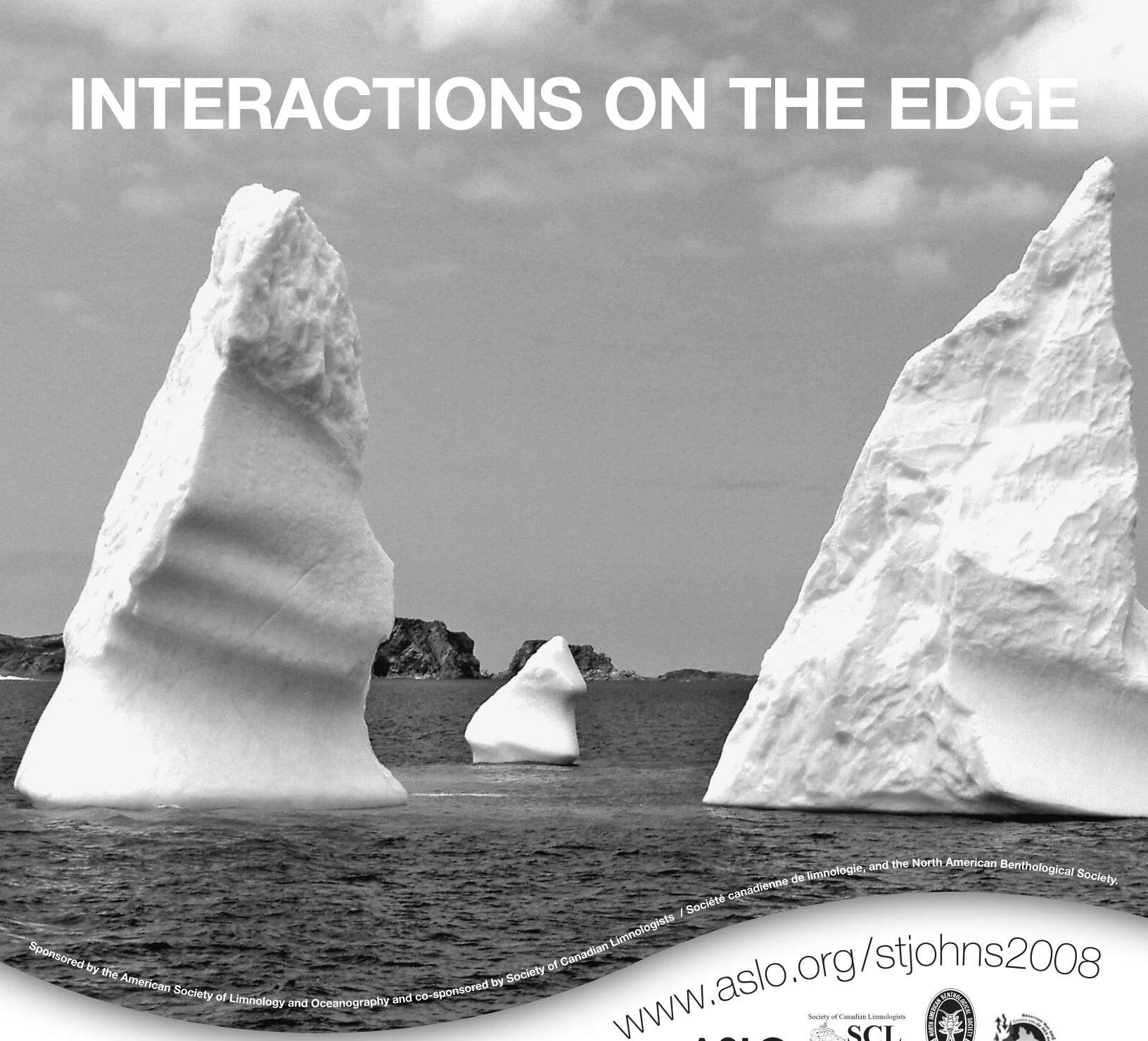
INTERACTIONS ON THE EDGE



Sponsored by the American Society of Limnology and Oceanography and co-sponsored by Society of Canadian Limnologists / Société canadienne de limnologie, and the North American Benthological Society.

www.aslo.org/stjohns2008

ASLO
Advancing the science of limnology and oceanography

Society of Canadian Limnologists
SCL
Société Canadienne de Limnologie

ST. JOHN'S

HYDRO
THE POWER OF COMMITMENT

2008 ASLO Summer Meeting

8-13 June 2008 · St. John's, Newfoundland & Labrador · Canada

Abstract Book

Acharya, K., Desert Research Institute, Las Vegas, USA, k.acharya@gmail.com;
Bukaveckas, P. A., Virginia Commonwealth University, Richmond, USA, pabukaveckas@vcu.edu

UNIFORM VS. HETEROGENEOUS DIET: WHICH ONE DOES ZOOPLANKTON FAVOR?

In nature, the zooplankton diet is most likely to be heterogeneous in nature as it is composed of particles with different nutrient and biochemical contents. Most research on zooplankton dietary implications is based on treatments in which all food particles are treated equal in nutrient and biochemical contents. In this study, we compared several studies done on various species of Daphnia (pulicaria, galeata, lumholtzi, magna) and Bosmina feeding on many diet types such as seston, algal amended seston, uniform algae, and mixed algae of high and low qualities. In most cases, juvenile growth rate and fecundity were measured but in some cases long term growth and mortality were also measured. Overall the results suggested that all the species of Daphnia performed better in laboratory grown, uniform algae over seston or heterogeneous algae of equivalent nutrient and biochemical contents. Most dietary constraints seemed to arise from either the nutrient or the biochemical limitation. Our experiments also suggested that algal amended seston provided a better diet than seston alone. However, the magnitude of the impact differed on different species.

Ackerman, D., SCCWRP, Costa Mesa, USA, drewa@sccwrp.org

MODELING CLIMATE CHANGE AND SEA LEVEL RISE IN WATERSHEDS AND ESTUARIES

Climate change and sea level rise have the potential to dramatically affect a wide range of coastal habitats. As the climate changes, the hydrology and sediment transport from coastal watersheds will likely be different than the current conditions. These differences along with changes in sea level and tidal range have the potential to affect the structure and function of coastal estuaries and the species that depend on them. Linked watershed-estuary models provide a tool to assess the impact of both terrestrial and oceanic forcing (on coastal watersheds and estuaries. Models can be used to evaluate a range of future scenarios on a variety of wetland systems. We applied this approach to approximately 50 estuaries in southern California. Given the number of distinct estuaries, we developed synthetic models representing categories of southern California coastal watersheds and estuaries. This enables results to be generalized across a broad range of conditions and localities and not tied to specific areas. In this study, we modeled the hydrology and sediment transport from three synthetic coastal watersheds and estuaries. The effect of those loadings on estuary circulation, hydrodynamics and sediment transport were also simulated. The results from the models will enable managers to quantify a spectrum of possible watershed and estuary responses to future climate and sea level conditions.

Adams, H. E., University of Michigan, Ann Arbor, USA, hea@umich.edu;
Crump, B. C., University Maryland Center for Environmental Science, Horn Point Laboratory, Cambridge, USA, bcrump@hpl.umces.edu;
Kling, G. W., University of Michigan, Ann Arbor, USA, gwk@umich.edu

DOWNSTREAM DISPERSAL AND ACTIVITY OF BACTERIA.

Bacterioplankton communities disperse into downstream habitats via advective flow along with carbon subsidies from upstream habitats. Persistence of communities in downstream habitats depends on residence time and species sorting processes such as competition based on available carbon sources. The combined influence of transient bacterial communities and associated carbon subsidies on resident downstream communities is poorly understood. To compare the activity of transient and resident bacterial populations, we performed in situ transplant experiments using dialysis bags in which bacteria from the inlet and outlet streams of a headwater lake were incubated in both environments during periods of low and high hydrologic connectivity (stream flow). Molecular fingerprinting indicated communities were very different at the two sites (~45% similarity) and showed little change in composition during incubations. Inlet bacteria had equal or increased activity when transplanted to the lake outlet while the outlet bacteria had depressed activity at the inlet, regardless of flow conditions. This indicates that transient, newly dispersed bacteria are still active in downstream habitats while resident lake bacteria have decreased activity on carbon that is transported from upstream.

