of Daphnia. Using a strain of *Microcystis aeruginosa* that synthesizes chymotrypsin (CT) inhibitors we demonstrate that these inhibitors specifically inhibit digestive CTs in *Daphnia magna*. Upon exposure to dietary CT-inhibitors the CT-pattern in *Daphnia* changes, which results in a higher tolerance to CT-inhibitors. The concentration of CT-inhibitors in cyanobacteria is several magnitudes higher than IC50-values for *Daphnia* CTs, which makes it reasonable to assume that inhibition of digestive proteases in *Daphnia* by cyanobacterial inhibitors is a mechanism of chemical defense in freshwater cyanobacteria.

Voss/Maren, M., Leibniz Institute for Baltic Sea Research, Rostock, Germany, maren.voss@io-warnemuende.de

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**GLYOXAL**

Sinreich, R., University of Colorado, Boulder, USA, rainer.sinreich@colorado.edu
Coburn, S., University of Colorado, Boulder, USA, sean.coburn@colorado.edu
Dix, B., University of Colorado, Boulder, USA, barbara.dx@colorado.edu

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**IN THE BALTIC SEA**

Korth/Frederike, F., Leibniz Institute for Baltic Sea Research, Rostock, Germany, frederike.korth@io-warnemuende.de

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**WIDE-SPREAD OCCURRENCE OF SIDEROPHORE-PRODUCING BACTERIA**

Iron is a fundamental trace element for microbial survival. The low solubility of iron(III) in aerobic, neutral pH, aqueous environments limits the availability of this critical micronutrient in the ocean. Microorganisms have evolved various pathways designed to acquire iron from their iron-depleted surroundings. One key strategy is the production and secretion of siderophores, low molecular weight high-affinity iron-binding molecules, whose biosynthesis is stimulated by low iron concentra-
tions. We report the isolation of a growing number of siderophore-producing bacteria from the marine environment. Siderophore-producing bacteria have been isolated from open ocean water over the continental slope off the West Coast of Africa, northeast of the Hawaiian Islands, the Gulf of Mexico after the Deepwater Horizon oil spill, as well as from the Santa Barbara basin. We present here the structural characterization of the siderophores produced by these bacterial isolates, as well as phylogenetic analyses. The structural similarities of marine siderophores in comparison with their abundant terrestrial counterparts will be highlighted.

**Wagner, C.** Leibniz-Institute for Baltic Sea Research Warnemünde, Rostock, Germany, carola.wagner@io-warnemuende.de

**Adrian, R.** Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, Adrian@igb-berlin.de

**CONSEQUENCES OF CHANGES IN THERMAL REGIME FOR PLANKTON DIVERSITY AND FUNCTIONALITY IN A POLYCYCLIC LAKE: A MATTER OF TEMPORAL SCALE**

Changes in plankton species diversity as a result of global warming are of growing concern, as these properties contribute to ecosystem functioning. We analyzed the effect of short term temperature rises and changes in the thermal regime on plankton diversity, community structure and functionality of polymeric Mūggelsee in Germany, from decadal records. Stratification events occurred significantly when the lake was stratified, consistently higher surface water temperatures and lower epilimnetic nutrient concentrations were found. As the length of thermal stratification increased phytoplankton shifted towards buoyant cyanobacteria species capable of N-fixation. Diatoms were placed at a disadvantage due e.g. to upper tolerance temperature limits being surpassed. Zooplankton species, with higher thermal and/or higher temperature specific growth rates (rotifers), gained advantage. While noticeable changes in functionality (i.e. a shift towards N-fixing cyanobacteria, rotifers and copepods becoming the main predators) were observed, there were minimal changes in diversity, except for an increase in cyclopoid copepod diversity. Because enhanced thermally stable conditions reduce short term fluctuations in water temperature and nutrient concentrations, the net effect for plankton diversity may be neutral due to species replacements.

**Wagner, C.** Leibniz Institute for Baltic Sea Research, Rostock, Germany, carola.wagner@io-warnemuende.de

**Boersma, M.** Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven, Germany, Maarten.Boersma@awi.de

**Edward, M., SAHFOS, Plymouth, United Kingdom, mae@sahfos.ac.uk**

**Pohlmann, T., University of Hamburg, Hamburg, Germany, pohlmann@ifs.m.uni-hamburg.de**

**Peck, M. A., University of Hamburg, Hamburg, Germany, myron.peck@uni-hamburg.de**

**LINKING FIELD, LABORATORY AND MODELING STUDIES TO EXPLAIN THERMAL HABITATS AND CLIMATE-DRIVEN CHANGES IN KEY NORTH SEA COPEPOD SPECIES**

Climate variability and change are considered to be major drivers behind observed changes in the spatial distribution of zooplankton in marine ecosystems worldwide. Within European systems, the principle mechanisms appear to be poleward shifts in temperature isoregions. In the North Sea, changes in both species composition and distribution of zooplankton coincide with increases in SST observed in the last three decades. In this study, field time series, laboratory experiments and modelling simulation data were combined to gain a more complete picture of changes in the North Sea zooplankton community from an ecophysiological perspective. Key copepods within the Acartia, Temora, Pseudocalanus, Oithona and Centropages and other genera were examined based upon 1) Helgoland Roads (HR) and the Continuous Plankton Recorder (CPR) time series data, 2) a literature review of thermal effects on vital rates, and 3) spatial and temporal changes in abiotic conditions in the upper 10 m of the water column predicted by a hydrodynamic model (HAMSOM). The investigation coupled HR, CPR and HAMSOM data sets with emphasis on inter- and intra-annual (phenological) changes occurring between 1970 to 2005.

**Warszki, B.** University of Oklahoma, Norman, USA, bwawrik@ou.edu

**Boling, W. B., University of Oklahoma, Norman, USA, Wilford.B.Boling-1@ou.edu**

**ASSIMILATORY NITRATE UTILIZATION BY BACTERIA ON THE WEST FLORIDA SHELF AS DETERMINED BY STABLE ISOTOPE PROBING AND FUNCTIONAL MICROARRAY ANALYSIS**

Dissolved inorganic nitrogen (DIN) uptake by marine heterotrophic bacteria has important implications for the global nitrogen (N) and carbon (C) cycles. It is typi-
LAND USE AFFECTS IN-STREAM TEMPERATURE AND THERMAL LOAD-
FROM COASTAL STREAMS
Temperature is a critical parameter in aquatic ecosystems because it controls rates of many important processes and transformations. Estuarine temperature is a topic of interest because of rising global temperatures and the ecological importance of these systems. Temperature and flow measurements were taken every 30 minutes over a 1-year period in ten coastal subwatersheds that lead directly into the New River Estuary in Camp Lejeune, NC. Our study streams had differences in land cover which were characterized using measures of forested area and developed land. We hypothesized that these two characteristics would affect stream temperature and thermal loading. Steam temperatures were generally higher at sites with higher development and lower forest cover. Correlation analysis revealed decreased forest cover was associated with increased thermal loading during base flow conditions, while increased developed land was associated with increased thermal loading during storm events. Increased in-stream temperatures and excess thermal loading can affect estuarine ecosystem function. These impacts must be considered in decisions regarding coastal development.

Walther, B., University of Hamburg, Hamburg, Germany, bettina.walter@uni-
hamburg.de

Peters, J., University of Hamburg, Hamburg, Germany, janna.peters@uni-hamburg.de

van Beusekom, J. E., Alfred Wegener Institute for Polar and Marine Research, Sylt, Germany, Justus.van.Beusekom@awi.de

St. John, M., University of Hamburg, Hamburg, michael.st.john@uni-hamburg.de

COMBINED EFFECT OF TEMPERATURE AND DEEP CONVECTION ON THE DYNAMICS OF SPRING BLOOM PHYTOPLANKTON IN THE NORTH ATLANTIC
Low temperatures and photoperiods during winter provide short ephemeral windows of light sufficient for primary production and growth of phytoplankton during periods of deep convection in the North Atlantic. Winter survival and the relationship between stratification and species-specific critical depths largely determines the onset, intensity and composition of the spring bloom. In laboratory experiments we simulated the effects of deep convection by applying different light regimes experienced by cells derived using a 1-D convective individual-based model. The critical depth of different phytoplankton species (focus on diatoms) was determined by applying these light regimes and by measuring growth rates and mortality. Constant in situ oxygen measurements and biochemical analyses of pigment and carbohydrate content are used to explain adaptation strategies to low light situation in terms of duration and long dark periods under different temperatures. Investigations on temperature effects and the interaction between light and temperature will help to resolve the key factors influencing phytoplankton survival during winter convection in the North Atlantic as well as allow us to understand the evolution of these systems in light of changing climate.

Walterm, T. L, Skidaway Institute of Oceanography, Savannah, USA, tina.walters@skio.usg.edu

Pavel, C. A., Skidaway Institute of Oceanography, Savannah, USA, christy.pavel@skio.usg.edu

Frazier, L. M., Skidaway Institute of Oceanography, Savannah, USA, lagina.frazier@skio.usg.edu

Thompson, M. E., Skidaway Institute of Oceanography, Savannah, USA, megan.thompson@skio.usg.edu

Paffenhöfer, G. A., Skidaway Institute of Oceanography, Savannah, USA, gustav.paffenhoefer@skio.usg.edu

Frischer, M. E., Skidaway Institute of Oceanography, Savannah, USA, marc.frischer@skio.usg.edu

MOLECULAR GUT CONTENT PROFILING OF DOLIOLETTA GEGENBAURI IN SOUTHEASTERN SUBTROPICAL CONTINENTAL SHELF INTRUSION WATERS: WHAT ARE THEY EATING?
The ability to investigate trophic interactions for zooplankton species is vital for understanding processes that structure marine ecosystems. Since it is difficult to assess gut content, little is known about the in situ diets of most zooplankton species. This is particularly true for the gelatinous pelagic tunicate Doliolleta gegenbauri which forms large swarms in subtropical shelf environments. We have hypothesized that while large D. gegenbauri gonozooids likely derive a fraction of their nutrition from large diatom species typical of intrusion waters, smaller animals do not. To address this hypothesis...
we presented intrusion water collected from the mid-shelf of the South Atlantic Basin, to large and small-sized D. gegenbauri gonozooids (1-7 mm in length) and identified their diet in situ using a molecular PNA-PCR-based gut content assay. Although large diatom species including Rhizosolenia spp., Nitzschia spp., Pseudo-Nitzschia spp., and Skeletonema spp. dominated the phytoplankton biomass, they were not well repre-sented in the dinoflagellate gut. Rather, smaller nanoplankton and softbodied alveolates were present suggesting their importance in the nutrition of D. gegenbauri.

**Walus, B.** Bigelow Laboratory for Ocean Sciences REU, West Boothbay Harbor, USA, Brandonwalus@yahoo.com

Fields, D. M., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA, Shema, S., Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, USA

**EFFECTS OF SUB-LETHAL CONCENTRATIONS OF CRUDE OIL ON COPE- POD BEHAVIOR: ACARTIA TONSA**

Deep sea and offshore drilling is becoming the preferred method of accessing crude oil. Oil spilled offshore operations rises through the water column releasing the water-soluble fraction (WSF). While the hydrophobic portion of crude oil floats on the sea surface, the WSF remains in solution throughout the water column. Little is known about the lethal concentration of WSF or the effects of the sub-lethal concentrations on the behavior of planktonic organisms. In this study we quantified the lethal concentration of the WSF of crude oil on Acartia tonsa, a planktonic copepod. We used three behavioral proxies to assess the effects of the sub-lethal WSF on copepod populations. Our data shows increasing mortality at concentrations of the WSF greater than 1%. We also found a decrease in the escape jump capabilities at concentrations as low as 0.03%. These results suggest that A. tonsa has high sensitivity to low concentrations of the WSF that could negatively impact recruitment rates.

**Wang, H.** University of Massachusetts, Amherst, USA, hyw@eco.umass.edu

Fogarty, M., NOAA Northeast Fisheries Science Center, Woods Hole, USA, mfog-arty@mercury.whoi.edu

Juanes, F., University of Massachusetts, Amherst, USA, Juanes@eco.umass.edu

**POPULATION DYNAMICS REFLECT AN INTERACTION OF LIFE HISTO- RIES, FISHING, AND TEMPERATURE VARIABILITY: EVIDENCE DRAWN FROM ATLANTIC COD**

Fishing can exert a strong impact on fish life histories and population growth via elevated mortality and the size-selective processes. Despite relatively high fishing intensities, however, different species or con-specific populations display variable population dynamics. Such variability may reflect that 1) other factors confound fishing effects on fish life histories, and/or 2) life history variation mediates differential population re- sponses to fishing. We evaluated these hypotheses based on an important commercial fish, Atlantic cod Gadus morhua. Different cod populations express a wide range of life history variation, and are influenced by variable environmental conditions and fishing intensities. Our analysis revealed a strong temperature effect on inter-population life history variation; after accounting for temperature, fishing effects on life history variation were not significant. Nonetheless, magnitudes of fishing mortality covaried with temperatures and life histories, and together these factors defined several distinct groups of cod. Moreover, different cod populations displayed differential population trends. Median lifetime spawning biomass (LSB) relative to the unfished levels ranged from 0.03 to 0.45 among populations. Temporally, different cod populations displayed increasing, sustained fluctuating, or decreasing trends in LSB.

**Wang, S.** University of California, Irvine, Irvine, USA, shanlinw@uci.edu

Moore, J. K., University of California, Irvine, Irvine, USA, jkmoore@uci.edu

Mahowald, N., Cornell University, Ithaca, USA, mahowald@cornell.edu

**IMPACTS OF DUST DEPOSITION VARIABILITY ON BIOGEOCHEMICAL CYCLES AND PRIMARY PRODUCTION**

We investigate the impacts of variability of atmospheric dust deposition on biogeochemical cycles, ecosystem structure and primary production with simulations by an ocean biogeochemical/ecosystem model, which runs within the coarse resolution ocean circulation component of the Community Climate System Model. Simulations were forced by meteorological reanalysis climatology data, satellite-based estimates of surface ice cover and observed dust deposition in the second half of 20th century [Mahowald et al., submitted]. Comparisons between simulations with modeled con-stant climatological dust deposition and historically varying dust deposition show that variations in dust deposition can alter some regional patterns of phytoplankton community structure, biological production and the ocean carbon sink. We also examine the impacts of using a spatially varying aerosol Fe solubility compared with using a constant solubility.

**Wang, Z.** Texas A&M University, College Station, USA, zhankunwang@tamu.edu

DiMarco, S. E., Texas A&M University, College Station, USA

Belabbas, L., Lighthouse R&D Enterprises, Inc., Houston, USA, Al-Kharusi, L. H., Marine Science and Fisheries Center, Muscat, Oman

**TEMPORAL AND SPATIAL VARIABILITY OF VERTICAL DIEL MIGRATION FROM ADCP BACKSCATTER IN THE UPPER WATER COLUMN OF NORTH- ERN ARABIAN/OMAN SEAS**

Previous studies have shown that backscatter from ADCPs can estimate zooplankton and mesopelagic fish biomass. As part of the Lighthouse LOBI project, three 75-kHz upward-looking ADCPs are deployed in northern Arabian/Oman Seas.

The project is coordinated by the Oman Ministry of Fisheries Wealth through the Marine Science and Fisheries Centre. Those ADCPs collect velocities and acoustic backscatter intensity (ABI) since December 2009. Oman Sea has the highest density of myctophids in the region with B. pterotum being the only species. Our ABI data document substantial diel vertical migrations. The fish ascend into shallower (<130 m) water at night and return to deep water (200 to 450 m) during the day. Two daytime layers and two nighttime layers are typically found. The upper daytime layer is centered at 230 m and densely concentrated. The lower daytime layer ranges between 350-450 m. The upper nighttime layer is above 130 m and the lower nighttime layer is between 220 and 270 m. Fish vertical migration speeds will be estimated from slopes of the scattering layers and compared with the direct measurements of verti-cal velocities from ADCP. Seasonal and spatial variations of vertical migrations and total biomass will be compared between stations and different monsoon seasons.

**Wannicke, N.** Leibniz Institut für Baltikum Sea Research/Freshwater Ecology and Inland Fishery, Rostock/Neuglobsow, Germany, Nicola.Wannicke@io-warnemuende.de

Endres, S., Alfred Wegener Institut, Bremerhaven, Germany, Sonja Endres@awi.de

Unger, J., Leibniz Institut für Baltikum Sea Research, Rostock, Germany, Juliane Unger@io-warnemuende.de

Engel, A., Alfred Wegener Institut, Bremerhaven, Germany, Anja Enge@awi.de

Grossart, H. P., Leibniz Institut für Freshwater Ecology and Inland Fishery, Neuglobsow, Germany, hgrossart@igb-berlin.de

Nausch, M., Leibniz Institut für Baltikum Sea Research, Rostock, Germany, Monika Nausch@io-warnemuende.de

Yoss, M., Leibniz Institut für Baltikum Sea Research, Rostock, Germany, Maren Voß@io-warnemuende.de

**GROWTH AND PRODUCTION OF NODULARIA SPUMIGENA UNDER ELEVATED CO2 CONCENTRATIONS**

This study presents results from a joint laboratory experiment investigating the effect of elevated pCO2 and P limited conditions (P <0.5 µM) on growth and production of the Nodularia spumigena. Batch cultures were grown under three different CO2 levels: (level 180, 380, and 780 ppm) over a 15 days growth phase. The filament number increased in all treatments but s most pronounced under the highest concentrations of CO2. Correspondingly, chlorophyll increased over the first 10 days, but decreased drastically while the phosphate pool was already exhausted at day 4 of the experi-ment. Growth rates depended on abundance and chlorophyll were significantly higher at 780 ppm. Moreover, C fixation rates were elevated in the highest pCO2 treatment by 14-31%, N2 fixation rates by 9-40% relative to present day CO2 condi-tions. A higher pCO2 level seemed to have compensated to a large extent P limited growth. Furthermore, our results suggest a CO2 limitation of nitrogen fixers at the present partial pressure of CO2, which was also found in previous experiments with the open ocean species Trichodesmium.