Agboola, J. I., Hokkaido University, Graduate School of Environmental Science, Sapporo, Japan, juliusia@ees.hokudai.ac.jp;
Kudo, I., Hokkaido University, Graduate School of Environmental Science, Sapporo, Japan;
Uchimiya, M., Hokkaido University, Sapporo, Japan

SPATIO-TEMPORAL ANALYSES OF NUTRIENTS AND PHYTOPLANKTON BIOMASS IN SUB-ARTIC COASTAL ENVIRONMENT OF JAPAN.

The distribution of nutrients and phytoplankton biomass (Chl *a*) are reported and related to the oceanographic conditions in spring, summer and autumn, and in-plume and out-plume regions on the Ishikari Bay, Japan. Nutrients distribution in surface waters was characterized by the general tendency to decrease from spring to autumn, and plume to out-plume region. In spring, when the in-sea diffusion of nutrients was highest, total Chl *a*) biomass was at par in plume (2.30 mg m^{-3}) and out-plume (2.39 mg m^{-3}) region. Marked seasonal differences in size fractions were also observed. When the water column was strongly stratified and nutrient concentrations were low at surface in summer, average total Chl *a* values were 0.80 mg m^{-3} and 0.38 mg m^{-3} respectively in plume and out-plume regions. In autumn, the intrusion of nutrients into the plume region by intense vertical mixing and riverine inputs produced an increase of the total autotrophic biomass (7.36 mg m^{-3}). This study illustrates how changes in environmental gradients of the coastal system in time and space are affected by seawater dilution, vertical mixing, biological activities and light attenuation.

Agustí, S., IMEDEA CSIC-UIB, Esporles, Mallorca, Spain, sagusti@uib.es;
Duarte, C. M., IMEDEA CSIC-UIB, Esporles, Mallorca, Spain, cduarte@uib.es;
Llabrés, M., IMEDEA CSIC-UIB, Esporles, Mallorca, Spain, moira.llabres@uib.es;
Kennedy, H., School of Ocean Sciences, University of Wales, Bangor, United Kingdom

RESPONSE OF COASTAL ANTARCTIC PHYTOPLANKTON TO SOLAR RADIATION AND NUTRIENT MANIPULATION: AN IN SITU MESOCOSM EXPERIMENT

Despite the HNLC situation described for Antarctic waters, coastal areas are susceptible to develop large phytoplankton blooms, which are not predictable. To test the role of solar irradiance and nutrient inputs on phytoplankton bloom formation in Antarctic coastal waters we performed a large-scale, in situ, mesocosm experiment in Sur Bay (Livingston Island, South Shetlands, Antarctica). Phytoplankton growth, nutrient use and biomass development remained low at reduced light and at ambient irradiances, and increased greatly (> 30 fold) to yield large phytoplankton blooms in response to moderate shading. Nutrient additions (ammonium) greatly stimulated (> one order-of-magnitude) phytoplankton growth, biomass, and nutrient use at ambient irradiances, and lead to a decline in the specific UV absorption by MAAs, indicative of an alleviation from stress derived from high UV and irradiance. Switching experimental treatments confirmed the role of nutrient additions in a second phase of the experiment. These results suggest a narrow window of irradiance where phytoplankton could develop blooms in the coastal Antarctica.

Albertin, A., University of Florida, Gainesville, USA, albertin@ufl.edu;
Sickman, J. O., University of California, Riverside, USA, jsickman@ucr.edu;
Pinowska, A., Michigan State, East Lansing , USA, pinowska@msu.edu;
Stevenson, R. J., Michigan State, East Lansing , USA, rjstev@msu.edu;
Anderson, M., University of Florida, Gainesville, USA, ytramnosredna@yahoo.com

STABLE ISOTOPE COMPOSITIONS OF MACROALGAE, SEDIMENT AND NITRATE IN FLORIDA SPRINGS

The aquifers supplying water to Florida's more than 700 karst springs are susceptible to human activities and land use change. While nitrate levels have increased in most springs over the last 30 years, no quantitative relationship exists between nitrate concentrations and biomass of macroalgae, making it difficult to establish protective nutrient criteria to prevent nuisance algal blooms in these springs. In order to determine nitrate and carbon sources to benthic macroalgal mats, the stable isotopes of macroalgae and spring sediments (δ15N and δ13C) as well as nitrate in spring water (δ15N and δ18O) were measured at three scales: (1) regionally, at multiple springs throughout Florida; (2) along four spring-river runs and; (3) within thick algal mats (>1m) at individual springs. Multiple factors are likely affecting

δ13C values in macroalgae. The regional and gradient studies showed distinct species-specific δ13C compositions, which may be indicative of an algae's relative uptake of and degree of availability for CO2 (aq) vs. HCO3- ion as a carbon source, which, in turn were controlled by pH. Unlike δ13C, macroalgal δ15N values did not show strong species-specific trends.

Alldredge, A. L., University of California, Santa Barbara, USA, alldredg@lifesci.ucsb.edu

THE ROLE OF MARINE SNOW AND GELS IN THE ECOLOGY OF THE SEA

Most of the organic carbon sequestered in the deep ocean sediments as relatively rare, large detrital aggregates known as marine snow. Because they are enriched in organic matter, microbes, and nutrients, these large particles are hot spots for biological and chemical process in the water column and important food sources for pelagic organisms. Recent evidence also reveals the existence of abundant carbohydrate gel particles in the ocean that are intricately involved in the formation of marine snow. These discoveries are changing the way we conceptualize the pelagic zone on small scales. We no longer imagine seawater as a relatively homogeneous fluid in which float a spectrum of dispersed molecules, particles, and organisms, but instead see it as a rich hydrated matrix of transparent organic gels, detritus, and cob-web like surfaces which provide microscale physical, chemical, and biological structure. This talk will focus on the origins, fate, and significance of marine snow and gels in the sea, including their role in carbon cycling, particle flux, food webs, and chemical and biological transformation.

Allen, J. T., National Oceanography Centre, Southampton, United Kingdom, jta@noc.soton.ac.uk;
Painter, S. C., National Oceanography Centre, Southampton, United Kingdom, scp@noc.soton.ac.uk;
Pidcock, R. E., National Oceanography Centre, Southampton, United Kingdom, remp103@noc.soton.ac.uk;
Martin, A. P., National Oceanography Centre, Southampton, United Kingdom, apm1@noc.soton.ac.uk;
Sanders, R. C., National Oceanography Centre, Southampton, United Kingdom, rics@noc.soton.ac.uk

THE BIOLOGICAL IMPORTANCE OF INSTABILITY: FROM DYNAMICS TO LARGE SCALE CHANGE

Eddies and filaments dominate our view of the productive upper ocean. Satellite derived ocean colour images are dominated by these mesoscale and sub-mesoscale physical structures from the patchy onset of the spring bloom through to the onset of deep winter mixing. We will present observations to show how the four principal vertical structures associated with eddies can have different effects on upper ocean productivity. We will present very recent observations of filamentary structures and discuss how these compare with modelling studies; which are considerably more advanced in this field. The relative importance between barotropic (horizontal advection) instability and baroclinic (vertical exchange) instability will be addressed with a particular focus on understanding the net impact of these processes at a basin scale. The major drivers for upper ocean productivity are stratification and nutrient supply. Reduced winter mixing in the N. Atlantic would have an impact on both seasonal surface nutrient replenishment and the vertical flux of nutrients effected by baroclinic instability; we ask the question how do we observe and quantify this impact ?

Allen, M. R., University of Illinois, Urbana, USA, mrallen2@uiuc.edu;
Smith, J. N., University of Illinois, Urbana, USA, jnsmith4@uiuc.edu;
Thum, R. A., Annis Water Resources Institute, Muskegon, USA, thumr@gvsu.edu;
Cáceres, C. E., University of Illinois, Urbana, USA, caceres@life.uiuc.edu

ECOLOGICAL SORTING OF LIFE HISTORY VARIATION IN RECENTLY FORMED LAKES

Metacommunity theory predicts dispersal should structure local species assemblages. An important aspect of this structure is the distribution of trait values within and among communities. We quantified the variation present in important life history traits for *Daphnia pulicaria* and *D. dentifera* present in a series of recently formed strip-mine lakes in central Illinois. Body size differed among lakes, with no lake exhibiting the full regional range of variation. Resource quality was not a significant indicator of among-lake differences in body size. However, phenotypic variation in the field is determined both by genetics and the specific environmental conditions. We tested for genetic differentiation in body size by measuring size at maturity for clones grown in a common garden on high food. Differences in among-lake variation were even more pronounced for size at maturity, representing ~25% of the total variance for both *Daphnia* species. These differences suggest dispersal is not high enough to prevent the subdivision of ecological variation among this series of lakes. Thus, ecological sorting, local adaptation, or persistent founder effects are partitioning local trait variation.

Anderson, K. E., University of California, Riverside, Riverside, USA, kurt.anderson@ucr.edu;
Nisbet, R. M., University of California, Santa Barbara, Santa Barbara, USA, nisbet@lifesci.ucsb.edu;
McCauley, E., University of Calgary, Calgary, Canada, mccauley@ucalgary.ca

SPATIAL SCALE DEPENDENCE OF TRANSIENT DYNAMICS IN STREAMS AND RIVERS

Many organisms disperse by advection in media possessing a net unidirectional flow. The systems these organisms inhabit, such as streams and rivers, are also characterized by a high degree of multi-scale spatial and temporal environmental variability. Recent modeling studies have explored how the equilibrium spatial distribution of organisms results from spatial variability at different scales in streams and similar systems, but have ignored transient responses and temporal dynamics. We address this gap by studying the transient dynamics, following a spatially-extended perturbation, of models describing populations residing in advective media. Our analyses emphasize metrics that can be related to the spatial scale of the perturbation. Population densities show a reduced transient amplification of perturbations, known as reactivity, and return to their equilibrium values quicker when the perturbations vary over smaller spatial scales. Furthermore, populations with high levels of advective dispersal exhibit a peak amplification of perturbations that is small and occurs fast. This relationship holds less generally in a specialist consumer-resource model due to the model's tendency for spatial instabilities.

Anderson, L., U.S. Geological Survey, Denver, USA, land@usgs.gov;
Striegl, R. G., U.S. Geological Surve, Denver, USA, rstriegl@usgs.gov;
Wickland, K. P., U.S. Geological Survey, Boulder, USA, kpwick@usgs.gov;
Finney, B. P., Idaho State University, Pocatello, USA, finney@isu.edu;
Guldager, N., USFWS - Yukon Flats National Wildlife Refuge, Fairbanks, USA, Nikki_Guldager@fws.gov

INFLUENCE OF HYDROGEOGRAPHIC SETTING ON LIMNOLOGY AND CARBON DYNAMICS OF LAKES IN THE YUKON FLATS, ALASKA

The Yukon Flats National Wildlife Refuge in central Alaska is a 26,300-km2 area of wetlands, lakes, river meanders and sloughs. Remote sensing studies suggest regional decreases in lake areas as a consequence of recent increases in evapotranspiration and permafrost degradation, having implications for fish, wildlife and lake carbon dynamics. However, direct observations indicate that changes in lake surface areas vary locally. To evaluate geologic, hydrologic, and other physical controls on limnology of the Yukon Flats, ten lakes were sampled for water chemistry, oxygen and carbon isotopes, and recent sedimentation. Dissolved organic carbon concentrations and chemical characteristics such as ultraviolet absorption and fluorescence correlate with increased lake evaporation that reflects longer lake water residence times. Water chemistry is related to geographic location (proximal to river, near lowland margins, or on uplands) and hydrologic connectivity with upland sourced groundwater or Yukon River water. Other relations among hydrogeographic setting and lake carbon characteristics, including organic sediment accumulation and dissolved gas concentrations, also were evaluated. Our results show that lake sensitivity to climate change varies spatially and is primarily a function of lake hydrology.

Anderson, T. R., National Oceanography Centre, Southampton, United Kingdom, tra@noc.soton.ac.uk

MODELLING MARINE ECOSYSTEMS AND THE "UNREASONABLE EFFECTIVENESS OF MATHEMATICS"

Eugene Wigner (1902-1995), Hungarian physicist and Nobel Prize winner, lauded the "unreasonable effectiveness of mathematics" in articulating the laws of nature in the physical sciences. Can the same be expected of ecological theory? Progress in marine ecosystem modelling continues apace, the simple NPZD models of yesteryear being replaced by the plankton functional type models of today. The application of these models, simple and complex alike, bears no resemblance, I argue, to the physicists' hypothetico-deductive method of hypothesising and critically testing theories. Instead, the usual procedure is to adjust an assortment of free parameters to forcibly ensure good agreement between model and data, the further step of critical testing (validation) being an extravagance undertaken by few. Should modeling therefore be relegated to the realm of pseudoscience, akin to voodoo or sorcery? I will discuss modeling method in context of the progress made in our understanding and prediction of marine ecosystem dynamics, focusing on its pros and cons as a research tool.

Arhonditsis, G. B., University of Toronto, Toronto, Canada, georgea@utsc.utoronto.ca;
Brett, M. T., University of Washington, Seattle, USA, mtbrett@u.washington.edu;
Stow, C. A., NOAA Great Lakes Environmental Research Laboratory, Ann Arnor, USA, Craig.Stow@noaa.gov;
Reckhow, K. H., Duke University, Durham, USA, reckhow@duke.edu

EUTROPHICATION RISK ASSESSMENT USING BAYESIAN CALIBRATION OF PROCESS-BASED MODELS

We introduce the Bayesian calibration of process-based models to address the urgent need for robust modeling tools that can effectively support environmental management. The proposed framework aims to combine the advantageous features of both mechanistic and statistical approaches. Models that are based on mechanistic understanding yet remain within the bounds of data-based parameter estimation and accommodate rigorous and complete error analysis. We examine the advantages of the Bayesian calibration using a four state variable model and the mesotrophic Lake Washington as a case study. Prior parameter distributions were formed on the basis of literature information, while Markov chain Monte Carlo simulations provided a convenient means for approximating the posterior parameter distributions. The model reproduces the key epilimnetic temporal patterns of the system and provides realistic estimates of predictive uncertainty for water quality variables of environmental interest. Finally, we highlight the benefits of Bayesian parameter estimation procedure, such as the quantification of uncertainty in model predictions, optimization of the sampling design of monitoring programs using value of information concepts from decision theory, alignment with the policy practice of adaptive management, and expression of model outputs as probability distributions, that are perfectly suited for stakeholders and policy makers when making decisions for sustainable environmental management.

Armstrong, R. A., Stony Brook University, Stony Brook, USA, rarmstrong@notes.cc.sunysb.edu

SIZE STRUCTURE AND TAXONOMIC STRUCTURE: EMPIRICAL PATTERNS, BIOGEOCHEMICAL CONSEQUENCES, AND MODELING STRATEGIES

Size plays a critical role in structuring aquatic communities. For phytoplankton, size determines maximum nutrient uptake rates and susceptibilities to grazing. For zooplankton, size usually determines who eats whom. Taxonomic identity influences, and sometimes overrides, size, as when small dinoflagellates consume larger diatoms. While size per se is of no obvious biogeochemical consequence, taxonomic identity is: for example, diatom frustules provide ballast for sinking particles; and carbonate particles (coccoliths, and foraminiferal and pteropod shells) that sink to depth remove alkalinity from surface waters in addition to ballasting organic carbon to depth. In contrast, size influences biogeochemistry only indirectly, for example by favoring mineral-secreting organisms over non-shelled organisms, or vice versa. Here I discuss several patterns of plankton size and taxonomic structure; patterns from the IronEx II experiment will receive particular attention. A brief history of modeling size-structured communities will then be presented, including discussion of problems that have beset each method. I will conclude by discussing an approach that could obviate the most vexing problem in modeling phytoplankton size and taxonomy: representing and/or parameterizing zooplankton grazing.