**Wassmann, P.** University of Tromsø, Tromsø, Norway, Paul.wassmann@uit.no

Slagstad, D., SINTEF Fisheries and Aquaculture, Trondheim, Norway, Dag.Slags-tad@sintef.no

Ellingsen, L., SINTEF Fisheries and Aquaculture, Trondheim, Norway, Ingrid.H.Ellingsen@sintef.no

**EVALUATING PRIMARY AND SECONDARY PRODUCTION IN AN ARCTIC OCEAN VOID OF SUMMER SEA ICE: AN EXPERIMENTAL SIMULATION APPROACH**

Gross (GPP) and secondary production in the Arctic Basin, Eurasian shelves and the Barents Sea was investigated through the physically-biologically coupled, 3D SIMMOD model. We tested the effect of how retreating ice cover in the forthcoming century may affect the productivity in the Arctic Ocean by adding 2-8°C to the temper-ature forcing taken from ECMWF data. The model indicates that GPP increases along the temperature gradient both in the Arctic Basin and along the Eurasian
shelves from 10 to 40 and 30 to 60 g C m⁻² y⁻¹, respectively. In contrast, GPP in the Barents Sea stayed more or less constant (100 g C m⁻² y⁻¹). With an air temperature increase towards +8°C secondary production of Calanus glacialis in the Barents Sea dropped from about 3.9 to 0.3 g C m⁻² y⁻¹, while that of the Arctic Basin and Eurasian shelf increased from approximately -0.1 to 1.5 and 1.4 to 2.4 g C m⁻² y⁻¹, respectively. Secondary production changes are unevenly distributed during future warming with the most significant increases occurring along the Eurasian shelves and the Chukchi Sea.

Watanabe, S., Dépt de biologie & Centre d'études nordiques, Université Laval, Québec, Canada, shoshi.watanabe.1@ulaval.ca
Laurion, I., INRS-ETE, Université du Québec, Québec, Canada, Isabelle_Laurion@ete.inrs.ca
Vincent, W. F., Dépt de biologie & Centre d'études nordiques, Université Laval, Québec, Canada, Warwick.Vincent@sig.ulaval.ca

ABIOTIC CONTROL OF UNDERWATER LIGHT IN A DRINKING WATER RESERVOIR

The control of underwater light has important implications for resource monitoring. Interpretation of optical sensor data including in situ systems and satellite remote sensing requires a detailed understanding of the basic optical properties of target waterbodies; however, such information for inland waters is sparse relative to oceanic systems. Lac Saint-Charles is a mesotrophic north temperate lake providing drinking water to Quebec City, Canada. We undertook a detailed study of the lake in summer of 2008 to characterize its optical properties and their controlling factors. Within and above water measurements of apparent optical properties were obtained using Satlantic hyperspectral radiometers, and inherent optical properties were determined via a Welsbach AS-5 instrument and ancillary laboratory analyses. Colored dissolved organic matter and non-algal suspended particulate matter accounted for more than 80% of total absorption and scattering in the lake, while algal particles played a minor role in the observed optical variations. These results show how optical information may not directly reflect the biological properties of a water column, and optical monitoring information must therefore be interpreted with care by water resource managers.

Waters, M. N., Valdosta State University, Valdosta, USA, mwaters@valdosta.edu
Piehler, M. F., University of North Carolina-Chapel Hill, Morehead City, USA, mpiehler@email.unc.edu
Smol, J. M., University of South Florida-St. Petersburg, St. Petersburg, USA, smoak@mail.usf.edu
Bianchi, T. S., Texas A & M College Station, USA, tbianchi@tamu.edu

HISTORIC ALGAL COMMUNITY RESPONSES TO DYSTROPHICATION OF A SHALLOW LAKE

Dystrophic aquatic ecosystems have high concentrations of dissolved and particulate carbon that limit productivity, attenuate light and decrease pH; however less is known about the relationship between dystrophication and lake algal communities. We conducted a paleolimnological investigation of Pungo Lake, a shallow, dystrophic system in North Carolina, USA. Sedimentary photosynthetic pigments, lignin-phenols, nutrients and δ¹³C were measured on a sediment core. Data analysis identified three distinct zones of algal community structure corresponding to three regimes of organic matter inputs. Middle Holocene sediments represented a period of low organic inputs but significant benthic algal abundance (diatoms and other algal types). Late Holocene sediments showed an increase in organic matter deposition, lignin and a change in lignin type indicating an increase in terrestrial organic matter inputs, possibly from wetland expansion. These sediments also corresponded to increases in algal groups that favor low light environments (cyanobacteria and cryptophytes). Lead-210 dated sediments represent a period of high organic matter input and low algal abundance. Our results detail long-term changes in shallow lake algal community structure linking these changes to the process of dystrophication.

Watley, J. R., Texas Southern University, Houston, USA, jeraldwatley@yahoo.com

ASSESSMENT OF THE U.S. COASTAL CARIBBEAN FISH HABITAT PARAMETERS FOR THE NATIONAL FISH HABITAT ACTION PLAN (NFHAP)

The objective of this research was to assess the conditions of fish habitat parameters in coastal waters of Puerto Rico and the Virgin Islands. The basic approach involves developing a spatial framework, and compiling existing environmental data to fit the spatial framework. The spatial framework was developed using ArcGIS software, by delineating a map layer of territorial waters for Puerto Rico and the Virgin Islands. The coastal waters GIS layer was modified to identify several inshore bays and estuaries, including San Juan and Jobos Bays in Puerto Rico, Salt River in St. Croix, Virgin Islands, and other areas. Assessment data sets from EPAs National Coastal Condition Reports and NOAA's Mussel Watch program were summarized to match the spatial framework. The parameters assessed include water quality, and spatial and temporal trends of both metal and organic contaminants. This research will help describe the current status of pollution and detect changes in the environmental quality of our nation's estuarine and coastal waters, and will assist the National Fish Habitat Action Plan (NFHAP) assessment of fish habitat for conservation planning.

Webb, E. A., University of Southern California, Los Angeles, USA, ewebb@usc.edu
Nelson, W. C., University of Southern California, Los Angeles, USA, wchinc@gmail.com
Edmands, S., University of Southern California, Los Angeles, USA, sedmands@usc.edu
Waterbury, J. B., Woods Hole Oceanographic Institution, Woods Hole, USA, jwaterbury@whoi.edu

Kyrpides, N., Joint Genome Institute, Walnut Creek, USA, nckyrpides@lbl.gov
Land, M., Oak Ridge National Lab, Oak Ridge, USA, landml@ornl.gov
Larimer, F., Oak Ridge National Lab, Oak Ridge, USA, larimerf@ornl.gov
Hauser, L., Oak Ridge National Lab, Oak Ridge, USA, hauserl@ornl.gov
Holladay, S., Oak Ridge National Lab, Oak Ridge, USA, holladayk@ornl.gov
Heidelberg, J. F., University of Southern California, Los Angeles, USA, jheidelberg@gmail.com

TRICHODESMIUM SPP GENOMES – WINDOWS INTO THE GENETIC POTENTIAL AND EVOLUTION OF MARINE N₂ FIXATION

The free-living (i.e., non-pathogenic, non-symbiotic) cyanobacterium Trichodesmium is recognized as an important source of new nitrogen and fixed carbon to the oligotrophic tropical and subtropical oceans. Despite the ecological significance of this organism, we still know relatively little about the factors that affect its growth, distribution and evolution in the oligotrophic ocean, making studies focused on this organism active and important areas of research. In 2006, the Joint Genome Institute sequenced and closed the genome of Trichodesmium erythraeum IMS101. The 7.8Mbp IMS101 genome is in the size range expected for cyanobacteria in the order Oscillatoriales, but unlike the other fifty-eight cyanobacterial genomes available in the Integrated Microbial Genomes database, only about 63.8% of the IMS101 genome is predicted encode protein (cyanobacterial average ~ 86%). To determine if the gene content and coding percentage observed in IMS101 is commonplace in genuses, we phylogenetically sequenced the genomes (~8 fold coverage) of two other isolates of Trichodesmium, T. erythraeum and Trichodesmium theiabauitii H9-4 (isolated in 2006 from the North Atlantic and North Pacific, respectively). Comparisons of the genomes, estimates of the effective population size, and the evolutionary history of the genus will be discussed.

WEEKS, S. J., University of Queensland, Brisbane, Australia, s.weeks@uq.edu.au
WERDELL, P. J., NASA Goddard Space Flight Center, Greenbelt, USA, Jeremy.Werdel@nasa.gov
LEE, Z. P., Northern Gulf Institute, Sennis Space Center, USA, zplee@ngi.mstate.edu
CANTO, M., University of Queensland, Brisbane, Australia, m.canto@uq.edu.au
FELDMAN, G. C., NASA Goddard Space Flight Center, Greenbelt, Australia, gene.c.feldman.nasa.gov

SATELLITE DERIVED EUPHOTIC DEPTH ON THE GREAT BARRIER REEF: UNDERSTANDING PHYSICAL DRIVERS OF SPATIO-TEMPORAL PATTERNS OF WATER CLARITY

Mapping of key environmental variables in space and time forms an integral component in the development of an early warning system for stress on the Great Barrier Reef (GBR). Detecting changes to the transparency of the water column is critical for understanding the exposure of the GBR to risk factors that cause coral bleaching, or are involved in nutrient/flood dynamics. We investigate the optimal algorithm for light attenuation through the water column across the scale of the GBR. We implement and test the quasi-analytical algorithm. As a first order validation, we match GBR Secchi Depth data to Modis Aqua (2002-present) and SeaWiFS satellite data (1997-present). We regress the in-situ data against the 10% euphotic depth level and use a Type II linear regression of log-transformed satellite and in situ data to adjust the match in satellite data retrievals. We implement a GBR-validated euphotic depth algorithm and generate satellite time series across the scale of the GBR ecosystem. We apply an Empirical Orthogonal Function Analysis to the dataset and compare the spatio-temporal patterns to the physical dynamics.
ROLE OF VIRAL LYSIS FOR THE COMPOSITION AND USE OF ORGANIC MATTER

Weinberg, L., University of Hamburg, Hamburg, Germany, ingo.weinberg@zmaw.de
Bahlmann, E., University of Hamburg, Hamburg, Germany, enno.bahlmann@zmaw.de
Seifert, R., University of Hamburg, Hamburg, Germany, richard.seifert@zmaw.de
Michelis, W., University of Hamburg, Hamburg, Germany, walter.michaelis@zmaw.de

FLUXES AND ISOTOPE COMPOSITION OF SELECTED HALOCARBONS FROM SEAGRASS MEADOWS

Short-lived halocarbons play important roles in atmospheric chemistry. Many efforts have been made on the identification of sources and sinks of halocarbons in the marine and terrestrial environment. However, their atmospheric budget is still unbalanced with known sinks exceeding the known sources. The identified marine sources include macroalgae, plankton, and saltmarsh plants. Seagrass beds are among the most productive ecosystems in the oceans and might be an additional source of halocarbons to the atmosphere. To date, emissions and isotopic data of halocarbons from seagrass meadows are not available. Therefore, flow chamber measurements were conducted on a seagrass meadow in List/Sylt, Northern Germany. Fluxes of chloromethane (CH\textsubscript{3}Cl), bromomethane (CH\textsubscript{3}Br), iodomethane (CH\textsubscript{3}I) and bromoform (CH\textsubscript{3}Br\textsubscript{3}) were determined using a dynamic flow chamber system set up directly on the seagrass species zostera marina and zostera noltii. First results revealed both emission and deposition events of CH\textsubscript{3}Cl and CH\textsubscript{3}Br. In contrast, CH\textsubscript{3}I and CH\textsubscript{3}Br\textsubscript{3} were predominantly emitted from the seagrass. Compared to the isotope values of CH\textsubscript{3}I, those of CH\textsubscript{3}Cl were significantly depleted in \textsuperscript{13}C.

WEISSE, T., Institute for Limnology, Austrian Academy of Sciences, Mondsee, Austria, thomas.weisse@oeaw.ac.at

EXTREMELY ACIDIC MINING LAKES: AN ENVIRONMENT DOMINATED BY PROTISTS

Acidic mining lakes (AML) with pH <3 are extreme, man-made aquatic habitats with strongly reduced biodiversity. In contrast to most natural lakes, AML are disconnected from other surface water bodies. With respect to biogeography, they may be portrayed as acid island habitats in circumneutral surroundings. The eukaryotic food web is composed almost exclusively of protists and a few rotifers. Mixo trophic algae such as Chlamydomonas acidophila and Ochromonas spp. are the only primary producers in many AML. Together with small rotifers, ciliates of the genus Oxytricha are the most important herbivores. The heliozoan Actinophrys sol acts as top predator in the planktonic food web. This contribution presents results from laboratory and in situ experiments conducted in AML located in Austria and Germany. Growth and grazing rates of the dominant species will be discussed in relation to their fitness under changing pH. This study revealed local adaptation of several taxa below the species level and significant habitat x species interaction. In conclusion, although the overall diversity in AML is reduced, each AML may harbor a specific flora and fauna.

Welch, J. B., University of Minnesota-Duluth, Duluth, USA, welct021@umn.edu
Reed, A. J., University of Minnesota-Duluth, Duluth, USA, ajreed@d.umn.edu
Hicks, R. E., University of Minnesota - Duluth, Duluth, USA, rhicks@d.umn.edu

MOLECULAR ANALYSIS OF BACTERIAL COMMUNITY COMPOSITION OF SHIP BALLAST AND DULUTH-SUPERIOR HARBOR WATER

Ship ballast water is a potential vector for spreading exotic or invasive microorganisms and more ballast water is discharged into the Duluth-Superior Harbor than any other harbor within the Great Lakes. Little is known about the planktonic bacterial community composition within the harbor or the discharged ballast water released into this harbor. DNA fingerprint (T-RFLP) analyses indicated the differences in the composition of bacterial communities in harbor and ship ballast water samples. These differences were confirmed by 16S rDNA clone libraries created for a harbor water sample and three ballast water samples of either freshwater or seawater origin. Clone library analysis indicated that Proteobacteria (Betaproteobacteria 33%, Alphaproteobacteria 25%) and Actinobacteria (28%) dominated the harbor bacterial community. In freshwater ballast, members of the Bacteroidetes (44%) and Proteobacteria (Betaproteobacteria 19%, Alphaproteobacteria 9%) phyla were common. Bacteria from the Proteobacteria (Epulopiscirubrobacteria 47%, Alphaproteobacteria 27%) and Bacteroidetes (18%) phyla were more common in the seawater ballast community. Phylogenetic analysis of less common phyla further characterized the bacterial community composition and indicated the presence of microbes of interest.

Weisel, T., University of Puerto Rico Mayaguez- Dept. Marine Sciences, Mayaguez, USA, ewel@caribe.net
Ruiz, H., University of Puerto Rico Mayaguez- Dept. Marine Sciences, Mayaguez, USA, astreoides@hotmail.com
Anderson, D., University of Puerto Rico Mayaguez- Dept. Marine Sciences, Mayaguez, USA, davidandersonii@gmail.com

PERSPECTIVES ON CORAL DISEASES IN DEEP CORAL COMMUNITIES OFF PUERTO RICO

Shallow coral reefs have suffered significant live coral losses due to biotic diseases and bleaching. There is concern about the susceptibility of deep communities. Photographic surveys by divers and ROV video along deep (50-90m) communities off the southwest shelf-edge off Puerto Rico showed colonies of dominant coral species and other species with signs similar to those of virulent shallow water diseases. In one of our photo transects at 50m deep, a medium (832 cm\textsuperscript{2}) colony of Agaricia undata was rapidly killed by a condition similar to white plague. Rate of tissue mortality varied between 6-10 cm/month, slower than WPD rates in shallower waters, but faster than most other diseases. Average coral cover is low and bleaching. There is concern about the susceptibility of deep communities. In one of our photo transects at 50m deep, a medium (832 cm\textsuperscript{2}) colony of A. lamarcki was rapidly killed by a condition similar to white plague. Bleaching, WPD-like signs shallower waters, but faster than most other diseases. Average coral cover is low and bleaching. There is concern about the susceptibility of deep communities. In one of our photo transects at 50m deep, a medium (832 cm\textsuperscript{2}) colony of A. lamarcki was rapidly killed by a condition similar to white plague. Bleaching, WPD-like signs.
The trace nutrient iron can regulate bulk phytoplankton production and profoundly influences speciation of marine phytoplankton and likely bacteria. We used microfluidics to test whether species of marine bacteria and phytoplankton respond with chemotaxis to inorganic Fe(III), Fe(III)-EDTA, or Fe(III)-desferrioxamine B, a known marine siderophore. *Dunaliella tertiolecta* showed no chemotaxis towards the three iron substrates regardless of cellular iron status, consistent with the luxury iron uptake strategies of some marine phytoplankton. However, Fe(III)-desferrioxamine B elicited no chemotaxis in *D. tertiolecta*, indicating that it cannot effectively utilize this strongly complexed iron resource. These findings provide novel insights to the chemotaxis-facilitated utilization of Fe(III) substrates by motile marine microbes.

**Welsh, R. M.** Florida International University, North Miami, USA, rory.welsh@gmail.com

Vega Thurber, R. L., Florida International University, North Miami, USA, rvega@fiu.edu

**Rosales, S. M.** Florida International University, North Miami, USA, arosa007@fiu.edu

**Isolation and Characterization of the Predatory Bacteriovorax from Caribbean Corals**

Numerous types of bacteria associate with corals, and it has been suggested that some of these provide a beneficial role to the coral. Here we highlight a new member of the coral holobiont, a marine species of the genus *Bacteriovorax*. The predatory *Bacteriovorax* are highly motile gram negative bacteria that insert themselves into the periplasm of other gram negatives, replicate and lysate the host. Using standard culturing techniques, we isolated *Bacteriovorax* from the mucus layer of the Caribbean corals *Siderastrea siderea*, *Porites astreoides*, and *Montastraea cavernosa*. Genus specific primers were used to confirm the identity of the isolates and presence of these predatory bacteria in corals from control and nutrient enriched experimental reef sites as well as those exhibiting signs of black band disease (BBD). Finally, to illuminate the role of these predatory bacteria on the coral holobiont, we inoculated *M. cavernosa* corals with *Vibrio harveyi* in the presence and absence of our *Bacteriovorax*. Our results suggest that these newly described members of the holobiont maybe useful for regulating the abundance of coral pathogens.

**Wendling, C. C.** Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, carolin.wendling@awi.de

Bachtar, R.; Institute Pertanian Bogor (FPIK), Bogor, Indonesia, rbachtar@gmail.com

Lenz, M., Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, mlenz@ifm-geomar.de

von Jetzerenka, K.; Institute Pertanian Bogor (FPIK), Bogor, Indonesia, kjetzerenka@harwo.com

Wahl, M., Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, mwahl@ifm-geomar.de

**Population Differences in Susceptibility to Salinity Stress in the Green Mussel Perna Viridis from Contaminated and Uncontaminated Sites in Indonesia**

The consequences of global change and particularly the interactions between human impacts and warming will presumably alter the structure and functioning of marine ecosystems. In this context, we investigated the stress tolerance of populations of the green mussel (*Perna viridis*) stemming from two coastal locations in West Java, with different levels of human impact: Jakarta Bay is highly contaminated by nutrient input and pollution, while Tanjung Lesung represents a benign environment with less human influence. In laboratory stress experiments, we determined the mean stress tolerance of the two populations towards reduced salinity by 13 and 18 units, by measuring fluctuations in oxygen consumption, feces production and survival rates. Our results reveal that under reduced salinity responses were significantly different between both populations. In the face of salinity stress mussels from Jakarta Bay showed significantly higher survival and metabolic rates than mussels from Tanjung Lesung, suggesting that the origin of a population contributes substantially to its tolerance towards increasing environmental stress. We discuss possible mechanisms that could underlie these differences in stress tolerance of two populations stemming from different coastal habitats.

**Werdel, P. J.** NASA Goddard Space Flight Center, Greenbelt, USA, jeremy.werdel@nasa.gov

Franz, B. A., NASA Goddard Space Flight Center, Greenbelt, USA, bryan.a.franz@nasa.gov

**Generalizing Ocean Color Inversion Models that Retrieve Marine Inherent Optical Properties**

Ocean color measured from satellites provides daily, global observations of marine inherent optical properties (IOPs). IOPs, namely the absorption and scattering characteristics of seawater and its constituents, describe the contents of the upper ocean, information critical for improving our understanding of marine biogeochemical processes. Semi-analytical algorithms (SAAs) provide one mechanism for inverting the color of the water observed by the satellite into IOPs. While numerous SAAs exist, most are similarly constructed and few are appropriately parameterized for all water masses for all seasons. To initiate community-wide discussion of these limitations, NASA organized two workshops that deconstructed SAAs to identify similarities and uniqueness and progressed towards consensus on a unified SAA. This effort included developing the Generalized IOP (GIOP) model – software that allows for the construction of different SAAs at run-time by selection from an assortment of model parameterizations. Several insights into IOP modeling will be presented, all realized using GIOP. The hierarchical sensitivity of SAAs to various model parameterizations will be discussed, as will the current capabilities of SeWiFS, MODIS, and MERIS to produce comparable and complementary time-series of IOPs.

**Westhorpe, D. P.** NSW Office of Water & University of Technology, Sydney, Armidale, Australia, Doug.westhorpe@water.nsw.gov.au

Mitrovic, S. M., University of Technology, Sydney & NSW Office of Water, Sydney, Australia, Simon.mitrovic@water.nsw.gov.au

**Using Environmental Flows to Increase Delivery of Dissolved Organic Carbon to a Flow Modified River and Potential Changes in Heterotrophic Dominance**

Flow regulation in the highly regulated lowland Namoi River was found to reduce the amount of allochthonous dissolved organic carbon (DOC) entering main channels through less frequent wetting of benches and banks. Higher concentrations and loads of DOC were transported to the river during flow and flood events. Environmental flows have been allocated to the river with the intention to increase the amount of DOC delivered to the river. Relationships between DOC and flow were developed and this information was used to model the delivery of DOC to the river under current flow, with environmental flow, and natural flow scenarios. Environmental flows were found to increase DOC delivery relative to current flows. In-situ microcosms showed
the lowland riverine bacterioplankton to be DOC limited when flow events were absent. Based on the present results, environmental flows should increase the duration of allochthonously driven heterotrophic dominance, thus rendering regulated lowland rivers to more natural conditions for greater periods of time.

Westman, W. M., Florida Institute of Technology, Melbourne, USA, wwestman2008@my.fit.edu
Fields, D. M., Bigelow Laboratory for Ocean Sciences, USA
Sharma, S. D., Bigelow Laboratory for Ocean Sciences, USA

BARNACLES: FANS OF VISCOSITY. THE EFFECTS OF KINETIC VISCOSITY ON FEEDING BEHAVIOR IN BALANUS BALANOIDES.

Barnacles are filter feeder organisms with global distribution. Ocean currents, ship hulls, and ballast waters all contribute to dispersal of barnacles. At latitudes where barnacles can be found, water temperatures vary, affecting metabolic rates of animals and physical properties of fluids such as viscosity. In this study we explored the effects of fluid viscosity independent of temperature on barnacles’ feeding behavior using two prey sizes (~10mm, ~150mm). Water viscosity was manipulated using polyvinylpyrrolidone. Grazing experiments were conducted at 15°C over four hours, at low and high viscosity. Despite a 20% increase in viscosity, there was no measurable effect on the ingestion rate of small prey, and an increased ingestion of large prey. To determine if barnacles modify the boundary layer through behavioral mechanisms we measured feeding fans’ beat frequency at a range of temperatures, and then at low and high viscosity. These results show that barnacles alter the boundary layer between cirri to maximize feeding. An increased beat frequency at a higher viscosity allows the ingestion rate to be constant for smaller prey, but to increase for larger prey.

Whipple, S. J., University of Georgia, Athens, USA, whipples@gmail.com
Patten, B. C., University of Georgia, Athens, USA, bmtpatten@earthlink.net

NITROGEN PROCESSING IN THE NEUSE RIVER ESTUARY: WHY POINTS OF ENTRY DETERMINE SUBSEQUENT DYNAMICS

Substance dynamics in ecosystems are often described by compartment models that can be represented by systems of differential or difference equations. Substance enters compartments as boundary inputs, and movement is delayed by storages, where cumulative delays represent compartmental residence times. Residence time is a diagnostic compartment feature, measured empirically as stock/throughflow ratio, throughflow being the sum of each compartment’s outflows. In output environs, where each distinct input defines a unique pattern (network) of intrasystem transfers, residence times of introduced substances are determined by where the introductions occur. Compartments’ residence times are not strictly functions of their biotic or abiotic identities, but are composite quantities whose components are defined by their environ partitions. This will be demonstrated for residence times of nitrogen in a model of the Neuse River, NC estuary, but the principle can be extended to other substances and systems. Environments, which are whole-system partition elements, are the operational interior unit, and thus where a substance enters a system determines the course of its subsequent dynamics within the system.

Whitall, D., NOAA, Silver Spring, USA, dave.whitall@noaa.gov
Zitello, A., NOAA, Silver Spring, USA, adam.zitello@gmail.com
Potter, T., USDA ARS, Tifton, USA, Tom.Potter@ars.usda.gov
Dieppa, A., Jobos Bay National Estuarine Research Reserve, Aguirre, Puerto Rico, adieppa@gmail.com
Apeti, D., NOAA, Silver Spring, USA, dennis.apeti@noaa.gov
Palt, A., NOAA, Silver Spring, USA, tony.palt@noaa.gov

LAND BASED SOURCES OF POLLUTION TO JOBOS BAY, PUERTO RICO
Jobos Bay National Estuarine Research Reserve is located on the south shore of Puerto Rico. Land use in the watershed includes: agricultural production, low density residential areas, two electric power generation plants, a petroleum refinery, and several major chemical and pharmaceutical facilities. In 2007, NOAA, in collaboration with USDA and other project partners, began an integrated assessment of the Jobos Bay watershed and estuary. This on-going project is part of USDA’s Conservation Effectiveness Assessment Project (CEAP). The project has the goal of evaluating the effectiveness of Best Management Practices (BMPs) in agricultural watershed and using field data to construct quantitative models for use by coastal managers. As part of this effort, the project partners conducted a baseline assessment of the bay, including a biological assessment of coral reefs, contaminant analysis of coral tissue and marine sediments, water column nutrients and pesticides, and atmospheric deposition of nutrients and pesticides.

Whitehead, R. E., University of North Carolina Wilmington, Wilmington, USA, whiteheadr@uncw.edu
Hagenson, N. L., University of North Carolina Wilmington, Wilmington, USA, nlh4739@uncw.edu
Oliver, J. A., University of North Carolina Wilmington, Wilmington, USA, jao7670@uncw.edu
Szmant, A. M., University of North Carolina Wilmington, Wilmington, USA, szmanta@uncw.edu

CALCIFICATION, PHOTOSYNTHETIC, AND RESPIRATION RATES OF THE REEF CORAL EUSYMIILA FASTIGIATA IN RESPONSE TO CHANGES IN SEA-WATER CHEMISTRY

Ocean acidification (OA), by reducing aragonite saturation state, is expected to reduce coral calcification. However, most coral calcification occurs during daytime...
hours when photosynthesis elevates internal coral tissue pH and 0, and presumably also saturation state. This effect, known as light stimulated calcification, has the potential to counteract the effects of external seawater chemistry. In our experiments with Eusmina fastigata, we manipulated seawater chemistries (pH, O₂, HCO₃, and CO₂ concentrations) during both dark and light incubations in order to discern whether pH or pO₂ is the driver for light enhanced calcification and to test the hypothesis that under high light levels and with intact symbiont populations, corals will demonstrate little response to seawater acidification. Calcification rates in the light were 50-100 % higher than in the dark. High pH but not high O₂ doubled dark calcification to values similar to those in the light. Further manipulations of pH with TRIS buffer and of DIC show that Eusmina calcification rates are consistently elevated at high pH even when DIC is low. Experiments with reduced pH are in progress.

Whitney, L. P., University of Rhode Island, Kingston, USA, leann.pritchard@gmail.com
Mercier, M., University of Rhode Island, Narragansett, USA, mmercier@gso.uri.edu
Dyhrman, S. T., Woods Hole Oceanographic Institution, Woods Hole, USA, sdyhrman@whoi.edu
Saito, M. A., Woods Hole Oceanographic Institution, Woods Hole, USA, msaito@whoi.edu
Rynearson, T. A., University of Rhode Island, Narragansett, USA, rynearson@gso.uri.edu
Jenkins, B. D., University of Rhode Island, Kingston, USA, bjenkins@uri.edu

RESPONSE TO IRON LIMITATION IN THE MARINE DIATOM THALASSIO- SIRA PSEUDONANA REVEALED BY GLOBAL TRANSCRIPTOMIC ANALYSIS

Iron restricts diatom growth in vast regions of the oceans, limiting their contribution to primary production and carbon export. The physiological impact of iron limitation has been well studied; however the molecular mechanisms driving these responses have been the focus of fewer studies that yield varying results. To address how iron limitation globally impacts diatom metabolism, we profiled the transcriptome of Thalassiosira pseudonana grown under Fe-replete and Fe-deficient conditions using high-throughput sequencing methods. Approximately 1.2 x 10⁷ and 2.1 x 10⁷ transcript tags were sequenced for the replete and Fe-limiting libraries, respectively. Expression was detected from 9427 genes in the Fe-replete library and 9462 genes in the Fe-limited library. The most highly upregulated genes have homology to transcriptional regulators. The most downregulated genes have homology to components of signal transduction and protein synthesis. Our results suggest that T. pseudonana’s transcriptional response to Fe limitation is complex and, likely impacts functioning of multiple downstream pathways.

Whitney, M. M., University of Connecticut, Grotto, USA, michael.whitney@uconn.edu

VARIABILITY OF DISTRIBUTED RIVER INPUTS AND INFLUENCES ON ESTUARINE DYNAMICS IN LONG ISLAND SOUND

Fresh waters enter the Long Island Sound from major rivers such as the Connecticut, Housatonic, and Thames and from numerous smaller coastal rivers. Observations show the coastal rivers have a more immediate and peaked response to storm events than major rivers. Simulation results indicate the coastal rivers have a disproportionately large effect on the estuarine density structure and circulation during the initial storm response. The distributed river inputs change the sign and magnitude of the along-estuary salinity gradient and modify the stratification, mixing, and straining conditions along the coast. Simulated drifters released from the mouths of major and smaller rivers follow indirect paths through the estuary that depend on discharge, tidal, and wind conditions. Wavelet analysis of discharge records indicates statistically significant multi-decadal variability that varies among rivers. Inter-comparison of simulation runs illustrates the estuarine effects of this multi-decadal variability and redistribution of river inputs.

Whitaker, K. A., Graduate School of Oceanography, University of Rhode Island, Narragansett, USA, kawhitta@gmail.com
Riganes, D. R., Graduate School of Oceanography, University of Rhode Island, Narragansett, USA, driag718@gmail.com
Olson, R. J., Biology Department, Woods Hole Oceanographic Institution, Woods Hole, USA, rolson@whoi.edu
Rynearson, T. A., Graduate School of Oceanography, University of Rhode Island, Narragansett, USA, rynearson@gso.uri.edu

GLOBAL-SCALE GENETIC AND PHYSIOLOGICAL VARIATION IN THE DIATOM THALASSIOSIRA ROTULA

Planktonic diatom species can harbor high levels of genetic diversity on local and regional scales. Here, we extend this to global scales by examining the geographic structure of intra-specific diversity from > 70 global isolates of the bloom-forming diatom Thalassiosira rotula. We analyzed three RNA regions, genome size, and physiology. Isolates of T. rotula from the Pacific, Atlantic, and Mediterranean exhibited no 18S or 28S divergence but possessed three ITS1 sequence types, revealing three distinct lineages. One lineage was globally distributed, while 2 others possessed geographically-restricted distributions. Genome size showed no correlation with ITS1 lineage, but the genome size of one isolate was twice that of all others. The detection of a possible genome duplication event within a single ITS1 lineage suggests that polyploidization may occur frequently in diatoms. Maximum acclimated growth rates of isolates incubated at six conditions revealed high physiological diversity, not correlated with ITS1 lineage or sampling location. Coexistence of cosmopolitan and geographically-restricted lineages exhibiting broad physiological diversity suggests that differential selection may play a significant role in structuring the large-scale spatial patterns of diversity in marine diatoms.

Whitney, C. J., Virginia Institute of Marine Science REU, Gloucester Point, USA, courtney.wickel@gmail.com

SECONDARY MACROBENTHIC PRODUCTION AND FOOD WEB STRUCTURE IN SHALLOW TIDAL FRESHWATER HABITATS INCLUDING BEDS OF THE EXOTIC PLANT HYDRILLA VERTICILLATA

Hydrilla verticillata is an invasive SAV (submerged aquatic vegetation), which has recently become the dominant species of SAV in the tidal freshwater reaches of Chesapeake Bay. To date, no research has been done to evaluate macrobenthic secondary production in these habitats within Chesapeake Bay. If exotic Hydrilla beds alter the secondary production of macrobenthos, then food webs and energy flow in the tidal freshwater regions of the estuary may also be affected. To assess the relative ecological value of Hydrilla habitat, daily production (mg AFDM m⁻² d⁻¹) of Corbicula fluminea was compared among three different habitats (unvegetated, Hydrilla dominated, and mixed vegetation) in the tidal freshwater region of the Mataponi River sub-estuary. Five random cores were collected in July and September 2009 within each habitat. Daily production was estimated for individual clams using an empirical method. Mean total production for was computed for 5 mm length classes by habitat type and month sampled. The unvegetated and mixed vegetation habitat sites exhibited greater mean production than the Hydrilla habitat; however, mean production did not differ significantly among the three habitat types.

Wickland, K. P., US Geological Survey, Boulder, CO, USA, kpwick@usgs.gov
Aiken, G. R., US Geological Survey, Boulder, CO, USA, graiken@usgs.gov
Spencer, R. G., Woods Hole Oceanographic Institute, Woods Hole, MA, USA, robspencer1979@gmail.com
Striegel, R. G., US Geological Survey, Boulder, CO, USA, rstriegel@usgs.gov

BIOAVAILABILITY AND TRANSPORT OF TERRESTRIAL DISSOLVED ORGANIC MATTER IN BOREAL RIVERS

Dissolved organic matter (DOM) in boreal rivers is predominantly of terrestrial origin. The Yukon River integrates DOM from diverse landscapes in northwest Canada and interior Alaska having distinct seasonality of concentration, chemical character, and bioavailability (B-DOM). Vegetation litter, organic and mineral soils, and river sediments produce chemically discrete pools of DOM that relate to Yukon River DOM character and reactivity over the annual hydrograph. The river transports highly labile DOM during ice-covered periods and at the onset of spring flush. Under-ice DOM resembles groundwater DOM and river sediment leachates, having low aromaticity, low lignin-phenol content, and high fluorescence index (FI). In contrast, spring flush DOM resembles fresh litter and shallow organic soil leachates, having high aromaticity and lignin-phenol content, and lower FI. While under-ice B-DOM (>50%/month) is greatest on a percentage basis, low discharge and DOM concentrations place winter behind spring flush (B-DOM ~35%/month) in terms of load. Smallest B-DOM (~20%/month) concentrations and loads occur during late summer into fall. Results from two major tributaries draining contrasting landscapes will be compared to patterns observed in the Yukon River.

Witmer, B., Old Dominion University, Norfolk, USA, bwitmer@odu.edu
Mulholland, M. R., Old Dominion University, Norfolk, USA, mmulholl@odu.edu

CYANATE AS A NITROGEN SOURCE FOR MARINE MICROBES: CYANATE UPTAKE IN THE COASTAL NORTH ATLANTIC OCEAN

Genetic and physiological evidence indicates that certain microbes, including the abundant marine cyanobacteria Synechococcus and Prochlorococcus, have the capability to take up and metabolize environmental cyanate producing ammonium and carbon dioxide. Bacterial and phytoplankton cultures have been grown on
cyanate, sometimes as the sole nitrogen source, and significant cyanate-derived carbon uptake has been observed in laboratory studies. However, it is unclear whether microbes utilize cyanate in the environment. As a product of spontaneous urea degradation and through several cellular metabolic pathways, cyanate may be present at biologically relevant concentrations in seawater. Here we demonstrate for the first time, to our knowledge, that cyanate is taken up at high rates, primarily as an N source, by natural microbial populations as a carbon and nitrogen source for growth. Cyanate uptake was measured in coastal waters in the North Atlantic Ocean along the North American continental shelf. We here demonstrate for the first time, to our knowledge, that cyanate is taken up at high rates, primarily as an N source, by natural microbial populations as a carbon and nitrogen source for growth.