Armstrong, S. D., Purdue University, West Lafayette, USA, sarmstro@purdue.edu;
Smith, D. R., USDA-ARS, West Lafayette, USA, Douglas.R.Smith@ars.usda.gov;
Owens, P. R., Purdue University, West Lafayette, USA, prowens@purdue.edu;
Joern, B. C., Purdue University, West Lafayette, USA, bjoern@purdue.edu;
Huang, C., USDA-ARS, West Lafayette, USA, Chi-hua.Huang@ars.usda.gov

IMPACTS OF A SWINE MANURE SPILL ON PHOSPHORUS PARTITIONING IN A FLUVIAL SYSTEM: EVALUATION OF AN ALTERNATIVE MANURE SPILL REMEDIATION METHOD

Manure spills from confined animal feeding operations (CAFOs) have become an international concern. The objectives of this study were to determine the P partitioning between fluvial sediments following a manure spill and to evaluate the effectiveness of chemically treating exposed sediments. A swine manure spill was simulated in three flumes pack with ditch sediments for 23 hr. Following the manure spills, four flumes were used with the following treatments: (1) no manure and no treatment; (2) manure spill without treating sediment; (3) manure spill followed by 1:1 molar ratio (Al:P) application of aluminum sulfate (alum); and (4) manure spill followed by 2:1 molar ratio (Al:P) application of alum. Phosphorus desorption was monitored using a 24 hr circulation of P free water. Soluble P concentrations post spill sharply increased to 3.80 mg P L-1 compared to 0.02 mg L-1 pre-spill. For clayey sediments the 1:1 treatment reduced SP concentrations by 50% and the 2:1 treatment reduced SP concentrations to near background concentrations. This study suggests that sediment treatment following a manure spill could reduce P desorption from highly enriched sediments.

Arts, M. T., Environment Canada, Burlington, Canada, Michael.Arts@ec.gc.ca;
Claramunt, R. M., Michigan Department of Natural Resources, Charlevoix, USA, claramur@michigan.gov;
Ebener, M. P., Chippewa-Ottawa Resource Authority, Sault Ste. Marie, USA, mebener@lighthouse.net;
Faisal, M., Michigan State University, East Lansing, USA, faisal@cvm.msu.edu;
Fitzsimmons, J. M., Department of Fisheries and Oceans, Burlington, Canada, John.Fitzsimons@dfo-mpo.gc.ca;
Honeyfield, D. C., U.S. Geological Survey, Wellsboro, USA, honeyfie@usgs.gov;
Hoyle, J., Ontario Ministry of Natural Resources, Picton, Canada, jim.hoyle@ontario.ca;
Johnson, T., Ontario Ministry of Natural Resources, Picton, Canada, tim.johnson@mnr.gov.on.ca;
Jones, M. L., Michigan State University, East Lansing, USA, jonesm30@msu.edu;
Kinnunen, R. L., Michigan State University , East Lansing, USA, kinnune1@msu.edu;
Koops, M., Department of Fisheries and Oceans, Burlington, Canada, marten.koops@dfo-mpo.gc.ca;
Mezek, T., University of Nova Gorica, Ljubljana, Slovenia, tadej.mezek@gmail.com;
Muir, A. M., Purdue University, West Lafayette, USA, ammuir@purdue.edu;
Richards, A., Department of Fisheries and Oceans, Burlington, Canada, agnes.Richards@dfo-mpo.gc.ca;
Sutton, T. M., University of Alaska Fairbanks, Fairbanks, USA, tsutton@sfos.uaf.edu;
Wagner, T., Michigan State University, East Lansing, USA, wagnerty@msu.edu;
Wright, G., Nunns Creek Fishery Enhancement Facility, Hessel, USA, gwright@sault.com

FATTY ACID PROFILES OF LAKE WHITEFISH (COREGONUS CLUPEAFORMIS) IN THE EVER-CHANGING GREAT LAKES

The widespread distribution and intermediate trophic position of lake whitefish (Coregonus clupeaformis) in the Great Lakes makes them potentially useful candidates for biomonitoring programs. In addition, lake whitefish are the largest of the remaining commercial fisheries on the Great Lakes and therefore there is considerable interest in understanding the underlying forces affecting their condition and natural mortality rates. In this regard, the analyses of fatty acids in selected fish tissues provides a valuable tool to assess fish condition and to make inferences about how large-scale environmental perturbations might propagate through the ecosystem. We showcase a variety of lipid-based metrics in essential fatty acids (EFA) of muscle and retinal tissues, ratios of EFA in total versus

polar muscle lipid fractions, reproductive fitness parameters, and novel biomarkers (e.g., poly-methelene interrupted fatty acids). Our results clearly illustrate the enormous plasticity in lake whitefish fatty acid profiles and that, from a biochemical perspective, fish condition is not always reliably assessed by traditional metrics that rely on simple mathematical relationships between length and weight.

Avery, T. S., Acadia University, Wolfville, Canada, trevor.avery@acadiau.ca;
Vander Kloet, S. P., Acadia University, Wolfville, Canada;
Northrup, V., Acadia University, Wolfville, Canada;
Snyder, M., Acadia University, Wolfville, Canada

MORPHOLOGY COLLIDES WITH GENETICS IN SCALLOP PHYLOGENY: FINDING A HOME FOR PLACOPECTEN.

Phylogenetic trees were constructed using 12S and 16S mitochondrial rRNA obtained from GenBank to determine the taxonomic status of the monotypic genus *Placopecten magellanicus*. A perusal of the taxonomic and nomenclatural history revealed inconsistencies resulting in the improper placement of *Placopecten* within the family Pectinidae. Morphologically, *P. magellanicus* is placed within the subfamily Chlamydinae, but genetically it is most closely related to both *Mizuhopecten yessoensis* (Chlamydinae) and *Argopecten irradians* (Pectininae) including the genera *Chlamys* and *Pecten*, respectively. Various bootstrap minimum evolution and maximum parsimony trees were constructed showing that the current phylogeny of Pectinidae, based on morphology, can not be entirely reconstructed genetically. The lack of full mitochondrial genomes may contribute to the lack of correspondence, however, 12S and 16S sequences are liberally used in phylogenetic analyses due to their proven success in resolving other lineages. In this instance, however, the sequences could not definitively resolve the placement of *Placopecten* in either *Pecten sensu lato* or *Clamys sensu lato*. Its alliance with *Argopecten irradians* does make biogeographic sense as both occur in NE North Atlantic waters, but occupy different niches.

Avramescu, M. L., University of Ottawa, Ottawa, Canada, mavra006@uottawa.ca;
Yumvihoze, E., University of Ottawa, Ottawa, Canada;
Lean, D., University of Ottawa, Ottawa, Canada, dlean@uottawa.ca;
Fortin , D., University of Ottawa, Ottawa, Canada, dfortin@uottawa.ca;
Hintelmann, H., Trent University, Peterborough, Canada, hhintelmann@trentu.ca

BIOGEOCHEMICAL FACTORS INFLUENCING MERCURY METHYLATION IN FRESHWATER SYSTEMS

High concentrations of monomethylmercury in fish have triggered a large body of scientific studies and led to major policy decisions related to safe consumption. Our study focuses on the biogeochemical factors that affect NET methyl mercury formation, more specifically the role played by iron and sulfate reducing bacteria and methonogens. Methylation and demethylation were measured by using enriched stable isotopes of mercury 200Hg2+ and Me199Hg+ in microcosms treated with specific bacterial inhibitors. Sediments were sampled in July and August 2007 from the St. Lawrence River in Cornwall, Ontario and incubated in the dark at room temperature in an anaerobic chamber for 96h. The amount of Me200Hg+ produced and the amount of Me199Hg+ remaining were measured and flux rates calculated. Monomethylmercury concentrations increased linearly during the first 24 h then stopped for all treatments, indicating that the small amount of mercury added was probably the only bioavailable form or that the processes of methylation and demethylation rapidly equilibrated. Stimulation of methylmercury production was observed when methanogens were inhibited, and methylation was only partially limited by sulfate-reducing bacteria inhibition suggesting that iron reducing bacteria might be involved in the methylation process.