Wiedenmann, J., University of Southampton, Southampton, United Kingdom, joerg.wiedenmann@noc.soton.ac.uk

Gittins, J., University of Southampton, Southampton, United Kingdom, J.R.Gittins@soton.ac.uk

D’Angelo, C., University of Ulm, Ulm, Germany, C.D’angelo@ulm.de

GENOMIC BASIS DEFINING THE CUMULATIVE RESPONSE OF FLUORESCENT PROTEINS TO MULTIPLE STRESS FACTORS

The future of coral reefs is strongly dependent on whether or not corals can adapt to the rapidly changing environment. Both, at the level of individuals and populations, adaptability will depend on the capacity of corals to modulate the expression of relevant genes and thus accumulate proteins necessary to sustain diverse metabolic processes under altered environmental conditions. Fluorescent proteins (FPs) represent the most important group of host pigments in reef-building corals. We have examined the genomic basis that allows FP-coding genes to respond to multiple environmental factors and endogenous drivers. We found that light- and heat stress act antagonistically on expression levels, with heat stress overriding the response to high light exposure. The study revealed the co-existence of fundamentally different genetic strategies of corals to respond to environmental stimuli at the level of individuals and populations. The activity of FP-coding genes can be quantitatively monitored by non-invasive measurements of tissue fluorescence, thereby offering a high potential to use these proteins as cumulative sensors of interacting environmental stress factors in coral reefs.

Wiedner, C., Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Stechlin-Neuglobsow, Germany, c.wiedner@igb-berlin.de

Mehnert, G., Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Stechlin-Neuglobsow, Germany, g.mehnert@igb-berlin.de

Wagner, C., Leibniz-Institute for Baltic Sea Research Warnemünde, Rostock, Germany, carola.wagner@io-warnemuende.de

Rücker, J., Brandenburg University of Technology, Bad Saarow, Germany, j.ruecker@tu-cottbus.de

Nixdorf, B., Brandenburg University of Technology, Bad Saarow, Germany, nixdorf@tu-cottbus.de

IMPACT OF GLOBAL WARMING AND TROPHIC STATUS ON THE PREDOMINANCE OF DIFFERENT CYANOBACTERIA TAXA IN DIFFERENT TYPES OF LAKES IN NORTHERN GERMANY

Cyanobacterial dynamics and environmental parameters were studied in 33 German lakes of different trophic status and morphology to evaluate main predicting variables of cyanobacterial dominance. Data were analyzed using multivariate statistics. Additionally, strains of selected taxa, native and invasive ones, were isolated and effects of temperature and light on their growth were studied in laboratory experiments. Analysis of the field data revealed significant positive correlations between the biovolume of Planktothrix and phosphorus concentrations in all lake types, while nostocalean taxa (Anabaena, Aphanizomenon, Cylindrospermopsis) were significantly positive correlated with water temperature and nitrogen concentrations in shallow polyhalic lakes. Results from growth experiments showed that the temperature optimum of all studied Nostocales is above the mean water temperature of the studied lakes during summer and that the growth rates of invaded species is significantly higher compared to native species at temperatures above 20°C. We conclude that declining phosphorus concentrations will cause a decline of the biovolume of Planktothrix, while increasing water temperatures will promote the development of Nostocales species in general and that of invasive species in particular.

Wiegand, M. D., University of Winnipeg, Winnipeg, Canada, mwiegand@uwinnipeg.ca

Johnston, T. A., Ontario Ministry of Natural Resources, Sudbury, Canada, tjohnston@laurentian.ca

Porteous, L. R., University of Winnipeg, Winnipeg, Canada, bluelibby21@hotmail.com

Wong, D. M., Queen’s University, Kingston, Canada

Moles, M. D., University of Guelph, Guelph, Canada, mmoles@uoguelph.ca

Casselman, J. M., Queen’s University, Kingston, Canada, john.casselman@queensu.ca

Leggett, W. C., Queen’s University, Kingston, Canada, w.leggett@queensu.ca

DIFFERENCES IN RESOURCE ALLOCATION TO REPRODUCTION IN TWO SYMPATRIC, EXPLOITED FISH: WALLEYE AND LAKE WHITEFISH

Walleye Sander vitreus, a piscivore, and lake whitefish Coregonus clupeaformis, a benthiere, are subject to important commercial, recreational and subsistence fisheries in Canadian lakes. Where sympatric, they have similar ages of maturity and reproductive life spans. We compared energy storage and allocation to reproduction in both species in Lakes Ontario and Winnipeg. In females of both lakes, relative fecundity was higher in walleye than whitefish, and the liver, where lipopolysaccharides and complex lipids deposited in eggs are assembled, was larger in walleye than whitefish. With increasing age walleye allocated more of their total body lipid to egg production; whitefish did the opposite. Percentages of the essential fatty acids, ARA and DHA increased with maternal length, in both neutral and polar lipids in Lake Ontario walleye eggs, while EPA percentages decreased. The opposite was true for all three fatty acids in Lake Ontario whitefish. Egg neutral lipids in whitefish contained higher percentages of DHA than did those in walleye. While older, larger walleye produce superior eggs, the situation in whitefish is unclear. Effective size-selective harvest strategies may differ between these species.

Wiener, C. S., University of Hawaii - Hawaii Institute of Marine Biology, Kaneohe, USA, cwener@hawaii.edu

Toonen, R. J., University of Hawaii - Hawaii Institute of Marine Biology, Kaneohe, toonen@hawaii.edu

Leong, J. C., University of Hawaii - Hawaii Institute of Marine Biology, Kaneohe, USA, jleong@hawaii.edu

Rivera, M. A., University of Hawaii - Hawaii Institute of Marine Biology, Kaneohe, USA, malaire@hawaii.edu

Kosaki, R. K., Papahanaumokuakea Marine National Monument, Honolulu, USA, randall.kosaki@noaa.gov

Kadl, S. A., University of Hawaii - Hawaii Institute of Marine Biology, Kaneohe, USA, skal@hawaii.edu

Keller, K., Papahanaumokuakea Marine National Monument, Honolulu, USA, kaylene.keller@gmail.com

COMMunicating science for ecosystem based management: A case study of the Hawaii Institute of Marine Biology Northwestern Hawaiian Islands Research Partnership

Advances in science have created disconnect between management and scientific findings. As larger amounts of information are generated, a greater emphasis must be placed on better translating this information to improve communication lines between managers and scientists. Science integration and communication are especially important components of ecosystem-based management. The Hawaii Institute of Marine Biology (HIMB) Northwestern Hawaiian Islands Research Partnership uses unique ecosystem-based science to promote an understanding of complex biological systems for management. The HIMB Northwestern Hawaiian Islands Research Partnership will be used as a case study to examine the intricacies of science management integration. A year-long evaluation was conducted that examined the successes of this partnership and produced recommendations for science integration into management. Evaluation and application of lessons learned will be used linking theory and practice, including a review of how the research partnership fits within the current science communications. The HIMB Northwestern Hawaiian Islands Research Partnership serves as a microcosm of many case studies that would rarely be found within a single partnership.
Wiggert, J. D., University of Southern Mississippi/Dept. Marine Science, Stennis Space Center, MS, USA, jerry.wiggert@usm.edu
Long, W., UMCES/Horn Point Laboratory, Cambridge, MD, USA, wenlong@hpl.umces.edu
Xu, J., NOAA/NOS/CSDL, Silver Spring, MD, USA, jiangtao.xu@noaa.gov
Hood, R. R., UMCES/Horn Point Laboratory, Cambridge, MD, USA, rhood@umces.edu
Mathukumalli, B. K., University of Maryland/ESSIC, College Park, MD, USA, mbkp@umd.edu
Lanerolle, L. W., NOAA/NOS/CSDL, Silver Spring, MD, USA, lyon.lanerolle@noaa.gov
Brown, C. W., University of Maryland/CICS, College Park, MD, USA, christopher.w.brown@noaa.gov

ASSESSMENT OF A COUPLED PHYSICAL-BIOGEOCHEMICAL MODEL DEVELOPED FOR WATER QUALITY AND ECOLOGICAL FORECAST USE IN CHESAPEAKE BAY

The Chesapeake Bay is a valuable recreational, ecological and economic resource that is commonly subject to harmful algal bloom (HAB) outbreaks that threaten its continued viability. With expanding knowledge of the water quality conditions likely to promote HAB occurrence, forecasting these events is becoming ever more tenable. HAB triggers include both physical and biogeochemical environmental properties; therefore a fully coupled physical-biogeochemical numerical model that accurately simulates, and forecasts, the Bay’s water quality fields is well-suited for an application as a means of generating nowcasts or forecasts of HAB occurrence. Attaining this technological capability has been a primary motivation for the development of the biogeochemical version of the Chesapeake Bay Regional Ocean Modeling System (ChesROMS). The ecosystem model includes components that explicitly accommodate the impact of river borne sediments, inorganic nutrients and dissolved organic matter. A mechanistic dissolved oxygen implementation has been developed with the intent of resolving seasonally developing hypoxic conditions within the Bay. Here, simulations for the year 1999 will be presented and characterized with respect to in situ observations made available by the Chesapeake Bay Program. These results will highlight and assess the realism of model simulated phytoplankton bloom dynamics and the seasonal evolution of dissolved oxygen distributions in the Bay.

Wigfors, G. H., NOAA/NMFS, Milford, USA, Gary.Wigfors@noaa.gov
Li, J., NOAA/NMFS, Milford, USA, July.Yaqin.Li@noaa.gov
Alix, J. H., NOAA/NMFS, Milford, USA, Jennifer.Alix@noaa.gov
Fuentes, M. S., NOAA/NMFS, Milford, USA, Maria.Soledad.Fuentes@noaa.gov

SURVIVAL STRATEGIES OF PSEUDO-NITZSCHIA MULTISERIES IN APHOTIC ZONE CONDITIONS

High cell densities of Pseudo-nitzschia multiseries have been reported at depth; therefore, it has been suggested that blooms of this species may be initiated by upwelling of seed populations from the aphotic zone. Mechanisms of bloom formation and physiology of P. multiseries exposed to the dark and cold conditions of the aphotic zone, however, are not well understood. In this study we tested the hypothesis that this species changes photosynthetic characteristics and uses stored lipid energy to survive at depth. Cell density, lipid content, and Fv/Fm were measured in exponentially-growing cultures of P. multiseries, cultures were exposed to dark and cold (4°C), samples were removed after 4, 15 and 30 days, the same variables were measured again, and recovery was analyzed. P. multiseries cells catabolized lipids under aphotic-zone conditions, but mortality increased to 42% after 30 days. Photosynthetic capacity also declined; however, cells recovered, resuming growth and increasing Fv/Fm values to control levels within days. Thus, P. multiseries populations can remain viable in conditions of the aphotic zone by consuming stored lipid without any apparent changes in morphology.

Wild-Allen, K., CSIRO Marine & Atmospheric Research, Hobart, Australia, karen.wild-allen@csiro.au
Andrewartha, J., CSIRO Marine & Atmospheric Research, Hobart, Australia, john.andrewartha@csiro.au
Rizwi, F., CSIRO Marine & Atmospheric Research, Hobart, Australia, farhan.rizwi@csiro.au
Skerratt, J., CSIRO Marine & Atmospheric Research, Hobart, Australia, jenny.skerratt@csiro.au
Jones, E., CSIRO Marine & Atmospheric Research, Hobart, Australia, emily.jones@csiro.au
Thompson, P., CSIRO Marine & Atmospheric Research, Hobart, Australia, peter.thompson@csiro.au
Parlows, J., CSIRO Marine & Atmospheric Research, Hobart, Australia, john.parlows@csiro.au
Herzfeld, M., CSIRO Marine & Atmospheric Research, Hobart, Australia, mike.herzfeld@csiro.au
Margvelashvili, N., CSIRO Marine & Atmospheric Research, Hobart, Australia, nugzar.margvelashvili@csiro.au

VALIDATION OF OPERATIONAL BIOGEOCHEMICAL MODELS FOR RESOURCE MANAGEMENT OF COASTAL WATERS

Operational biogeochemical models that simulate the complex high resolution 3D dynamics of coastal and estuarine waters are now available to inform resource managers. Validation of these models in near real time is a formidable challenge and essential for realistic assessment and communication of uncertainty in model predictions. Coastal observations span a wide range of spatial and temporal scales from satellite remote sensing, mooring networks, glider transects and autonomous under-water vehicle missions, to individual station profiles and analysis of bottle samples. Automated analysis and near real time communication of in situ data facilitates rapid synthesis of observations for model validation. Validation of a near real time and short term forecasting coupled 3D hydrodynamic, sediment and biogeochemical model of coastal and estuarine waters in southeast Tasmania, Australia with data from a multi-scale and multi dimensional observing program will be discussed.

Wilkerson, F. P., Romberg Tiburon Center, San Francisco State University, Tiburon, USA, fwilkers@sfsu.edu
Dugdale, R. C., Romberg Tiburon Center, San Francisco State University, Tiburon, USA, rdudale@sfsu.edu
Parker, A. E., Romberg Tiburon Center, San Francisco State University, Tiburon, USA, aparker@sfsu.edu
Marchi, A., Romberg Tiburon Center, San Francisco State University, Tiburon, USA
Blaser, S., Romberg Tiburon Center, San Francisco State University, Tiburon, USA, sarahblaser@gmail.com

ANTHROPOGENIC NUTRIENT ENRICHMENT IN SAN FRANCISCO ESTUARY/Delta- WATERS QUALITY IMPACTS ON PELAGIC FOOD WEBS AND PRODUCTIVITY

Estuaries receive large fluxes of nutrients including reduced forms of nitrogen (e.g. ammonium) as the result of human activities. One major source is effluent from municipal waste-water treatment plants (WWTP). Typically N loading leads to high productivity, blooms and hypoxia. However, in the San Francisco Estuary (SFE), a high relative contribution of ammonium versus nitrate to the DIN pool has detrimental consequences on primary production and phytoplankton community structure. Elevated ammonium precludes phytoplankton use of nitrate (the largest pool of DIN in the SFE) limiting the magnitude of phytoplankton biomass accumulation and may shift the dominant phytoplankton away from diatoms. In the northern SFE/Delta these bottom-up effects impact the food web and may contribute to the recently observed population declines of threatened and endangered fish. To assess the damage of elevated ammonium concentrations (supplied by the Sacramento WWTP effluent) on SFE phytoplankton, transects upstream and downstream were sampled for nutrients, phytoplankton and primary productivity along with ammonium and wastewater effluent addition experiments. Evaluating the role of this WWTP product, on the SFE food web is essential for ecosystem management.

Williams, C. J., Trent University, Peterborough, Canada, claytonwilliams@trentu.ca
Frost, P. C., Trent University, Peterborough, Canada, paulfrost@trentu.ca
Xenopoulos, M. A., Trent University, Peterborough, Canada, mazxenopoulos@trentu.ca

ENVIRONMENTAL REGULATORS ON PICO- AND NANOPHOTOLANKTON ABUNDANCE AND EXTRANELLULAR ENZYME ACTIVITY IN URBAN STORMWATER PONDS

We collected near-surface and bottom water from twenty-seven urban stormwater ponds located in three municipalities of southern Ontario, Canada. In addition to standard limnological variables, we analyzed water samples for heterotrophic bacterial abundance, pico- and nanophytoplankton abundance, and microbial extracellular enzyme activity. Bacteria (range, 0.1 – 4.2x10^8 cells l^-1) and phytoplankton (8 – 832x10^4 cells l^-1) abundance in urban ponds were on average ten and five times higher, respectively, than that of nearby natural freshwater bodies of southern Ontario. Alkaline phosphatase and aminopeptidase activities ranged from 24 to 602 and 37 to 749 nmol l^-1 h^-1, respectively, which are similar to activities measured in
meso- to eutrophic ecosystems. Overall, microbial abundances and enzyme activities did not significantly differ between surface and bottom water samples. Plankton abundance and enzyme activities correlated more strongly with chlorophyll and nutrient cycles are tightly coupled to the pond’s autotrophic community.

Williams, C. Q., USDA-ARS-SEWRL, Tifton, USA, candiss.williams@ars.usda.gov
Lowrance, R., USDA-ARS-SEWRL, Tifton, USA, richard.lowrance@ars.usda.gov
Williams, R., USDA-ARS-SEWRL, Tifton, USA, randy.williams@ars.usda.gov
Williams, J. R., Blackland Research Center, Temple, USA, jwilliams@brc.tamus.edu
Dieppa, A., Jobos Bay National Estuarine Research Reserve, Aguierre, Puerto Rico, dieppa@drna.gobierno.pr
Sotomayor, D., University of Puerto Rico, Mayaguez, Puerto Rico, dsotomayor@uprm.edu
Más, E. G., USDA-NRCS, Mayaguez, Puerto Rico, edwin.mas@pr.usda.gov
Strickland, T. C., USDA-ARS-SEWRL, Tifton, USA, tim.strickland@ars.usda.gov
Bosch, D. D., USDA-ARS-SEWRL, Tifton, USA, david.bosch@ars.usda.gov
Hubbard, R. K., USDA-ARS-SEWRL, Tifton, USA, rob.hubbard@ars.usda.gov

A COMBINED MODELING APPROACH TO EVALUATE WATER QUALITY BENEFITS OF RIPARIAN BUFFERS IN THE JOBOS BAY WATERSHED

The Jobos Bay Watershed, located in south-central Puerto Rico, is a tropical Conservation Effects Assessment Project (CEAP) Special Emphasis Watershed. The purpose of CEAP is to quantify environmental benefits of conservation practices and ecological processes and includes field and watershed modeling. In Jobos Bay, the goal is to determine the environmental impacts of conservation practices, implemented by farmers on the uplands, on coastal and associated coral reef ecosystems. Cultivated fields, adjacent to the Mar Negro mangrove forest, were evaluated to determine the potential effectiveness of a three-zone riparian buffer on the quality of water transported to the bay. The modeling approach included the Agricultural Policy/Environmental Xtender (APEX) and Riparian Ecosystem Management Model (REMM). The APEX model was used to simulate conservation practices on the cultivated field and REMM was used to simulate site-specific conditions of the riparian buffer. Outputs of hydrologic and nutrient data from APEX were used as input for REMM to simulate hydrology and water quality. Benefits of the riparian buffer and its management were determined by comparing potential reductions in water quality outputs.