Bailey, R., University of Western Ontario, London, Canada, ghost.rca@gmail.com;
Bailey, J., University of Western Ontario, London, Canada;
Cote, D., Parks Canada, Glovertown, Canada, david.cote@pc.gc.ca;
Reynoldson, T., Environment Canada, ,

DO I CARE WHERE I AM? THE IMPORTANCE OF BIOGEOGRAPHY IN DESIGNING BIOASSESSMENT NETWORKS

The Reference Condition Approach (RCA) has been adopted as the basis of national stream biomonitoring in Canada. The approach uses predictive models that utilize the relationship between invertebrate community structure and habitat to assess the condition of test sites. This approach requires the collection of a database of reference sites which include data on the invertebrate assemblages and associated habitat. From these data bases predictive models are constructed. Typical databases for the Fraser River watershed in British Columbia or the Yukon River watershed use 219 and 158 reference sites respectively. This is a considerable investment of resources and the collection of sufficient sites to cover all of Canada is likely prohibitive. One issue regarding the predictive models is whether or how much they can be applied outside the geographic boundaries of where they were developed. Using data bases from the Yukon, the Fraser, Northern Ontario and Newfoundland, we have examined the degree of large scale variation in the biological communities and early results indicate that these models may have application beyond the boundaries of their development.

Bailey, R. C., The University of Western Ontario, London, Canada, drbob@uwo.ca;
Bailey, J. L., The University of Western Ontario, London, Canada, jbaile3@uwo.ca;
Yates, A. G., The University of Western Ontario, London, Canada, ayates@uwo.ca;
Stammler, K., The University of Western Ontario, London, Canada, kstammle@uwo.ca

MIXED MESSAGES ARE INFORMATIVE: FISH VERSUS BUG BIOASSESSMENT DECISIONS.

When more than one taxonomic group is used for bioassessments, it is common to ask which "works" better, or which we could do without. We examined studies in northern (Yukon Territory) and southern (Ontario) contexts where fish and macrovertebrates had been collected simultaneously from the same sites. The sites varied with respect to their exposure to human stressors from reference (relatively unexposed to human activity) to highly exposed. The two taxa disagreed more than half the time when used to judge whether or not a site was in reference condition. The nature of the disagreement was further analyzed to discern the particular aspects of the natural and stressor environment that seemed to cause the difference in response of fish versus bugs. The ramifications of this mixed message in decision-making and management will be considered.

Bailey, S. A., Fisheries and Oceans Canada, GLLFAS, Burlington, Canada, sarah.bailey@dfo-mpo.gc.ca;
Rup, M. P., Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Canada, rup1@uwindsor.ca;
Wiley, C. J., Fisheries and Oceans Canada/Transport Canada, Sarnia, Canada, chris.wiley@dfo-mpo.gc.ca;
Minton, M. S., Smithsonian Environmental Research Center, Edgewater, USA, mintonm@si.edu;
Miller, A. W., Smithsonian Environmental Research Center, Edgewater, USA, millerw@si.edu ;
Ruiz, G. M., Smithsonian Environmental Research Center, Edgewater, USA, ruizg@si.edu;
MacIsaac, H. J., Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Canada, hughm@uwindsor.ca

LOOKING AT LAKERS: DOMESTIC SHIPPING AS A VECTOR FOR INTRODUCTION OR SPREAD OF AQUATIC NONINDIGENOUS SPECIES IN THE GREAT LAKES

Due to the vast volume and area of the Great Lakes, our ability to detect the initial introduction of new aquatic nonindigenous species (ANS) is overshadowed by the rate of spread, or secondary transfer, to new locations in the basin. Secondary vectors, such as ballast water carried by domestic commercial ships ("Lakers"), have the potential to spread ANS at rates many orders of magnitude greater than would be expected by natural mechanisms (such as downstream drift). We have conducted the first detailed analysis of the movement of ballast water by Lakers, documenting the geographical movement of ~200 million metric tonnes of ballast water, during ~30,000 vessel transits over a three year period at 135 ports between Duluth, Minnesota and Sept Iles, Quebec. In addition, we report results to date from ongoing biological surveys to determine the diversity and abundance of zooplankton, phytoplankton and fish viruses transported in

Laker ballast water. Detailed knowledge of the major ballast water donor and recipient ports, as well as the taxa likely to be entrained in tanks, will be valuable for future targeted monitoring and management strategies.

Baines, S. B., Stony Brook University, Stony Brook, USA, sbaines@ms.cc.sunysb.edu

WILL ZEBRA MUSSELS ALTER THE RESPONSE OF ECOSYSTEMS TO INCREASING DOM SUPPLY

The ability of zebra mussels to use dissolved organic matter (DOM) as an energetic subsidy can allow these organisms to cause persistent declines in phytoplankton biomass without starving. Consequently, the presence or absence of zebra mussels in a lake or river may have a profound effect on the response of these ecosystems to increases in the supply of DOM from the terrestrial environment. In this study, we re-analyze physiological and water column data from the Hudson River to assess the role that terrestrial DOM subsidies have played in the reduction of algal biomass by zebra mussels. We show that without this subsidy, phytoplankton biomass would be approximately 2-fold higher than it is today and blooms would be more frequent. Using extant data on the zebra mussel population, we also assess whether increases in DOM within the Hudson may have amplified the effects of zebra mussels over time as predicted. Finally, we use a more general population model to address the conditions under which DOM subsidies are most likely to enhance the effect of zebra mussels.

Baker, K. D., Memorial University, St. John's, Canada, p24kdb@mun.ca;
Haedrich, R. L., Memorial University , St. John's, Canada, haedrich@mun.ca

RECOVERY TIMES FOR EXPLOITED DEEP-SEA FISH POPULATIONS

Because of their slow growth rates, late maturity, low fecundity and long lifespans, deep-sea fishes are vulnerable to and theoretically slow to recover from overexploitation and bycatch. Definitive assignment to an IUCN category for most species, however, is hampered by a lack of basic biological information, especially generation times. The same information is needed to calculate intrinsic rates of population growth, thus limiting efforts to determine possible recovery times. Such information does exist for two potentially "at-risk" Atlantic grenadiers, and their calculated times to recovery with no fishing mortality range from over a decade to over a century. Given documented declines, the lack of basic data on life-history parameters, and the demonstration here of long recovery times for two species, adherence to the precautionary principle requires immediate implementation of conservation measures and careful consideration of the timescales used to assess conservation targets in the deep sea.

Ban, S., University of Shiga Prefecture, Hikone, Japan, ban@ses.usp.ac.jp;
Tamura, M., University of Shiga Prefecture, Hikone, Japan;
Mori, T., Nihon University, Fujisawa, Japan, tellme07@brs.nihon-u.ac.jp

CROWDING EFFECT ON ENERGY ALLOCATION IN *DAPHNIA MAGNA*

Growth and reproduction rates in *Daphnia magna* were examined at 1, 10 and 20 ind./50-ml-vessel using a flow-through system that keeps constant food supply and avoids accumulation of own metabolites. Additionally, ingestion and respiration rates at the three densities were measured, to clarify the crowding effects on energy allocation. *D. magna* reared in the two crowding treatments grew slower after maturation and produced less offsprings as compared with those of a single one. Although the daphniids matured at the same timing in any treatments, the crowded daphniids matured at smaller size and laid larger eggs. Ingestion rates decreased while respiration rates increased with the density. Gross production was almost the same between the treatments though the crowded daphniids less ingested, therefore assimilation efficiency increased with the density. This indicates that crowded *D. magna* feeds on less amount of food alga, but compensates the input energy with high assimilation efficiency. Finally, net production was the same between the treatments, but reproductive investment was higher in the crowded treatments. This implies the trade-off between growth and reproduction under crowding situation.