Williamson Whitney, V. A., Institute for Broadening Participation, Damariscotta, USA, vivian.whitney@sbglobal.net
Johnson, A., Institute for Broadening Participation, Damariscotta, USA, apytler@ibparticipation.org

A CASE STUDY: INTELLECTUAL MERIT AND BROADENED IMPACT ACTUALIZED THROUGH MENTOR ENGAGEMENT

Since 2003, the Minorities Striving and Pursuing Higher Degrees of Success (MS PHD'S) Professional Development Program has maintained a team mentoring structure. Student interaction with multiple mentors resulted in exposure to diverse learning perspectives and increased one-on-one, mentee/mentor interaction. Care was taken to pair MS PHD'S mentees with mentors of similar research and professional interests. Fifteen minority Earth system scientists served as program mentors and 131 minority and non-minority scientists served as meeting mentors. This case study addresses effective mentor recruitment, engagement and retention strategies employed through the MS PHD'S Professional Development Program.

Wilson, A. E., Auburn University, Auburn, USA, wilson@auburn.edu
Bradley, P. J., Tuskegee University, Tuskegee, USA, pbдрley@783@mtyu.tuskegee.edu
Peck, K. E., Smith College, Northampton, USA, kpeck@smith.edu
Chisolm, M. F., Auburn University, Auburn, USA, MFC002@auburn.edu

THE DIAZOTROPH, CYLINDROSPERMOPSIS RACIBORSKI, DOMINATES UNDER VERY LOW AND VERY HIGH NITROGEN-TO-PHOSPHORUS RATIOS: IMPLICATIONS FOR ITS CONTROL

Total nitrogen to total phosphorus ratio (N:P) is considered an important mechanism for structuring phytoplankton communities. The current paradigm suggests that nitrogen-fixing cyanobacteria should persist or dominate under low N:P (< 64:1, by atoms) but be outcompeted by non-nitrogen-fixing cyanobacteria or phytoplankton under higher N:P. Using 2,500 L limnocoreals installed in a eutrophic lake (ambi-ent N:P = 40) whose algal community was dominated by the invasive cyanobacterium, Cylindropermopsis raciborskii, we tested the ability of Cylindropermopsis to persist under very low N:P (7) or very high N:P (122). At the start of the experiment, twelve enclosures were randomly distributed among the control (ambient N:P) and low or high N:P treatments, which were established by adding either P or N, respectively. Throughout the entire 49-day study, Cylindropermopsis, dominated the algal communities in all treatments, including under high N loading. Mass balance calculations showed large P loss in all these treatments (range = -19% to -34%) and a loss of N in the high N:P treatment (-19%). Interestingly, the two treatments with limiting N showed large N gains (92% to 114%) presumably through nitrogen fixation. The ability of Cylindropermopsis to dominate algal communities under such extreme N:P shows that short-term management of nutrients is not likely to be effective for suppressing established blooms of this noxious cyanobacterium.

Wilse, B. J., Queen’s University, Kingston, Canada, Brendan.Wilse@queensu.ca
Paterson, A. M., Dorset Environmental Science Centre, Dorset, Canada, Andrew.Paterson@ontario.ca
Cumming, B. F., Queen’s University, Kingston, Canada, Brian.Cumming@queensu.ca

AN ASSESSMENT OF THE RECENT CHANGES IN DIATOM ASSEMBLAGES FROM EIGHT UNDISTURBED REFERENCE LAKES AT THE EXPERIMENTAL LAKES AREA, NORTHEASTERN ONTARIO

A recent meta-analysis of ‘relatively’ undisturbed lakes (Ruhl et al., 2008, Global Change Biology) suggests that diatom communities show a distinct response to recent climate change across the Northern Hemisphere, with changes occurring earlier in high-latitude lakes. The effects and timing of recent climate change on aquatic ecosystems are often confounded by multiple environmental stressors and differences in lake bathymetry. We studied the response of eight lakes in the Experimental Lakes Area (ELA) to recent climate change because this area is relatively minimally impacted by both local and regional anthropogenic stressors. Sediment cores from 210-Pb dated sediment cores were analyzed for changes in diatom assemblages, at a sub-decadal resolution, over the last ~200 years. Coherency of these changes was assessed under equal temporal resolution among lakes and with the historical climate record. Similar to Rühl et al., we observed a rise in small planktonic taxa, such as Cyclotella stelligera, with changes beginning in the late 1800s, comparable to the timing in subarctic lakes.

Wiltshire, K. H., Biologische Anstalt Helgoland, Alfred Wegener Institute for Polar and Marine Research, Helgoland, Germany, Karen.Wiltshire@awi.de
Boersma, M., Biologische Anstalt Helgoland, Alfred Wegener Institute for Polar and Marine Research, Helgoland, Germany, Maarten.Boersma@awi.de
Franke, H. D., Biologische Anstalt Helgoland, Alfred Wegener Institute for Polar and Marine Research, Helgoland, Germany, Heinz-Dietz.Franke@awi.de
Kraberg, A. C., Biologische Anstalt Helgoland, Alfred Wegener Institute for Polar and Marine Research, Helgoland, Germany, Alexandra.Kraberg@awi.de
Scharfe, M., GKSS Research Centre, Institute for Coastal Research, Geesthacht, Germany, miroco.scharfe@gkss.de

NORTH SEA, GERMAN BIGHT: A REVIEW OF 45 YEARS OF CHANGE

The Helgoland Roads time series is one of the richest temporal marine data sets available. They include daily surface water sampling from 1962 until the present day, resulting in a pelagic data set comprising of phytoplankton, salinity, Secchi and nutrient analyses. Concurrently the time series are augmented by the biological parameters zooplankton, rocky shore macroalgae and macro-zoobenthos and bacteria data series which were sampled discontinuously until the 1990ties and which now have been restarted. Until recently it was relatively difficult to interpret the long term data acquired at Helgoland. This was mainly due to a lack of meta-information and quality control of the data which has now been rectified. We present these data sets and give examples of the major changes in evidence for phytoplankton, through to macro-benthos at Helgoland. We discuss changes in currents, salinity, temperature and nutrients. The changes in the hydrography, temperature and salinity and relate this to changes in species are presented. The evidence we have for neobiota and their placement in the system as well as species shifts are evaluated and related to changes in the hydrography, temperature and salinity.

THE DIAZOTROPH, CYLINDROSPERMOPSIS RACIBORSKI, DOMINATES UNDER VERY LOW AND VERY HIGH NITROGEN-TO-PHOSPHORUS RATIOS: IMPLICATIONS FOR ITS CONTROL

Total nitrogen to total phosphorus ratio (N:P) is considered an important mechanism for structuring phytoplankton communities. The current paradigm suggests that nitrogen-fixing cyanobacteria should persist or dominate under low N:P (< 64:1, by atoms) but be outcompeted by non-nitrogen-fixing cyanobacteria or phytoplankton under higher N:P. Using 2,500 L limnocoreals installed in a eutrophic lake (ambi-
CARBON SYSTEM DYNAMICS IN THE NEAR SHORE WATERS OF THE NORTHWEST HAWAIIAN ISLANDS

Inorganic carbon chemistry was examined in the water column surrounding the Northwestern Hawaiian Islands in the summer of 2009. This research was designed to: (1) establish a baseline against which future changes can be measured, and (2) assess the magnitude and extent of the elevated carbonate saturation state observed on previous expeditions. This “halo” is believed to be produced by the dissolution of highly soluble magnesite calcites and aragonite in the water column surrounding the islands. Transects were conducted at several locations from shallow water to the open ocean 15 km from the island. Continuous hydrographic profiles were collected for pH, oxygen, fluorescence and beam transmission and discrete water samples were collected for the measurement of carbon system parameters. Our results do show that biological processes impact the chemistry of the surrounding water column. In addition, our data also suggest that physical and/or biological processes near the steep slopes surrounding the islands, may affect the distribution of chemical parameters up to 15 km away from the islands.

We present a high resolution record of a 32 cm speleothem collected in 2007 from a cave located near the Belize/Guatemala border at approx. 17°N, 89°W. The cave is able to survive at 4000 ppm CO2. However, highest primary production as well as production of 53 and 49 O2 m-2 h-1, which is comparable to temperate regions. For the second part, one abundant benthic diatom species was incubated with different concentrations to limit algal growth in rivers. Links between particulate P and ecological status were very complex and stream dissolved P concentrations needed to be well below 100 μg P/L in order to minimise the risk of poor ecological status. Deployment of stream-channel flumes at a wider range of sites provided a simple way to identify threshold dissolved P concentrations to limit algal growth in rivers. Links between particulate P and ecological status were poorly defined.

DO and DIC to evaluate the spatial and temporal coupling of these metabolic gases as well as their dependence on biological vs. physical forcing across the northern Gulf of Mexico. While DO is helpful in generating ambient P-R and productivity estimates as well as scrutinizing bottom-water respiration processes, DIC analyses can yield estimates of long-term productivity patterns and quantify sub-oxic respiration. During seasonal sampling, we quantified the importance of the study area as a carbon sink or source, and during multi-year summer surveys we could estimate the relative impact of large physical disturbances (tropical storms) on DO and DIC dynamics. Together, the combined analysis of DO and DIC dynamics is improving our understanding of metabolic processes and their sensitivity to physical and biological forcing, and applications of this approach are far beyond coastal hypoxic areas.

Wothers, P. J., Bangor University, Bangor, United Kingdom, p.wothers@bangor.ac.uk
Jarvie, H. P., Centre for Ecology and Hydrology, Wallingford, United Kingdom, hjp@ceh.ac.uk
Bowes, M. J., Centre for Ecology and Hydrology, Wallingford, United Kingdom, mib@ceh.ac.uk
Harper, D. M., Leicester University, Leicester, United Kingdom, dmh@leicester.ac.uk
LINKING AGRICULTURAL PHOSPHORUS SOURCES TO EUTROPHICATION IMPACTS IN UK RIVERS: A REVIEW OF THE EVIDENCE BASE

Agriculture contributes significant concentrations and loads of phosphorus (P) to water but a direct link between agriculturally-derived P and ecological impacts has not been proven. Evidence of such a link is important in persuading farmers/landowners that their adoption of best management practices will make a difference. A major UK study (PARIS) of stream chemistry and ecology in rural agricultural areas conducted over 5 years concluded that P export from intensively farmed catchments did increase stream P status resulting in a switch to photosynthesis as the energy source, an increase in stream biomass, a shift from shredder to collector-dominated invertebrate communities and an overall reduction in biodiversity. However sources of P in these agricultural catchments were very complex and stream dissolved P concentrations needed to be well below 100 μg P/L in order to minimise the risk of poor ecological status. Deployment of stream-channel flumes at a wider range of sites provided a simple way to identify threshold dissolved P concentrations to limit algal growth in rivers. Links between particulate P and ecological status were poorly defined.

Woolf, J., University of Rostock, Institute of Biological Sciences, Applied Ecology, Rostock, Germany, jana.woelf@uni-rostock.de
Wannicke, N., Leibniz Institute for Baltic Sea Research, Department Biological Oceanography, Rostock, Germany, niola.wannicke@io-warnemuende.de
Hübener, T., University of Rostock, Institute of Biological Sciences, Botany, Rostock, Germany, thomas.huebener@uni-rostock.de
Karsten, U., University of Rostock, Institute of Biological Sciences, Applied Ecology, Rostock, Germany, ulf.karsten@uni-rostock.de
EFFECTS OF DIFFERENT CO2 CONCENTRATIONS ON MICROPHYTOBENTHIC FUNCTION (SOUTHERN BALTIC SEA)

Despite the importance of benthic diatoms for elemental cycling in oceans, almost nothing is known on their ecophysiology and even less on the effects of rising CO2 concentrations. Therefore, this project is divided into two parts: a) field monitoring of community succession in relation to seasonal changes and b) investigations of effects of different CO2 concentrations on selected species under controlled conditions in the laboratory. For the field monitoring a quarterly sampling (investigation period: 2009-2012) was performed at the Southern Baltic Sea. At two stations with different flow and sediment characteristics, sediment cores were taken (0.5 m water depth) for biomass and primary production measurements. The cores incubated under different light and constant temperature conditions exhibited rates of gross production of 53 and 49 02 m2 h-1, which is comparable to temperate regions. For the second part, one abundant benthic diatom species was incubated with different CO2 concentrations (380, 780, 2000, 4000 ppm). First results indicate that this taxa is able to survive at 4000 ppm CO2. However, highest primary production as well as growth was measured at 780 ppm.

Wollenburg, J., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, Jutta.Wollenburg@awi.de
Tiedemann, R., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, Ralf.Tiedemann@awi.de
NOVEL AUTOCLOVE AQUARIA FACILITATES HIGH-PRESSURE METHANE SEEPAGE-EMULATING CULTURE EXPERIMENTS ON BAROPHILIC DEEP-
SEA FORAMINIFERA

Our understanding on paleo-deep-water circulation modes, and deep-water renewal are essentially based on isotopic and geochemical ratios recorded in tests of Fontbotia wuellerstorfi or related barophilic calcareous benthic foraminifera. In this context the δ13C test value of F. wuellerstorfi is postulated to reflect the bottom water dissolved inorganic carbon concentrations in a 1:1 ratio. However, at modern hydrocarbon seeps no typical relationship between bottom water DIC and foraminiferal shell δ13C is observed. Thus, culture experiments on deep-sea benthic foraminifera are needed to test the established hypotheses. However, F. wuellerstorfi neither formed new chambers nor reproduced in mesocosms kept at 1 bar. Because the solubility of methane is pressure dependent and some deep-water foraminifera exhibit a barophilic behavior we used a newly developed autoclave technique to culture benthic seep foraminifers under in situ (high-pressure) conditions. For several months the high-pressure aquaria were bathed in heavily methane-enriched, calcine-tagged seawater. Here we show that long-lasting high-pressure methane-seepage emulating culture experiments on underpressurized deep-sea sediments lead to successful reproduction of barophilic benthic foraminifera. We also show that during the experiments methane was immediately converted to DIC, and that the mean DIC was biominalized in tests of experimental foraminiferal offspring.

Wollrab, S., Ludwig-Maximilian University Munich, Munich, Germany, wollrab@bio.lmu.de
Diehl, S., Umeå University, Umeå, Sweden, sebastian.diehl@emg.umu.se
de Roos, A. M., University of Amsterdam, Amsterdam, Netherlands, A.M.deRoos@uva.nl

ENERGY FLOW AND SPECIES PERSISTENCE IN A WIDESPREAD PELAGIC FOOD WEB MODULE

Understanding the transfer of energy and matter through the planktonic food web is necessary to predict effects of human impacts such as eutrophication and fisheries on the global ocean. We therefore investigate a planktonic food web module that is found throughout the world’s oceans consisting of a limiting nutrient, two competing algae (small nanophytoplankton and larger algae represented by diatoms), a ciliate that preys on nanophytoplankton, and a crustacean top consumer (copepod) that preys on ciliates and diatoms. We theoretically explored the effect of enrichment and increased copepod mortality on the dynamics of the web using Lotka-Volterra-like equations. Additionally, we investigated the effect of different feeding behaviors of copepods (assuming different functional responses) on the dynamics and persistence of the web. We found that with nutrient enrichment all members along the chain of even length increase whereas the intermediate species of the chain of odd length (the diatoms) decreases and eventually goes extinct. The pattern is reversed with increased top consumer mortality. A functional response type 3 for copepods highly stabilizes the system and enlarges the coexistence area.

Wommack, K. E., University of Delaware, Newark, USA, wommack@dbi.udel.edu
Sakowski, E., University of Delaware, Newark, USA, esakows@UDel.EDU
Polson, S. W., University of Delaware, Newark, USA, polson@dbi.udel.edu
Hyatt, M., University of Delaware, Newark, USA, marahyatt@gmail.com
Kress, W., University of Delaware, Newark, USA, wekress@UDel.EDU
Schmidt, H., University of Delaware, Newark, USA, schmidth@UDel.EDU
Wray, J., University of Delaware, Newark, USA, wjef@UDel.EDU
Marine, R., University of Delaware, Newark, USA, rmarine@udel.edu
Williamson, S. J., J. Craig Venter Inst, Sand Diego, USA, swilliamson@jcvi.org

VIRAL METAGENOMICS AS AN EDUCATIONAL PLATFORM: STUDYING VIRIOPLANKTON DIVERSITY THROUGH GENES ENCODING CHAPERONINS AND NUCLEOTIDE METABOLISM PROTEINS

Viral metagenomics has uncovered the extraordinary diversity and surprising genetic capacity of virioplankton assemblages. By and large, these studies have relied on broad analyses of taxonomic and gene function with only cursory attention to genetic details that can reveal much about the predominant biological features within the virioplankton. To address this shortcoming, the phylogenetic diversity and frequency of genes within three functional gene families — ribonucleotide reductase, chaperonins, and DNA polymerase I — was assessed for several virioplankton metagenome libraries. While ribonucleotide reductase and DNA polymerase I are well known in phages, chaperonins have only rarely been reported, but were surprisingly abundant in the viral metagenomes. Using protein clustering and sequence assembly approaches, nearly full length homologs of large subunit chaperonins (groEL) and ribonucleotide reductase (rntA) as well as DNA polymerase were obtained. These investigations showed that virioplankton contain novel alleles and a great diversity of these well known genes. This work represents the collective scientific output of undergraduate researchers thus demonstrating that gene-centric metagenomic analyses can serve as an excellent resource for practical application of bioinformatic analyses in environmental science.

Wood, R. J., NOAA Cooperative Oxford Laboratory, Oxford, USA, Bob.Wood@noaa.gov
Johnson, J. M., USEPA Chesapeake Bay Program Office, Annapolis, USA, johnson@chesapeakebay.net
Martino, E. J., NOAA Cooperative Oxford Laboratory, Oxford, USA, Ed.Martino@noaa.gov
Zhang, X., NOAA Cooperative Oxford Laboratory, Oxford, USA, Xinseng.Zhang@noaa.gov

ZYGANGES BETWEEN CLIMATE DYNAMICS, SEASONAL AND DECADAL VARIABILITY IN HYDROGRAPHIC CONDITIONS, AND PLANKTON AND FISH STRUCTURE AND FUNCTION IN CHESAPEAKE BAY

Improving our understanding of how climate variability influences fisheries recruitment and productivity is critically important to ongoing efforts to improve the state of global fisheries, especially considering the looming specter of future climate changes. The Chesapeake Bay is an ideal coastal ecosystem to study climate-fishery linkages because: 1) it is one of the best monitored estuarine ecosystems in the world; 2) it serves as a critically important estuarine nursery area and feeding ground for many ecologically and economically important coastal Atlantic fish and shellfish populations; and 3) it is subject to pronounced annual climate fluctuations, as it straddles the boundary between continental and maritime climate provinces and is subject to contrasting polar and subtropical air masses. In this talk we quantitatively illustrate the linkages that occur between hemispheric-scale teleconnections, synoptic-scale weather patterns, the Chesapeake’s estuarine hydrographic conditions, its springtime plankton community, and over a century of landings data for striped bass and Atlantic menhaden in the Chesapeake and Mid-Atlantic.

Wright, L. D., Southeastern Universities Research Association, Washington DC, USA, wright@sura.org
Friedrichs, C., College of William and Mary/Virginia Institute of Marine Science, Gloucester Point, USA, cfried@vims.edu
Harding, J., Mississippi State University/Northern Gulf Institute, Stennis Space Center, USA, jharding@ngi.msstate.edu
Howlett, E., Applied Science Associates, Inc, South Kingstown, USA, ehowlett@asascience.com
Levin, D., National Oceanic and Atmospheric Administration, Silver Spring, USA, doug.levin@noaa.gov
Luetich, R., University of North Carolina, Morehead City, USA, rick_luetich@unc.edu
Smith, F. A., Southeastern Universities Research Association, Washington DC, USA, F.A.smiith@sura.org

A SUPER-REGIONAL TESTBED TO IMPROVE MODELS OF ENVIRONMENTAL PROCESSES FOR THE U.S. ATLANTIC AND GULF OF MEXICO COASTS

The U.S. Integrated Ocean Observing System (IOOS) links observations to modeling and predictions to advance an understanding of our oceans and coasts, so decision makers can take action to improve safety, enhance the economy, and protect the environment. The goal of this NOAA IOOS-funded project is to create a multidisciplinary, community-modeling testbed that will facilitate improved operational coastal ocean prediction. The testbed will allow scientists to share models, observations, and tools needed to elucidate, prioritize, and resolve issues associated with interoperable coupling of models. The goals include improving and evaluating models already in operational use within the Atlantic and Gulf Coast super-region, developing and assessing metrics for model skill and system performance, and facilitating the transition of models from research environments to operational centers. Testbed projects will address three chronic issues of high relevance within the super-region: (1) coastal inundation in the Gulf of Maine and Gulf of Mexico; (2) estuarine hypoxia in the Chesapeake Bay and (3) shelf hypoxia in the Gulf of Mexico. A crosscutting theme of the testbed involves the design and implementation of a cyberinfrastructure (CI) to support the three science themes. The super-regional testbed is a showcase for federal-academic-industry collaboration, involving 20 universities, 11 federal centers and programs and 2 private corporations.
Limited research has been performed on the role of the stream biofilm in controlling fate of endocrine disrupting compounds (EDCs). The transformation of select EDCs (17β-estradiol, estrone, 17α-ethynylestradiol, 4-nonylphenol) was evaluated in stream biofilm and sediment matrices collected from locations above and below a wastewater treatment plant effluent discharge. The sediment microbial community was initially more effective that the stream biofilm at biodegrading 4-nonylphenol and 17β-estradiol. Biodegradation of 17α-ethynylestradiol was only observed in treatments with the sediment microbial community. Results indicate that transformation of EDCs by these matrices is controlled by: (1) partitioning onto organic matter, which effectively limits compound bioavailability; (2) delivery of compounds to the heterotrophic community; and (3) metabolic differences in the heterotrophic community in response to differences in available organic energy sources. Sorption to both the stream biofilm and to the sediments occurs on a faster temporal scale (< 1 h) than the potential of the stream biofilm to biodegrade the target compounds (50% mineralization > 70 d). Therefore these compounds tend to accumulate in the stream biofilm, and this has important ecological implications.

As a means of determining if uptake can be used to assess nutrient availability, we measured the uptake of 15N/RWT (Rhodamine WT) along the 0.5 km flowpath to the lake outlet. However, epiphytic periphyton near the lake inflow cumulated only 15% more 15N/RWT ratios, whereas those distant from the inflow had low isotopic 15N/RWT ratios, indicating that the nutrient tracer was depleted prior to reaching the benthic plankton. Despite getting first access to nutrients, seston accumulated only 15% more 15N than epiphyte+macrophytes, thus emphasizing the importance of benthic uptake and production in this ecosystem.
There are two phytoplankton blooms observed on the Mid-Atlantic Bight. One occurs in the fall-winter time and the size of the bloom is tightly coupled to factors that influence the water column mixing in. High mixing is associated with smaller blooms, presumably due to light limitation. The second major bloom on the MAB outer shelf is the spring bloom, which is associated with the rate of stratification, again related to the cells overcoming light limitation. Here we use a high-resolution three-dimensional biogeochemical model we simulated the seasonal phytoplankton blooms for the MAB for the years 2004-2007. We use the ratio of light over the mixed layer depth (MLD) to determine the critical threshold for inducing blooms. We find that for the shallow shelf the critical ratio is 80 (watt m-2) and 150 (watt m-2) for the outer shelf. This ratio can be related to water column depth, providing a means to predict the onset of phytoplankton blooms. A sensitivity study is made to test the role of wind to change the ratio and influence the timing and magnitude of blooms.

Ye, H., Scripps Institution of Oceanography, La Jolla, USA, hye@ucsd.edu
Glaser, S., University of Kansas, Lawrence, USA, sarahmglaser@gmail.com
Teo, S., NOAA Southwest Fisheries Science Center, La Jolla, USA, Steve.Teo@noaa.gov
IDENTIFYING SPATIAL STRUCTURE IN NORTH PACIFIC ALBACORE TUNA (THUNNUS ALALUNGA) USING CHAOTIC TIME SERIES ANALYSIS
Stock assessments of highly migratory fish often make use of multiple indices of abundance to better model and forecast populations. In the case of albacore tuna (Thunnus alalunga) in the North Pacific Ocean, a single index of abundance is used for the US commercial troll fishery, which targets juvenile albacore in the California Current System and North Pacific gyre. Past and current studies, based on morphology and tagging, suggest that there may be two distinct subpopulations that occur to the north and south of the 40°N latitudinal line. We present an additional line of evidence, using nonlinear forecasting techniques based on chaotic time series analysis, that the tuna targeted by this fishery exhibit two different patterns of population dynamics and that these spatial patterns support the hypothesis of intermingling northern and southern subpopulations.

Ye, L., Institute of Hydrobiology the Chinese Academy of Sciences, Wuhan, China, yeling@whxb.ac.cn
Chang, C. Y., Institute of Oceanography, National Taiwan University, Taipei, Taiwan ROC, +886-2-3117111@ntu.edu.tw
Hsieh, C. H., Institute of Oceanography, National Taiwan University, Taipei, Taiwan ROC, chsieh@ntu.edu.tw
BAYESIAN PROBABILISTIC MODEL FOR AUTOMATED ZOOPLANKTON CLASSIFICATION: A NOVEL FRAMEWORK WITH EMPHASIS ON PREDICTIVE CONFIDENCE AND RAPID CATEGORY AGGREGATION
We proposed a novel framework for automated zooplankton classification with an emphasis on predictive confidence and rapid category aggregation based on Naïve Bayesian Classifier (NBC). We take advantage of the posterior probability of NBC to aggregate categories and to single out the objects of low predictive confidence for manual re-classifying to achieve a high final accuracy efficiently. The application on the East China Sea zooplankton samples with 154,289 objects showed that the NBC can achieve rapid class aggregation and a reasonable performance with an overall accuracy of 0.69 for 26 planktonic and 1 aggregated non-planktonic categories. More importantly, after manual checking the 19% - 42% objects of low confidence (depending on how one defines “low confidence”), the final accuracy increases to 85% - 96%. This approach especially achieves significant improvement in recognition accuracy of rare categories, thereafter facilitating ecological applications by improving the estimates of richness, diversity, abundance, and biomass from results of automated classifiers. Our approach can make up the deficiencies of current automated zooplankton classifiers and facilitates an efficient semi-automated zooplankton classification, in which human experts only need to check the objects of low confidence.

Yerger, D. R., Woods Hole Oceanographic Institution, Woods Hole, USA, dyerger@whoi.edu
Gorman, C. R., Woods Hole Oceanographic Institution, Woods Hole, USA, cgerman@whoi.edu
Camilli, R., Woods Hole Oceanographic Institution, Woods Hole, USA, rcamilli@whoi.edu
Kinsey, J., Woods Hole Oceanographic Institution, Woods Hole, USA, jkinsey@whoi.edu
Nakamura, K., Nat’l Institute of Advanced Industrial Sci & Technology, Tsukuba, Japan, koichi.nakamura@aist.go.jp
De Beer, D., Max-Planck-Institute for Marine Microbiology, Bremen, Germany, dbeer@mpi-bremen.de
Boetius, A., Alfred Wegener Institute for Polar and Marine Research in the Helmholtz Association, Bremen, Germany, aboetius@mpi-bremen.de
SYSTEMATIC EXPLORATION OF COLD SEEPS BY AUV? NEW RESULTS USING SENTRY AT THE HAAKON MOSBY MUD VOLCANO, SEPTEMBER-OCTOBER 2010
Novel AUV-based technologies have been proven valuable in the systematic exploration and first characterization of deep-water hydrothermal vent and seep
ecosystems. In September-October 2010, the Sentry AUV team from WHOI joined the ESONET LOOME recovery cruise to the Haakon Mosby Mud Volcano to evaluate strategies for rapidly assessing change in a known and active system. High-resolution multibeam bathymetry documented the continuing evolution of the surface morphology of the HMMV. Water column records from the multibeam sonar can show bubble-rich plumes emanating from the seabed. A Sub Bottom Profiler mounted on Sentry for the first 3 dives of the study was used to investigate sedimentary structures immediately underlying the surface of the Mud Volcano. Co-registered photographic observations together with in situ chemical sensing (CTD, Optical Backscatter, Eh, TETHYS Mass Spectrometer) allowed systematic mapping of both biological and geological features on the seabed. Finally, a series of investigations were conducted using the TETHYS in situ mass spectrometer aboard the AUV Sentry, both directly above the HMMV and in a series of surveys around the perimeter of the site to begin a more careful characterization of export fluxes to the surrounding ocean.

Yoo, M. H., Inha Univ., Incheon, Republic Of Korea, ryu10005@hanmail.net
Roh, S. M., Inha Univ., Incheon, Republic Of Korea

ThH contribution of microphytobenthos to the biomass and production in water column and benthic zone of intertidal area

To study the roles of microphytobenthos as a primary producer in the pelagic and benthic layer of Ganghwa intertidal zone, macrotidal area (8 - 9 m) of Korea, we measured the nutrients, light intensity, suspended materials (SPM), biomass and primary production of phytoplankton and microphytobenthos in the mudflat for 6 hours. Environmental factors showed high variation with the tidal change: SPM (328 – 736 mg l^-1), light intensity (n.d. – 350 uMm^-2s^-1) and salinity (23 – 30 psu). High concentration of SPM was induced from the resuspension of silt and clay on the surface of mudflat by the strong tidal current. Nutrients showed similar trend to concentration of SPM in the water column. The biomass of microphytobenthos was higher during exposed period than submerged period in the tidal flat. Over 26% of total biomass of microphytobenthos in the tidal flat transferred to water column during the submerged period. During the submerged period, the biomass of microphytobenthos contributed to more than 50% of total biomass of primary producer in the water column. However the primary production showed significant low in the water column being due to the high concentration of SPM except standing tide period. During the exposed period, the microphytobenthos contributed to the high primary production in the mudflat. The microphytobenthos contributed over 80% of total primary production in the water column and tidal flat.

Yoshimura, T., Central Research Institute of Electric Power Industry, Abiko, Japan, ytakesh@criepi.denken.or.jp
Suzuki, K., Hokkaido University, Sapporo, Japan, kojis@ees.hokudai.ac.jp
Sugie, K., Central Research Institute of Electric Power Industry, Abiko, Japan, sugie@criepi.denken.or.jp

IMPACTS OF OCEAN ACIDIFICATION ON THE PRODUCTION OF ORGANIC MATTER

We conducted a CO2 manipulation experiment in high nutrients and low chlorophyll regions (the Bering Sea and the central subarctic Pacific) in summer 2007 to investigate the response of the organic matter production to CO2 increase. Surface waters with iron stressed natural phytoplankton assemblages was incubated with bubbling air containing different CO2 concentrations (180, 380, 750, and 1000 ppm). Temporal changes in dissolved organic carbon (DOC) and phosphorus (DOP) were observed for 14 days. In the Bering Sea, net DOC production (ADOC)

Yoshino Kenji, K., Saga University, Saga, Japan, c1894@cc.saga-u.ac.jp
Katano Toshiya, , Saga University, Saga, Japan
Ito Yui, , Saga University, Saga, Japan
Hamada Takaharu, , Saga University, Saga, Japan
Hayami Yuichi, , Saga University, Saga, Japan

HYPOXIC IMPACTS ON THE BENTHIC COMMUNITY IN ARIAKE BAY

Hypoxia is a major problem of coastal waters. Recently, in the inner part of Ariake Bay, Japan, hypoxia occurs in summer periods (about mid July to August) at the organically-enriched bottom. According to our past study in 2006, benthic community structures significantly changed and increased the variability between May (before hypoxia) and August (after hypoxia). This suggested the hypoxic impact on the benthic ecosystem, but no temporal data between the two months made it difficult to precisely assess the hypoxic impact. To compensate the insufficiency, we investigated the more detailed temporal changes in benthic community in this area using the data monthly collected from May in 2010. The community structures before hypoxic months were similar, but after hypoxia species richness and total abundance significantly decreased. Moreover community structures after hypoxia significantly increased the variability as found in our past study. Present results show once again that the impact of annual summer hypoxia is serious and would be a major cause of the recent deterioration of the benthic ecosystem of this site.

Young, A. M., University of Maine, Orono, USA, a.m.young@gmail.com
Karp-Boss, L., University of Maine, Orono, USA, lee.karp-boss@maine.edu
Jumars, P. A., University of Maine, Orono, USA, jumars@maine.edu

FORM AND FUNCTION IN PHYTOPLANKTON: INSIGHTS INTO MECHANICAL PROPERTIES OF DIATOM CHAINS

Diatoms are unicellular, but formation of chains of diverse morphologies is common. Adaptive advantages of chains and processes that control their formation have remained enigmatic despite the dominance of chain-forming species in primary production and sinking fluxes. The morphological and mechanical properties of chains affect their interactions with the physical environment and can provide important insights into chain ecology and evolution. Although morphological characteristics of chains are readily available, information on their mechanical properties is scarce. We calculated the flexural stiffness of four morphologically diverse species of diatom chains by measuring their bending moments in a characterized flow. Results show large variation in the degree of flexibility and brittleness of chains. Further experiments suggest that chains become more brittle under nutrient limitation. These results allow us to design more realistic models of diatom chains to study flow effects on nutrient uptake, encounter with grazers, and aggregate formation.

Young, C. W., University of Hawaii-Manoa, Honolulu, USA, cwyoung@hawaii.edu
Ruttenberg, K. C., University of Hawaii-Manoa, Honolulu, USA, krutten@soest.hawaii.edu
McManus, M. A., University of Hawaii-Manoa, Honolulu, USA, mcmanus@hawaii.edu

PERTURBATION OF TROPICAL COASTAL NUTRIENT INVENTORIES AND PHYTOPLANKTON ECOLOGY DURING STORM EVENTS, OAHU, HAWAII

Tropical islands, characterized by highly variable rainfall, experience dynamic changes in coastal ocean dissolved nutrient inventories and particulate loads. Episodic storm events can impact nutrient concentrations and ratios such that the effects are felt throughout the coastal ecosystem. We report results from a 13-month study focusing on a historical Hawaiian fishpond, on the Island of Oahu. The fishpond is influenced by freshwater and seawater inputs and receives fluvial sediment flux from the uplands. We observe storm-induced perturbations in nutrient ratios and resulting changes in phytoplankton community composition. These seasonal changes are a function of the relationship between baseflow and storm fluvial discharge and the associated residence time of the coastal receiving waters.