Bastien, J., Environnement Illimité inc., Montreal, Canada, julie.bastien@envill.com;
Tremblay, A., Hydro-Québec, Montreal, Canada, Tremblay.Alain@hydro.qc.ca;
Demarty, M., Environnement Illimité inc., Montreal, Canada, maud.demarty@envill.com

CO2 AND CH4 PARTIAL PRESSURE UNDER-ICE IN EASTMAIN-1 RESERVOIR (QUÉBEC, CANADA)

The magnitude of the loss of greenhouse gases at spring ice-melt is not well known in northern reservoirs. Field campaigns to measure dissolved greenhouse gases (GHG : CO2 and CH4) under-ice were carried out in the winter of 2007 and 2008 in the Eastmain-1 reservoir and natural lakes in the vicinity. Over forty stations were sampled in the Eastmain 1 reservoir and in natural lakes. The reservoir stations were spread over different flooded land types (lakes, forests and peatlands). Partial pressure was measured in-situ (EGM-4 and air exchanger) and ex-situ (chromatography) for CO2, and ex-situ only for CH4. Dissolved oxygen and temperature profiles were taken at all stations. Surface pCO2 varied from about 1,300 to 5,000 µatm, and pCH4 from 3 to 149 µatm for the Eastmain 1 Reservoir. The pCO2 in the young Eastmain 1 reservoir is higher than in the natural lakes. The pCO2 is higher in winter compared to summer and fall. Eastmain-1 reservoir's winter pCH4 is similar to those of natural lakes and lower during winter compared to summer and fall. We did not observe a relationship between the flooded environment (lake, forest and peatlands) and pCO2 but we did observe a higher pCH4 over peatlands. Low water temperature and well oxygenated waters of these oligotrophic systems are not favourable for CH4 production. Annual GHG budget will also be presented.

Bastviken, D., Stockholm University, Stockholm, Sweden, david.bastviken@geo.su.se;
Cole, J. J., Institute of Ecosystem Studies, Millbrook, USA, colej@ecostudies.org;
Pace, M. L., Institute of Ecosystem Studies, Millbrook, USA, pacem@ecostudies.org;
Van de Bogert, M. C., University of Wisconsin, Madison, USA, mcvandeb@wisc.edu

THE FATES OF METHANE FROM DIFFERENT LAKE HABITATS - CONNECTING WHOLE-LAKE BUDGETS AND CH_4 EMISSIONS

Methane (CH_4) represents a major product of organic matter decomposition in lakes. Once produced in the sediments, CH_4can be either oxidized or emitted as a greenhouse gas to the atmosphere. Lakes represent an important source of atmospheric CH_4, estimated to contribute 6-16 % of the natural CH_4 emissions, and the regulation of CH_4 production, oxidation, and emissions require further attention. We quantified internal cycling and methane emissions in three lakes during summer stratification. These methane budgets included: sediment release of CH_4 at different depths; water column transport patterns and methane oxidation; methane storage in the water column; and methane emissions to the atmosphere by diffusion and ebullition. The contribution of CH_4 carbon via oxidation by methanotrophic bacteria, to pelagic food webs was also estimated. This study indicates very different fates of the CH_4 depending on at what depth it was produced, and highlights the importance of CH_4 dynamics in shallow sediments, as well as the physical transport mechanisms, for increasing our understanding of how methane emissions are regulated.

Baulch, H. M., Trent University, Peterborough, Canada, helenbaulch@trentu.ca;
Dillon, P. J., Trent University, Peterborough, Canada, pdillon@trentu.ca;
Maranger, R., Universite de Montreal, Montreal, Canada, r.maranger@umontreal.ca;
Schiff, S. L., University of Waterloo, Waterloo, Canada, sschiff@uwaterloo.ca

DIFFUSIVE AND EBULLITIVE FLUXES OF GREENHOUSE GASES FROM LOW ORDER STREAMS: ARE BUBBLE-MEDIATED FLUXES IMPORTANT?

Current IPCC models suggest that streams may be an important source of nitrous oxide, a potent greenhouse gas, and contributor to stratospheric ozone depletion. The role of small streams in carbon dioxide release is well established, and accumulating evidence suggests that methane emissions from many streams can also be quite high. In this study, we contrast diffusive and ebullitive (bubble-mediated) fluxes of the three major biogenic greenhouse gases from a series of four low-order streams. Rates of bubble release (measured from June-Sept 2007) were highly variable within and among streams, ranging from 14 to 317 mL^{-2} d^{-1} (seasonal averages). No

predictable seasonal patterns in ebullition rate were observed. Methane was consistently the dominant component of the bubbles, followed by carbon dioxide. Nitrous oxide content of the bubbles was typically less than 200ppb. We will discuss the importance of ebullition to total fluxes, and sources of variation in bubble content and flux rate.

Bautista, J., Ryerson University, Toronto, Canada, jbautista@ryerson.ca;
Laursen, A. E., Ryerson University, Toronto, Canada, alaursen@ryerson.ca

NITROUS OXIDE PRODUCTION IN LAKE MICROCOSMS: EFFECTS OF ELEMENTAL RATIOS ACTING THROUGH PRIMARY PRODUCER SELECTION

This research tested the hypothesis that elemental ratios in lakes could affect elemental ratios in a manner that influences carbon and nitrogen cycling. Elemental ratios that select for dense, or benthic algal species, for example, would result in greater carbon accrual in sediments, stimulating microbial activity in sediments. As organic nitrogen is remineralized and processed, this could result in greater production of nitrous oxide through nitrification and denitrification. In lake microcosms, Si, N, and P loading ratios were manipulated, with absolute nutrient loading rates that should support equivalent algal biomass in each treatment. High Si:N loading (3:1) significantly increased N_2O production relative to low Si:N (1:1) in both light and dark conditions. High Si:N also stimulated net photosynthesis, and respiration. Variations in N:P, however, had no influence on these processes. Changes in elemental ratios did affect primary producer community composition. These results will be presented in the context of species specific settling rates to predict differences in carbon deposition related to elemental ratios.

Becker, S., KNAW-NIOO Centre for Limnology, Nieuwersluis, Netherlands, s.becker@nioo.knaw.nl;
Matthijs, H. C., University of Amsterdam, Amsterdam, Netherlands, hansmatt@science.uva.nl;
van Donk, E., KNAW-NIOO Centre for Limnology, Nieuwersluis, Netherlands, vandonk@nioo.knaw.nl

INDUCED DEFENCE IN THE TOXIC CYANOBACTERIUM *MICROCYSTIS AERUGINOSA*

Among the induced defence mechanisms due to grazing by zooplankton, colony and spine formation as well as toxin production have been observed in cyanobacteria. The molecular mechanisms, however, behind these phenomena that are important in aquatic foodwebs have not been elucidated so far. Here we present a study on induced defence mechanisms in the toxic cyanobacterium *Microcystis aeruginosa* PCC 7806. We have used batch culture experiments to demonstrate direct and indirect effects of *Daphnia magna* as a grazer. Results are presented on colony formation of the cyanobacterial cells and toxin production. Additionally, with quantitative reverse-transcription PCR we measured the expression of genes that code for microcystin synthetase. We have also evaluated the genome of two sequenced and annotated *Microcystis* strains with respect to the genetic background of induced defence mechanisms. We intend to present for the first time genome-wide gene expression studies with DNA microarrays for *Microcystis*.

Benincà, E., University of Amsterdam, Amsterdam, Netherlands, ebeninca@science.uva.nl;
Huisman, J., University of Amsterdam, Amsterdam, Netherlands, jef.huisman@science.uva.nl;
Heerkloss, R., Department of Biological Sciences, Rostock, Germany, reinhard.heerkloss@biologie.uni-rostock.de;
Jöhnk, K. D., University of Amsterdam, Amsterdam, Netherlands, kjohnk@science.uva.nl;
Branco, P., University of Amsterdam, Amsterdam, , pmayerbr@science.uva.nl;
Van Nes , E. H., University of Wageningen, Wageningen, Netherlands, Egbert.vanNes@wur.nl;
Scheffer, M., University of Wageningen, Wageningen, Netherlands, Marten.Scheffer@wur.nl;
Ellner, S. P., Cornell University, Ithaca, USA, spe2@cornell.edu

CHAOS IN A LONG TERM EXPERIMENT WITH A PLANKTON COMMUNITY

Mathematical models predict that plankton communities may generate chaos. However, these mathematical predictions have never been demonstrated empirically. Here, we present the first demonstration of chaos in a complex planktonic food web (Benincá et al. 2008. Nature 451: 822-825). Our food web was isolated from a coastal ecosystem in the Baltic Sea, and consisted of phytoplankton, zooplankton, heterotrophic bacteria, and detritivores. The food web was cultured in a laboratory mesocosm experiment for more than 2300 days, and sampled twice a week. Despite constant external conditions, the species abundances showed striking fluctuations over several orders of magnitude. The population dynamics were characterized by significantly positive Lyapunov exponents. Predictability was limited to a time horizon of 15-30 days, only slightly longer than the local weather forecast. Hence, our results provide the first experimental demonstration of chaos in a complex food web. This implies that stability is not required for the persistence of complex food webs, and that the long-term prediction of species abundances can be fundamentally impossible.

Benoit, J. M., Wheaton College, Norton, MA, USA, jbenoit@wheatonma.edu;
Shull, D. H., Western Washington University, Bellingham, WA, USA, david.shull@wwu.edu;
Harvey, R. M., Wheaton College, Norton, MA, USA, harvey_rebeca@wheatonma.edu;
Beal, S. A., Wheaton College, Norton, MA, USA, beal_samuel@wheatonma.edu

SEDIMENT BIOTURBATION AND SEDIMENT-WATER FLUX OF METHYLMERCURY IN BOSTON HARBOR, MASSACHUSETTS, USA

Coastal marine and estuarine sediments are important sites of methylmercury (MeHg) production and may supply dissolved MeHg to near-shore and off-shore waters. We hypothesized that the transfer of MeHg from sediments to the water column would be affected by bioirrigation, which influences MeHg production as well as sediment-water exchange. Our work in Boston Harbor evaluates MeHg flux from sediments with a range of bioirrigation intensities. At four sites we quantified infaunal population densities, Rn-222 pore-water profiles, and infaunal burrow distributions. We also measured total MeHg flux using core incubations and established MeHg pore-water gradients. Fickian diffusive flux was calculated based on the MeHg concentration gradient below the sediment-water interface. Results indicate that total fluxes were highly correlated with infaunal burrow densities. Diffusive fluxes, however, were low and fairly consistent across three of the sites, but the lowest bioturbation site had a high diffusive flux despite a negative total flux. These results demonstrate that infaunal burrows strongly affect the efflux of MeHg and that diffusive fluxes from pore-water profiles do not reflect actual fluxes in sediments with high rates of bioirrigation.

Berecibar, E., University of Algarve /Center of Marine Sciences, Faro, Portugal, estibaliz@ualg.pt;
Ben-Hamadou, R., University of Algarve /Center of Marine Sciences, Faro, Portugal, bhamadou@ualg.pt;
Tavares, A. M., University of Algarve /Center of Marine Sciences, Faro, Portugal, amafaldatavares@gmail.com;
Tavares, D., University of Algarve /Center of Marine Sciences, Faro, Portugal, biogotavares@gmail.com;
Santos, R., University of Algarve /Center of Marine Sciences, Faro, Portugal, rosantos@ualg.pt

LONG-TERM CHANGES IN THE PHYTOGEOGRAPHY OF THE PORTUGUESE COAST

The Portuguese coast is ideal to assess the effects of global change on marine biota as it constitutes an important biogeographical transition zone. As the sea surface temperature increases due to global warming, marine species are expected to shift their distribution according to their thermal tolerance. In this study, we analyze the long term phytogeographic variations by comparing the description of the intertidal seaweed flora of Portugal made during the 60's by Ardré (1971) with a recent one made during 2003 and 2004 at the same sampling sites. The results revealed that the major discontinuities of the seaweed flora along the Portuguese continental coast has moved northward in the last 50 years, in accordance to the predictions of the effects of global warming on the distribution of organisms. As the minimum winter temperature rose more rapidly than the maximum summer temperature, the main flora changes were due to the introduction of south-

ern species rather then to the extinction of northern species. The effects of these changes on seaweed diversity will be discussed.

Bisagni, J. J., Univ. of Massachusetts Dartmouth, School of Marine Science and Technology, New Bedford, USA, jbisagni@umassd.edu;
Mountain, D. G., Univ. of Massachusetts Dartmouth, School of Marine Science and Technology, New Bedford, USA, dmountain@capecod.net

SHELF WATER SALINITY VARIABILITY, EASTERN NEWFOUNDLAND TO CAPE HATTERAS, 1950-2003

Given large Middle Atlantic Bight shelf water salinity and volume variability from the 1970s to 1990s, an analysis from 1950 to 2003 was conducted using data from eastern Newfoundland to Cape Hatteras to examine possible sources. Analysis uses data containing all temperature and salinity pairs from Bedford Institute's "Climate" database, along with Russian data from a NOAA-funded "data-rescue", providing over 500,000 data pairs. Partitioning data into ten sub-regions allows examination of regional seasonal and inter-annual variability (IAV). Results show a seasonal pulse of surface, low-salinity water entering off eastern Newfoundland during September, propagating southwest to the Scotian shelf by November. Timing of this freshwater signal occurs 2-3 months earlier than seaward movement of the shelf-slope front within the same region. From the Gulf of Maine to Cape Hatteras shelf, lowest salinities occur nearly simultaneously due to annual spring freshets. Salinity IAV increases westward, with largest anomalies located from the eastern Scotian shelf to Cape Hatteras. IAV of salinity in this western-most region may be due to upstream freshwater sources from both the eastern Newfoundland shelf and Gulf of St. Lawrence.

Boersma, M., GKSS Research Centre & AWI, Helgoland, Germany, maarten.boersma@awi.de;
Aberle, N., AWI. Biologische Anstalt Helgoland, Helgoland, Germany, nicol.aberle-malzahn@awi.de;
Hantzsche, F. M., GKSS Research Centre & AWI, Helgoland, Germany, florian.hantzsche@awi.de;
Schoo, K., AWI & IfM-Geomar, Helgoland, Germany, katherina.schoo@awi.de;
Wiltshire, K. H., AWI & Jacobs University, Helgoland, Germany, karen.wiltshire@awi.de;
Malzahn, A. M., AWI, Helgoland, Germany, arne.malzahn@awi.de

ZOOPLANKTON NUTRITION. FROM ENERGY BUDGETS TO ECOLOGICAL STOICHIOMETRY

Much has changed in our understanding of the processes that govern feeding, food uptake and utilization of resources in the last 25 years. One of the main changes in the last years has been that we now consider the quality of the food as one of the main factors governing growth and reproductive success of zooplankters both in freshwater and marine habitats. Many quality determining factors have been identified: size/morphology, palatability/toxicity, biochemical composition and nutrient stoichiometry, and the relative influence of these under different conditions has been under great debate. It is now well accepted that nutrient limitation of plants affects the growth and survival of the herbivores feeding on these plants, generally leading to lower performance of herbivores on nutrient stressed plants. It is also well accepted that the addition of biochemical components such as unsaturated fatty acids or sterols can greatly enhance growth. Here, we will discuss how far we have come in 25 years, identify the issues currently under debate, and give potential directions for further research.

Borer, P., Institute of Biogeochemistry and Pollutant Dynamics, ETH Zurich, Zurich, Switzerland, paul.borer@env.ethz.ch;
Sulzberger, B., Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dubendorf, Switzerland, barbara.sulzberger@eawag.ch;
Hug, S. J., Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dubendorf, Switzerland, stephan.hug@eawag.ch;
Kraemer, S. M., Department of Environmental Geosciences, University of Vienna, Vienna, Austria, stephan.kraemer@univie.ac.at;
Kretzschmar, R., Institute of Biogeochemistry and Pollutant Dynamics, ETH Zurich, Zurich, Switzerland, ruben.kretzschmar@env.ethz.ch

PHOTOREDUCTIVE DISSOLUTION OF LEPIDOCROCITE AND OTHER IRON (HYDR)OXIDES IN THE ABSENCE OF ORGANIC LIGANDS: EXPERIMENTAL STUDIES AND KINETIC MODELING

Photoreductive dissolution of lepidocrocite (gamma-FeOOH) was investigated in the absence of organic ligands. The formation of dissolved Fe(II) was observed under irradiation with artificial sunlight up to pH 6. Combined irradiation/dark experiments at pH 3 revealed that after the light source was turned off, dissolved Fe(II) was reoxidized on a timescale of minutes/hours in aerated suspensions. The presence of H2O2 was confirmed by additional measurements. A kinetic model for photoreductive dissolution of lepidocrocite was developed, which was based on the assumption that photolysis of Fe(III)-hydroxo groups at the surface of lepidocrocite leads to the formation of surface Fe(II) and OH radicals. The model suggests that H2O2 can only be formed in considerable amounts if the surface-catalyzed reoxidation of Fe(II), incorporated in the lattice surface structure, by molecular O2 is much faster than the corresponding reoxidation of adsorbed Fe(II). Additional photodissolution experiments conducted in the presence of radical scavengers or an iron-binding ligand (desferrioxamine B) showed that photodissolution of crystalline Fe(III) (hydr)oxide phases can be significanty enhanced and also occurs at seawater pH.