Young, E. B., University of Wisconsin-Milwaukee, Milwaukee, USA, eyoung@uwm.edu
Lowes, C. I., University of Wisconsin-Milwaukee, Milwaukee, USA, c.lowes@uwm.edu
Hanson, A. M., University of Wisconsin-Milwaukee, Milwaukee, USA, hanson2@uwm.edu

ORGANIC PHOSPHORUS SOURCES SUPPORT NEARSHORE PRODUCTIVITY IN FRESHWATER ECOSYSTEMS

Phosphorus availability typically limits primary production in freshwater ecosystems but terrestrial runoff contributes allochthonous organic P sources including the widely used phosphonate herbicide glyphosate. Phytoplankton and benthic algae can use dissolved organic phosphonates via extracellular alkaline phosphatase activity (APA) and some freshwater cyanobacteria can use phosphonates. This study aimed to examine use of organic P sources including phosphates, and regulation of APA by phytoplankton. Growth and APA were examined in laboratory cultures and natural phytoplankton assemblages from nearshore Lake Michigan, in response to P supply. Monophosphate esters and glyphosate both stimulated growth of P-limited natural phytoplankton more than did phosphate. Growth of cultures supplied with glyphosate was stimulated by addition of natural bacterial assemblages. Plankton APA was greatly suppressed by high phosphate exposure over several days. We conclude that Lake Michigan phytoplankton are well adapted to use of organic P sources from terrestrial runoff, and that the uplands. We observe storm-induced perturbations in nutrient ratios and result- ing changes in phytoplankton community composition. These seasonal changes are a function of the relationship between baseflow and storm fluvial discharge and the associated residence time of the coastal receiving waters.
USE OF STABLE CARBON ISOTOPES TO DETERMINE THE RESPONSE OF PHYTOPLANKTON TO ANTHROPOGENIC CARBON DIOXIDE

Phytoplankton play an important role in the biological carbon pump and it is important to understand their sensitivity to rising anthropogenic CO2. Oceans are a major sink of CO2 and phytoplankton are a key component in carbon fixation and export. However, the response of phytoplankton to rising CO2 is poorly understood. The ratio of stable carbon isotopes (d13C) in organic matter is a sensitive indicator of phytoplankton utilisation of carbon. This can give us valuable insight not only to modern day anthropogenic responses but can be used as a calibration for the d13C paleoCO2 proxy. d13C was measured along a meridional transect of the Atlantic Ocean and compared to previously published results over the last 40 years. This was combined with a decadal record of carbonates and group specific organic material, alkenones, from sediment traps off Bermuda, along with nutrient, productivity and physics data. Our research provides valuable information of the sensitivity of d13C in organic material and the response of phytoplankton to changes from anthropogenic CO2 which could have major repercussions to global carbon cycling.

Jennifer Young, Queens College, City University of New York, New York, NY, jyoung101@qc.cuny.edu
O’Mullan, G. D., Queens College, City University of New York, Flushing, USA, gordon.omullan@qc.cuny.edu
Juhl, A., Lamont-Doherty Earth Observatory of Columbia University, Palisades, USA, andyjuhl@deo.columbia.edu

ENVIRONMENTAL CONTROLS ON THE DISTRIBUTION AND DIVERSITY OF ANTIMICROBIAL RESISTANT MICROBES IN THE HUDSON RIVER ESTUARY

Microorganisms resistant to tetracycline and ampicillin, two commonly used antibiotics, were detected in the Hudson River and other urban waterways around New York City. Culture dependent approaches were used to quantify the abundance of antibiotic resistant microbes and to examine their correlation to raw sewage inputs, while 16S rRNA gene sequences were used for taxonomic identification and to examine how diversity patterns of resistant bacteria were associated with environmental conditions. Whole and particle-filtered water samples were collected following precipitation events and periods of dry weather in Flushing Bay, NY. Eight additional sites in the Hudson River Estuary were sampled during monthly research cruises to examine spatial variability in resistant microbes and their relationship to environmental conditions. Both ampicillin and tetracycline resistant bacteria were found in greater abundance following precipitation events. The abundance of Enterococcus, a sewage indicating microbe, was found to be correlated with levels of resistance, suggesting a shared sewage-associated source for the indicator microorganism and the phylogenetically diverse resistant bacteria. Patterns in abundance and diversity suggest additional environmental controls on the distribution of resistant bacteria.

Yu, H., UMCES, Solomon's Island, USA, hyu@umces.edu
Bi, H., UMCES, Solomon's Island, USA, bbi@umces.edu
Peterson, B., NOAA, Newport, USA, Bill.Peterson@noaa.gov

ENVIRONMENTAL FACTORS AFFECTING SPATIAL DISTRIBUTION OF JUVENILE CHINOOK SALMON OFF WASHINGTON AND OREGON, U.S.A

Yearling Chinook salmon (Oncorhyncus tshawytscha) and environmental factors were sampled along the Washington and Oregon coast every June 1998-2008. A constrained zero-inflated generalized additive model (COZIGAM) was fitted to the survey data with the result that water temperature, salinity, chlorophyll and zooplankton biomass were significantly correlated with the abundance of salmon. The catch of yearling Chinook salmon also varied over time and space with higher abundances in some years (1999, 2002, 2003, 2007 and 2008) than the other years. Using the latitude of Columbia River as a border, the survey area was divided into the north region and south region. Chinook salmon showed high preferences for the northern region. To investigate the effects of ocean currents on salmon distributions, the ocean current vectors were decomposed into zonal and meridional components. The log transformed proportion of the catch between the south region and north region showed significantly negative linear relationship with six months cumulative alongshore transport. However, the effect of zonal transport is not significant. Results suggest that salmon distribution is determined not only by standard habitat parameters (water properties and planktonic biomass) but by speed of coastal currents. Further study on large-scale ocean conditions, wind variation and life history of salmon will be necessary to develop appropriate models for salmon stock assessment and management.

Zacharias Bios, Z. S., Peruvian Marine Research Institute (IMARPE), Callao, Peru, zacamzarias@imarpe.pe
Yepez Pinillos, V. E., Peruvian Marine Research Institute (IMARPE), Callao, Peru, vyepesz@imarpe.pe

EFFECTS OF HUMAN ACTIVITY ON THE POPULATION OF FRESHWATER SHRIMP, CYPRIHOPS CLEMENTINUS

The freshwater shrimp, Cyprihops clementinus, has economic importance and supports an artisanal fishery in central and southern rivers of the Peruvian coast. As a result of biological and fishery monitoring prospections conducted during 1996 to 2010 in the Cahuete, Ocota, Majes-Camaná and Tambo rivers, information related to its population and biological fishery aspects is reported. An analysis of physicochemical parameters of the water was performed to establish the relationship between its fluctuations and the distribution of the resource. The results indicate the reduction of the specimen fraction with total length higher than 70 millimeters; Ocota river shows specimens larger than average; according to the analysis of the parameter length - weight, the populations were composed by small individuals with better nutritional condition; higher proportion of male specimens in the four prospected rivers; higher density and average biomass in the bottom altitudinal stratum; as well as higher densities of the resource in the rivers Majes - Camaná and Tambo. Average biomass of the resource has been diminished year after year; because of fishing pressure, illegal fishing and other anthropogenic factors.

Zaitsev, H. M., Woods Hole Oceanographic Institution, Woods Hole, USA, emzaitsev@gmail.com
Johnson, M., Woods Hole Oceanographic Institution, Woods Hole, USA, mattjohnson@WHOI.edu

INVESTIGATING THE ROLE OF NITRIC OXIDE, OXIDATIVE STRESS, AND TEMPERATURE IN Symbiodinium spp.

The breakdown of the coral Symbiodinium symbiosis under high sea surface temperatures has resulted in numerous coral reef bleaching events in the last several decades. Although the molecular mechanism leading to these bleaching events is not well understood, work thus far has highlighted oxidative stress as a distinct characteristic of the stress response in both the symbiont and its host. The present study sought to characterize the role of reactive oxygen species (ROS) and the signaling and oxidative molecule nitric oxide (NO), in modulating the responses of Symbiodinium to acute and persistent heat stresses. Here we show a functional role for NO in the sensitization and ultimate destruction of the alga in response to heat stress, while finding little support that ROS alone can elicit metabolic dysfunction and death. Furthermore, differences between genetically similar heat-sensitive and heat-tolerant strains’ responses to the loss or gain of NO in the presence of heat-stress and under normal conditions point to possible differences in regulation of intracellular NO, which may be an underlying cause for their different phenotypes.

Zamor, R. M., University of Oklahoma, Norman, USA, rmzamor@ou.edu
Glenn, K. L., University of Oklahoma, Norman, USA
Hambright, K. D., University of Oklahoma, Norman, USA, dhambright@ou.edu

EARLY WARNING DETECTION OF THE INVASIVE, TOXIGENIC GOLDEN ALGA, PRYMNESIUM PARVUM

Prymnesium parvum is a toxigenic marine algal species that has invaded freshwater systems throughout the world, threatening fisheries, wildlife, and possibly human health. In practical terms, a fish kill is currently one of the first signs that golden algae may be in a particular system. We compared detection and quantification of P. parvum by quantitative real-time polymerase chain reaction (qPCR) and standard microscopy (3–6 replicate haemocytometer slides, 20X) using plankton samples from Lake Texoma (OK-TX) and laboratory cultures. Relative to microscopy, qPCR analysis showed similar P. parvum abundance patterns during three years in Lake Texoma, but eliminated species identification uncertainties. More importantly, qPCR analysis increased sample throughput rates by 5-20 times and allowed for reduction in the practical limit of detection from ~333 to 10 cells mL−1. Faced with the relatively fast recent spread of P. parvum in the US, the large number of systems susceptible to invasion, and the critical importance of these systems in water supply, fisheries, and recreation, qPCR offers an efficient and reliable alternative to microscopy for early warning detection of golden algae.
An increasing number of studies indicate that phytoplankton communities in the subtropical North Atlantic are phosphorus (P) stressed. P stress may be further enhanced as human activity raises atmospheric nitrogen (N) deposition with respect to atmospheric P deposition. However, the magnitudes of atmospheric-deposited P are poorly quantified; contributions from anthropogenic P and water soluble organic P are particularly understudied. Here, we present N and P aerosol and wet deposition data collected at two sites in the subtropical North Atlantic: Miami and Barbados. Mineral dust is the major source of atmospheric P. A strong relationship between dust and P and a unique long-term aerosol record enables a 30+ year estimate of dust-derived P deposition to the western subtropical North Atlantic. More recent samples indicate that in Miami, pollution supplies an additional ~30% of atmospheric P deposition. Water soluble organic compounds contribute at most 15% of total dust P deposition, and 30-50% of total soluble phosphorus. Based on these data we are able to refine expectations of how atmospheric nutrient deposition affects regional new production and P stress.

Zappa, C. J. Columbia University / Lamont-Doherty Earth Observatory, Palisades, NY, USA, zappa@ldeo.columbia.edu

Raymond, P. A., Yale University, New Haven, CT, USA, peter.raymond@yale.edu

McGillis, W. R., Columbia University / Lamont-Doherty Earth Observatory, Palisades, NY, USA, wade.mcgillis@columbia.edu

THE EFFECT OF ATMOSPHERIC STABILITY ON GAS TRANSFER AND REGIONAL ESTUARINE CO2 FLUX

Recent research has highlighted the importance of riverine CO2 evasion to regional and global carbon budgets, with current estimates being comparable to the global oceanic CO2 sink. However, the accuracy of these studies is generally limited by their ability to adequately resolve the rate of gas transfer, k, and the variability in aqueous CO2. Here, we investigate the influence of atmospheric stability on k and the CO2 flux. Because of the stable boundary layer in temperate river systems, the impact on regional CO2 budgets using a long-term time series on the Hudson River, USA is examined. Results show that under conditions of a stable atmosphere, k for CO2 is less than predicted by traditional wind speed parameterizations. The cumulative flux of CO2 at this site is demonstrated to be significantly less when considering atmospheric stability than would be determined if using a traditional wind speed parameterization. This result has implications for the seasonal flux of CO2 in coastal regions since both the CO2 and atmospheric stability, and hence gas transfer velocity, are observed to have a seasonal cycle.

Zavala Lopez, A., California State University Northridge, Northridge, USA, angie_zavala@yahoo.com

Hogue, C., California State University Northridge, Northridge, USA, cheryl.hogue@csun.edu

SHEADING RATE OF FREE-LIVING INFECTIVE STAGES OF THE TREMATODE EULAHAPLORCHIS CALIFORNICAEN IN RESPONSE TO TEMPERATURE

Global climate change is predicted to impact parasitic disease by increasing transmission rates. Temperature will most likely influence the free-living infective stages of trematodes parasites because the adult trematodes are found in endotherms. Production of parasitic infective stages has been shown to increase with temperature. Theoretically, the production of infective stages cannot continue to increase as temperature increases due to an upper threshold limit for the parasites. To understand the effect of increased temperature on trematode shedding rate, I investigated how free-living infective stages of the parasite Eulahaplorchis californicaen respond to temperature. I hypothesize that there is a linear relationship between temperature and shedding rate of E. californicaen. Laboratory experiments were conducted at five different temperatures over a four-hour period on a temperature gradient platform (10 to 45 degree Celsius). Results indicate that temperature and shedding rate increase linearly. Shedding rates continue to increase with temperature until the thermal limit of the host snail is reached. The results suggest that the upper temperature threshold of E. californicaen might be higher than of the snail host.

Zayas-Santiago, C. C., University of Puerto Rico at Humacao, Humacao, Puerto Rico, zayas.carlos30@gmail.com

Colón-Rivera, R. J., Texas A&M University, College Station, USA, ricardojcolon@gmail.com

Feigin, R. A., Texas A&M University, College Station, Puerto Rico

BIOLUMINESCENCE IN THE HUMACAO NATURAL RESERVE: POPULATIONS DYNAMICS OF PYRODIUNUM BAHAMENSI

Rising sea level will cause salt water intrusion in coastal areas impacting coastal wetland ecology. In the Humacao Natural Reserve (HNR) salt water intrusion has been accelerated by a man-made canal that connects the HNR coastal lagoons to the Caribbean Sea. An unexpected outcome of this salt water intrusion was the introduction of Pyrodinium bahamense, a dinoflagellate that produces bioluminescence when in high densities. This research is comparing the population dynamics of Pyrodinium bahamense along a salinity gradient that runs through the linear series of the two lagoon subsystems within the HNR. We are examining: 1) P. bahamense densities along a salinity gradient, 2) physical parameters of the water column depth (m), secchi transparency (m), water temperature (°C), dissolved oxygen (mg/L), specific conductance (μS/cm), salinity (ppt) and pH. Research is being conducted for 12 months to include samples from the dry season and the wet season. We expect that P. bahamense densities will be determined by the salinity gradient due to the marine nature of the organism. For this reason we also expect to find a significant difference between the two lagoon subsystems.

Zbigniew, Z. S., UCSC, Santa Cruz, USA, zolober@gmail.com

Tozzi, S., UCSC, Santa Cruz, USA, stozzi@ucsc.org

BIMODAL EFFECTS OF OCEAN ACIDIFICATION ON MARINE PHYTOPHANKTION

Using a series of laboratory incubations and field experiments in the vicinity of station ALOHA, we have observed bimodal responses in photosynthetic activity of marine phytoplankton to increasing pCO2 and decreasing pH levels. Under nutrient replete conditions elevated pCO2 generally stimulated the photosynthetic activity and the growth rates of selected phytoplankton species as well as the natural phytoplankton communities. The detrimental effects of the accompanying pH change were observed at relatively large pH shift of 0.6 – 0.8 pH units, far exceeding those anticipated within the next 100 years. Under nutrient depleted conditions, however, thresholds of the negative pH effects were much lower, in a range of 0.3-0.4 units, well within the pH shifts anticipated by the end of this century. A result, ocean responses to increasing pCO2 levels are likely to vary between the coastal/upwelling regions, and the oligotrophic gyres of the open ocean. These differential effects are likely to be exacerbated by the anticipated progression of ocean stratification that may further limit nutrient fluxes to the euphotic zone in the oligotrophic ocean. Our data also suggest that changes in pCO2 and pH levels may affect the dynamics of open ocean blooms, resulting in faster progression, higher amplitude, but shorter time-scales of these blooms.

Zeebe, R. E., University of Hawaii, SOEST, Honolulu, USA, zeebe@hawaii.edu

ACIDIFICATION WILL HIT MID/HIGH-LATITUDE CALCIFYS HARDER THAN ANY TIME DURING THE PAST 65 MILLION YEARS
If anthropogenic CO2 emissions continue unabated, the surface ocean saturation state will decrease substantially over the next few centuries, with possible detrimental consequences for marine calcifying organisms. In the surface ocean, the saturation state correlates with temperature. Thus, even during the preindustrial era, the ocean’s surface in mid/high-latitude regions had a lower saturation state than the warm, low-latitude regions. Consequently, the effects of carbon release on surface saturation state and on calcifiers are more pronounced in mid/high-latitudes. This holds for present as well as past rapid carbon releases throughout Earth’s history. I will present results on future and Cenozoic latitudinal gradients in surface ocean saturation state based on climate- and ocean carbon cycle models. Model results are constrained by temperature and carbonate chemistry proxy reconstructions over multi-million year time scale, as well as during aberrations including the Paleocene-Eocene Thermal Maximum. My results suggest that because of modern climatic boundary conditions, the anthropogenic CO2 release will have the largest impact on mid/high-latitude saturation state throughout the past 65 million years—-even if previous events had the same carbon input rate.

**Zeppe, R. G.** U.S. EPA, Athens, GA, USA, zeppe.richard@epa.gov

Cyterski, M., U.S. EPA, Athens, GA, USA, cyterski.mike@epa.gov

Molina, M., U.S. EPA, Athens, GA, USA, molina.mariooa@epa.gov

White, E., U.S. EPA, Athens, GA, USA

Otero, E., University of Puerto Rico-Mayaguez, Mayagüez, Puerto Rico

Wolfe, K., U.S. EPA, Athens, GA, USA

Parmar, R., U.S.EPA, Athens, GA, USA

**PREDICTIVE MODELING OF CULTURABLE AND qPCR ENTEROCOCCI AT BOQUERÓN BEACH, PUERTO RICO**

Contamination of recreational waters and drinking water supplies by pathogenic microorganisms is often assessed using densities of fecal indicator bacteria (FIB), such as fecal enterococci, that correlate with health effects. During the summer of 2009, a study was conducted at Boquerón Beach, Puerto Rico to develop models for prediction of FIB densities at the beach. The Virtual Beach software tool was used to build multiple linear regression (MLR) models using culturable and qPCR-based enterococci measurements as well as other concurrently-observed hydrometeorological and biogeochemical independent variables that characterized conditions at the beach. Results of the study indicated that enterococci levels were low (<1% of the water samples exceeded water quality criteria). ADCP data indicated that low current speeds (<4 cm/s) limited movement of the enterococci from nearby sources to the beach area. Predicted and observed levels of enterococci correlated reasonably well (adjusted R² was 0.43 for culturable and 0.23 for qPCR models). Turbidity, antecedent rainfall and swimmer density were the most important variables for the culturable model and water temperature, wind direction, cloud cover and debris for the qPCR model.

**Zetsche, E.** Vrije Universiteit Brussel (VUB), Brussels, Belgium, e.zetsche@nioo.knaw.nl

Dubois, F., Université Libre de Bruxelles (ULB), Brussels, Belgium, frdubois@ulb.ac.be

Yourassowsky, C., Université Libre de Bruxelles (ULB), Brussels, Belgium, cyourass@ulb.ac.be

El Mallahi, A., Université Libre de Bruxelles (ULB), Brussels, Belgium, aelmallah@ulb.ac.be

Meysman, F., Vrije Universiteit Brussel (VUB), Brussels, Belgium, fmeysman@nioo.knaw.nl

**ALIVE OR DEAD? COMBINING STAINING METHODS AND DIGITAL HISTOLOGIC MICROSCOPY FOR VIABILITY DETERMINATION OF MICRO- AND MESOPLANKTON**

Rapid and efficient analysis of plankton samples has been a key goal of recent technological developments in (semi-)automated analysis and imaging instruments. In addition to identification and abundance estimates, there is a wide spectrum of research applications that requires accurate viability determinations in a sample. One such application is the inspection and monitoring of invasive species in ship ballast water. A variety of methods are available to differentiate live from dead plankton (e.g. SYTOX® Green nucleic acid stain, neutral red vital stain, cell digestion assay), but studies involving these methods have not been targeting larger planktonic organisms. Currently, we are developing and testing a new technique based on digital holographic microscopic imaging, including fluorescence imaging, to assess the number of live zooplankton in ship ballast water. Results are presented from the application of stains to zooplankton as part of a general review of the current knowledge of live-dead determinations for these organisms.

**Zhang, H.** CILER University of Michigan, Ann Arbor, MI, USA, zhanghy@umich.edu

Rutherford, E. S., NOAA/GLERL, Ann Arbor, MI, USA, Ed.Rutherford@noaa.gov

Mason, D. M., NOAA/GLERL, Ann Arbor, MI, USA, Doran.Mason@noaa.gov

Johnson, T. B., Ontario Ministry of Natural Resources, Picton, ON, Canada, tim.johnson@ontario.ca

Adamack, A. T., CILER University of Michigan, Ann Arbor, MI, USA, adamack@umich.edu

Zhu, X., Fisheries and Oceans Canada, Winnipeg, MB, Canada, Xinhua.Zhu@dfo-mpo.gc.ca

Lodge, D. M., University of Notre Dame, Notre Dame, IN, USA, ddodge@nd.edu

**ECOLOGICAL FORECAST OF THE IMPACTS OF ASIAN CARP ON LAKE ERIE FOOD WEB AND FISHERIES—AN EWE APPROACH**

Asian carp (silver carp (Hypophthalmichys molitrix) and bighead carp (H. Nobilis)) were introduced into the United States in early 1970s to control plankton in aquaculture ponds. They escaped into the Mississippi river basin, and now threaten to invade the Great Lakes. The carp grow fast and feed voraciously on plankton, competing with key forage fish species that support valuable fisheries. We used an ecosystem model, Ecopath with Ecosim (EwE), to investigate the impacts of Asian carp on the food web and fisheries of Lake Erie’s central basin. Carp were added to the existing Ecopath model for Lake Erie that has been previously calibrated in Ecosim using time series data from 1994 to 2005. Each carp species was simulated using two life stages (juvenile, adult). Model parameter values for the carp were derived from literature sources. We assumed that potential predators could consume juvenile carp but were unable to consume adults, and that carp could successfully reproduce in the central basin. Impacts are reported of Asian carp on the food web and fisheries in Lake Erie’s central basin.

**Zhang, H.** Lancaster University, Lancaster, United Kingdom, h.zhang@lancaster.ac.uk

Sochaczewski, L., Lancaster University, Lancaster, United Kingdom

Stockdale, A., Lancaster University, Lancaster, United Kingdom

Davison, W., Lancaster University, Lancaster, United Kingdom

**UNDERSTANDING HIGHLY LOCALIZED MOBILIZATION OF METALS AND SULFIDE IN SEDIMENTS**

During the last decade DGT measurements of metals and sulfide in sediments have shown very sharp features of localized mobilization. DGT measurements reflect the concentration in the porewaters at the surface of the device, which is not necessarily the same as the concentration in the porewater without the DGT perturbation. Localised maxima in the DGT measurement can arise if there is a highly localized source of solute in the sediment, which locally raises the concentration. However, as the DGT measures the concentration in the solid phase's ability to supply solute could also lead to maxima. We used the COMSOL package to model the fluxes to a DGT device adjacent to various types of localized sources. The results showed that locally elevated concentrations in the porewaters will be reasonably accurately reproduced by DGT. By using a range of realistic sediment conditions we showed that the sharp localized maxima that have previously been observed are unlikely to be caused by heterogeneity in the solid phase.

**Zhang, R.** Xiamen University, Xiamen, China, ruizhang@xmu.edu.cn

Li, L., China

Jiao, N., Xiamen University, Xiamen, China, jiao@xmu.edu.cn

**GLOBAL PATTERN OF EPIPELAGIC VIRAL ABUNDANCE AND ITS ECOLOGICAL IMPACT**

The viral distribution is dependent on their host and trophic status. Moreover, bacterial mortality by viruses was higher in oceanic waters according to our calculations. Host carbon released by viruses accounted for higher percentage of primary production in coastal/shelf waters than in oceanic waters which indicated that viruses displayed significant interaction with host abundance and Chl a concentration suggesting that viral distribution is dependent on their host and trophic status. Moreover, bacterial mortality by viruses in coastal waters was higher than in oceanic waters, but picoplankton mortality by viruses was higher in oceanic waters than in coastal waters according to our calculations. Host carbon released by viruses accounted for higher percentage of primary production in coastal/shelf waters than in oceanic waters which indicated that viruses played a more active role in coastal/shelf ecosystem than in oceanic ecosystem.
Recurrent hypoxia is well known to occur on the eastern Louisiana shelf due to processes associated with the Mississippi/Atchafalaya river system. In this study, a realistic hydrodynamic model of circulation over the Texas and Louisiana continental shelf is configured with a simple oxygen respiration model to investigate this hypoxia event off the Texas coast. The model domain covers the continental shelf from Texas/Mexico border to the Mississippi/Alabama border, and from the coastline to the continental slope. The model is used to investigate the roles of different mechanisms controlling Texas hypoxia, such as summer-time upwelling-favorable wind, vertical mixing associated with strong near-inertial motions, benthic respiration, and river-plume related stratification.

Zhang, Z., The University of Western Australia, Perth, Australia, zhangz04@student.uwa.edu.au

LOWE, R. J., The University of Western Australia, Perth, Australia, Ryan.Lowe@uwa.edu.au
Falter, J. L., The University of Western Australia, Perth, Australia, jim.falter@uwa.edu.au
Ivey, G. N., The University of Western Australia, Perth, Australia, ivery@sese.uwa.edu.au

A NEW PROCESS-BASED NUMERICAL MODEL FOR SIMULATING BIOGEO-CHEMICAL TRANFORMATIONS IN CORAL REEF ECOSYSTEMS

Biogeochemical processes in coral reefs depend strongly on small-scale physical interactions between benthic organisms and spatial and temporal variability in waves and currents. Nutrient fluxes impact the growth of corals and reef algae, and with other stressors, can cause reef communities to shift from being coral- to algal-dominated. To forecast the human impacts and climate change effects on coral reefs, we must first be able to model the fundamental processes driving nutrient dynamics within these systems. We developed a benthic biogeochemical model to simulate dissolved inorganic nutrients uptake, which was embedded in a three-dimensional numerical ocean model (ROMS) coupled to a numerical wave model (SWAN). Relationships between nutrient uptake and bottom stress derived from flume and field studies were incorporated into the biogeochemical model. Field experiments were carried out on Ningaloo Reef in Western Australia to quantify the dominant hydrodynamic processes and spatial distribution of nutrients. Simulated nutrient uptake distributions revealed a strong dependency on wave and current energy, and agree well with the observed nutrient distributions across a coral reef system.

Zheng, Q., Xiamen University, Xiamen, China, zhengqiang@xmu.edu.cn
Zhang, R., Xiamen University, Xiamen, China, ruizhang@xmu.edu.cn
Jiao, N., Xiamen University, Xiamen, China, jiaoxmu.edu.cn

PHOTOSYNTHETIC GENES GAIN AND LOSS: REVEALED BY COMPARISON OF TWO CITROMICROBIAL BACTERIAL GENOMES

Proteobacteria are thought to be diverged from a phototrophy ancestor according to the scattered distribution nature of phototrophy throughout the proteobacterial clade. The closely numerous closely-related phototrophic and non-phototrophic microorganisms are found as result of the loss of phototrophic genes. Comparison of two genomes of Citromicrobium bacteria, one is Citromicrobium bathyomarinum JL354 that is holding two copies of photosynthetic operons, and the other is Citromicrobium sp. IJT1363 that is non-phototrophic, which have 98.1% sequence similarity of complete 16S rRNA genes, we found the evidence of the loss of phototrophic genes. The incomplete photosynthetic operon (psuLMC-psuhCBA) in strain JL354 was located on integrating conjugative elements which could have greater implications on the horizontal gene transfer of phototrophic genes. Although two photo-synthetic operons were found in strain C. bathyomarinum JL354, its contribution for marine carbon and energy cycle is lower than aerobic anoxygenic phototrophic bacteria in Roseobacter clade.

Zhou, Y., University of Michigan, Ann Arbor, USA, yzhou@umich.edu
Michalak, A. M., University of Michigan, Ann Arbor, USA, amichal@umich.edu
Obenour, D., University of Michigan, Ann Arbor, USA, obenour@umich.edu

TEMPORAL VARIABILITY OF HYPOXIC VOLUME IN THE CHESAPEAKE BAY

Hypoxia was first reported in the Chesapeake Bay (CB) in the 1930s, and has become more common and widespread since the late 1950s and early 1960s due to nutrient influx resulting from anthropogenic activities. Both the spatial extent and duration of hypoxia affect spawning grounds, migratory pathways, feeding habitats, and fishing grounds. Knowledge of the seasonality and interannual variability of hypoxia is necessary for proper water quality forecasting. The purpose of this work is to estimate the bi-weekly variability of hypoxia since the 1980s in CB; and to explore the main ecological, anthropogenic and climatic factors that explain its variability. Therefore, we develop a geostatistical data fusion tool to combine in situ measure-
ments with ancillary information (e.g., bathymetry, remote sensing data) which has the potential of providing some spatial information. This proposed approach will show the hypoxic volumes in three dimensions and evaluate the significance of auxiliary variables. Currently, vertical location (depth) where dissolved oxygen is measured is shown as a significant variable affecting the spread of hypoxia, and the effects of other related variables will be presented as well.

Zhu, Q., Stony Brook University, Stony Brook, USA, qzhu@notes.cc.sunysb.edu
Aller, R. C., Stony Brook University, Stony Brook, USA, raller@notes.cc.sunysb.edu

ANALYSIS OF VITAMIN B12 IN SEAWATER AND SEDIMENT POREWATER USING ELISA

Vitamin B12 (VitB12) is an organometallic compound required by phytoplankton species for marine primary production. The potential role and sources of VitB12 in marine environments are still poorly understood, however, and its distribution, transport and factors controlling production patterns in marine sediments are essentially undocumented, in large part due to the lack of suitable analytical tools. Here a sensitive and highly specific enzyme-linked immunosorbent assay (ELISA) was developed for analysis of VitB12 in seawater and pore water by using VitB12 antibody. Calibration graphs for VitB12 were linear over the range of 0.3 - 74 nM with a direct detection limit of 0.1 nM. Coupled with C18 column solid phase extraction, the method is readily applicable to seawater levels (~1 - 10 nM). Humic acids, DOM, and salinity do not interfere with detection. The concentrations in seawater and porewater samples, and the distribution of VitB12 in marine sediment revealed by our method provide new insights into the cycling and transport of VitB12, and further basis for modeling the behavior of biogeochemically active elements at the seafloor.

Zimmer, L., Old Dominion University, Norfolk, USA, lzimmer@odu.edu
Wurl, O., Old Dominion University, Norfolk, USA, owurl@odu.edu

HIGH RESOLUTION DISTRIBUTIONS OF REACTIVE PHOSPHATE AND ALKALINE PHOSPHATASE ACROSS NORTH ATLANTIC SURFACE WATERS

The role of phosphate as a limiting nutrient in oceanic surface waters is becoming widely recognized. However, this realization is very data limited due to a lack of measurements of reactive phosphate (orthophosphate) at nanomolar levels and sampling resolution sufficient to compare the cycling of phosphate with physical and biogeochemical processes. As part of the 2010 US GEOTRACES North Atlantic Zonal Section (Lisbon, Portugal to Woods Hole, Massachusetts, USA), we used liquid core waveguides and continuous, segmented flow colorimetry to measure surface water phosphate concentrations at nanomolar levels. Phosphate was determined continuously on the transect from Lisbon to the upwelling region off western North Africa, then through the oligotrophic waters of the central Gyre and Sargasso Sea, and finally across the Gulf Stream to Massachusetts. Data were averaged on 15 min intervals, and alkaline phosphate assays were conducted on 6 hour intervals. Depth profiles for discrete samples were also taken at 24 stations along the transect. Data from this very recent cruise will be discussed in terms of input and transport processes, as well as internal cycling of the element.

Zong, R., Xiamen University, Xiamen, China, zarahzong@gmail.com
Jiao, N. Z., Xiamen University, Xiamen, China, jiao@xmu.edu.cn

PROTEOME-BASED ANALYSIS OF METABOLIC PROFILE IN ROSEOBACTER LITORALIS OCH149 UNDER CARBON LIMITATION AND LIGHT REGIMEN

The aerobic anoxygenic photosynthetic bacteria (AAPB) Roseobacter litoralis OCH149 was cultured in carbon limited medium with light regimen. LC-MS/MS was used to determine the protein profile at stationary phase and 2D-MALDI-TOF-TOF-MS/MS was used to detect relative abundance changes of global proteins with the effect of light at both exponential and stationary phases. In total, 395 proteins were identified, of which carbon metabolism and transporter related proteins were two dominant functional groups. The absence of gpi gene in its genome suggests that the ED pathway plays an important role in glucose metabolism, and the two key enzymes of both ED and EMP pathways, Fba and Eda, were down-regulated under light period. Moreover, the reuse of poly-β-hydroxyalkanoate (PHA) was found in carbon limited medium and PhbB was down-regulated under light period. The fluorescence induction and relaxation measurement showed that functional absorption cross section (ơ) decreased during the dark period and recovered to the previous level during the light period. Our findings support the view that AAPB can utilize the light to supply energy partially substituting organic carbon.

Zulkifly, S., University of Wisconsin Madison, Madison, USA, zulkifly@wisc.edu
Graham, J. M., University of Wisconsin Madison, Madison, USA, jgraham@wisc.edu
Graham, L. E., University of Wisconsin Madison, Madison, USA, lkgraham@wisc.edu

SILICON EFFECTS ON GROWTH OF DIATOMS ISOLATED FROM THE PERIPHYTON OF A HYPEREUTROPHIC LAKE

Periphyton communities dominated by the filamentous green macroalgae Cladophora glomerata bearing diverse microalgal epiphytes, including large populations of diatoms, are common in hypereutrophic freshwater bodies worldwide. Because seasonal changes in silica concentration are thought to impact seasonal dynamics of periphytic diatoms, the effects of Si concentrations ranging from 60-780 micrograms Si per ml were examined for Cyclotella meneghiniana and other diatoms isolated from the periphyton of hypereutrophic Lake Mendota, Dane Co., WI. The standing stock of C. meneghiniana increased to a maximum of 2.510.016 cells per ml at 420 micrograms Si per liter, with noticeable declines at higher levels. These results will be compared to those from similar growth analyses of co-occurring diatoms.

Zurbrügg, R., ETH Zurich, Institute of Biogeochemistry and Pollutant Dynamics / Eawag, Surface Waters, Zurich / Kastanienbaum, Switzerland, roland.zurbrugg@env.ethz.ch
Wanamura, J., University of Zambia, Integrated Water Resources Management Center, School of Mines, Lusaka, Zambia, jwanamura@gmail.com
Lehmann, M. F., University of Basel, Institute of Environmental Geosciences, Basel, Switzerland, moritz.lehmann@unibas.ch
Nyangme, I., University of Zambia, Integrated Water Resources Management Center, School of Mines, Lusaka, Zambia, iyangmbe@gmail.com
Wehrl, B., ETH Zurich, Institute of Biogeochemistry and Pollutant Dynamics / Eawag, Surface Waters, Zurich / Kastanienbaum, Switzerland, bernhard.wehrle@eawag.ch
Senn, D. B., ETH Zurich, Institute of Biogeochemistry and Pollutant Dynamics / Eawag, Surface Waters, Zurich / Kastanienbaum, Switzerland, david.senn@eawag.ch

EFFECTS OF HYDROLOGICAL RIVER-FLOODPLAIN EXCHANGE ON C AND N BIOGEOCHEMISTRY IN THE DAM-IMPACTED KAFUE FLATS (ZAMBIA)

Biogeochemical processes such as organic matter mineralization and nutrient export in tropical floodplain ecosystems are strongly influenced by the annual flooding and the magnitude of hydrological exchange between river and floodplain. This study is exploring river-floodplain exchange and its effects on river water chemistry, organic carbon and nutrient dynamics in the dam-impacted Kafue Flats, a 7000 km2 seasonal wetland drained by the Kafue River, Zambia. During flood recession in May 2008-2010, ~70% of water exits the main channel, forced into the floodplain by channel constrictions. Evaporated (conductivity, δ18O-H2O) low-oxygen floodplain water reenters the channel further downstream, resulting in a 4-fold increase in flow and low (<2 mg/L) oxygen values over 130 km of river. River and floodplain are characterized by low inorganic N levels (<1 μM) and indications of N limitation, but maintain relatively high organic N (~20 μM), and we observed considerable net export of organic N and C and from the system. This presentation will focus on characterizing river-floodplain exchange and its influence on the quantity and quality (spectroscopy and stable isotope techniques) of exported organic C and N.
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