Bowman, J. S., University of Washington, Seattle, USA, bowmanjs@u.washington.edu;
Sachs, J. P., University of Washington, Seattle, USA, jsachs@u.washington.edu

DEVELOPMENT OF A PROXY FOR SALINITY FROM LIPID BIOMARKERS IN HALOTOLERANT MICROORGANISMS

Throughout the world inter-annual variations in precipitation constitute a major feature of the climate. The salinity of lakes and lagoons is fundamentally related to the relative rates of precipitation and evaporation. A proxy for salinity based on the ratio of deuterium to hydrogen (D/H) in lipid biomarkers from phytoplankton has recently been applied to reconstruct hydrologic changes in the geologic past from sediment cores taken in the ocean and in lakes. We propose a new proxy for salinity based on changes in the lipid composition of halotolerant and halophilic microorganisms. Preliminary analyses of the polar fraction of lipids from the haloterant gammaproteobacteria Salinivibrio grown at NaCl concentrations of 100 and 150 ppt suggest a markedly different lipid composition. A selection of two lipid biomarkers, one that changes with salinity and one that does not, will allow for a ratio that describes salinity independent of the abundance of the organism. We will report on the analysis by column and gas chromatography and mass spectrometry of the lipid composition of halotolerant strains of Halomonas and Salinivibrio grown at NaCl concentrations of 30, 60, 90, 120, and 150ppt.

Boyle, E. S., University of Maryland Chemistry Department, College Park, USA, eboyle@umd.edu;
Del Vecchio, R., University of Maryland ESSIC, College Park, USA, rossdv@umd.edu;
Blough, N. V., University of Maryland Chemistry Department, College Park, USA, neilb@umd.edu

WAVELENGTH DEPENDENCE OF FLUORESCENCE LIFETIMES IN CHROMOPHORIC DISSOLVED MATTER

Fluorescence lifetimes were obtained by time-correlated single photon counting for Suwannee River humic and fulvic acid standards, lignin models, and C-18 extracts (CDOM) acquired from estuarine, coastal, and offshore waters of the Middle Atlantic Bight. Excitation wavelengths at 385, 400, and 440 nm were employed in combination with a series of long-pass emission filters to analyze wavelength dependence of the lifetimes at ~30 nm intervals up to ~715 nm. Decays were fit to a triple exponential form, F(t)= ÃŽÂ£(n=3) αiexp(-t/Ã â€ži), yielding a sample mean lifetime Ã â€žm= ÃŽÂ£(n=3) αiÃ â€ži. The shortest mean lifetimes were observed in alkali carboxylated lignin, followed by humic acid, fulvic acid, and the C-18 extracts. However, all samples exhibited a very similar spectral dependence of the mean lifetimes. In particular, beyond the 495 nm cutoff filter all samples showed monotonic decrease in mean lifetime with successively longer cutoff filters. This decrease is primarily driven by an increasing amplitude of the very short lived component (<100 ps). These data are consistent with and are interpreted within the previously proposed charge transfer model of CDOM optical properties.

Brönmark, C., Lund University, Lund, Sweden, christer.bronmark@limnol.lu.se;
Lakowitz, T., Lund University, Lund, Sweden, thomas.lakowitz@limnol.lu.se

COSTS OF PREDATOR-INDUCED MORPHOLOGY IN A FRESHWATER SNAIL

We investigated the potential for predator-driven variability in shell morphology in a freshwater snail, Radix balthica, and whether found differences were a result of local adaptation or phenotypic plasticity. Shell shape was quantified in snails from ponds with and without molluscivorous fish. Further, in a common garden experiment we investigated the reaction norms of snails from populations with/without fish when exposed to chemical cues from tench (Tinca tinca), a molluscivorous fish. We also investigated if there were any costs associated with the expression of the induced morphology. We found that snails from fish-free ponds had a narrow shell with a well developed spire, whereas snails that coexisted with fish had more rotund shells with a low spire, a shell shape that reduce predation rate from shell-crushing predators. The common garden experiment mirrored the results from the field survey and showed that the expression of shell shape was independent of population origin. The plastic response also incurs fitness costs that were expressed as reduced growth and egg production when snails were grown in the presence of chemical cues from fish.

Bradbury, I. R., Oceanography Dept. / Biology Dept., Dalhousie, Halifax, Canada, ibradbur@dal.ca;
Snelgrove, P. V., Ocean Sciences Center, Memorial University , St. John's, Canada, psnelgro@mun.ca;
Bentzen, P., Marine Gene Probe Laboratory, Biology Department, Dalhousie University, Halifax, Canada, paul.bentzen@dal.ca;
DeYoung, B., Dept. of Physics and Physical Oceanography, Memorial University of Newfoundland , St. John's, Canada, bdeyoung@physics.mun.ca;
Gregory, R. S., Department of Fisheries and Oceans, St. John's, , GregoryR@dfo-mpo.gc.ca ;
Morris, C., Department of Fisheries and Oceans, St. John's, , Morrisc@dfo-mpo.gc.ca

STRUCTURAL AND FUNCTIONAL CONNECTIVITY OF MARINE FISHES WITHIN A SEMI-ENCLOSED NEWFOUNDLAND FJORD

We examined the interplay between structural and functional connectivity in marine fish in a semi-enclosed coastal fjord (Holyrood Pond, Newfoundland). Genetic differentiation was examined in three species with contrasting life histories (rainbow smelt, anadromous benthic eggs; White hake, pelagic spawner; Atlantic cod, pelagic spawner) using microsatellite loci and a protein-coding locus, PanI (Atlantic cod). Previous work on otolith composition and adult tagging indicated that smelt rarely stray from coastal estuaries such as Holyrood Pond. Accordingly, smelt displayed moderate differentiation between the fjord and adjacent bay (FST~ 0.03) and increased structure between the south and northeast coasts of Newfoundland (FST~ 0.18). Hake and cod displayed weak microsatellite differentiation, however, fine-scale structure was observed in the high rates of Bayesian self-assignment (<75%) and significant PanI differentiation (FST~ 0.02-0.16; Atlantic cod). Nonetheless, assignment and differentiation of the fjord and adjacent bay was consistently lower than between the more distant northeast and southeast coasts. Overall, gene flow in these species appears not limited by low structural connectivity, yet the observed differentiation suggest biocomplexity over small spatial scales likely associated with life history and dispersal potential.

Brandes, J. A., Skidaway Institute of Oceanography, Savannah, USA, jay.brandes@skio.usg.edu;
Ingall, E. D., Georgia Institute of Technology, Atlanta, USA;
Benitez-Nelson, C., University of South Carolina, Columbia, USA

NITROGEN TRANSFORMATIONS ACROSS AN ANOXIC INTERFACE: EFFINGHAM INLET, BC

Anoxic basins and fiords represent modern analogues to the anoxic environments of previous eras. The full range of nitrogen cycle processes can take place in these environments, especially where the oxic-anoxic boundary lies close to the surface. Effingham Inlet, on the Western coast of Vancouver Island, Canada, is a semi-permanent Anoxic basin. We examined water column and sedimentary particulate and dissolved nitrogen isotopic patterns present within Effingham during the spring and summer of 2007. The isotopic composition of suspended particulates varied significantly throughout the redox zone, and did not correspond to the integrated sinking flux isotopic composition. In addition, strong isotopic gradients existed in the nitrate, ammonium and N2 gas pools within the basin. N2 gas excesses were too large to be accounted for by standard N:P deficit calculations, indicating that processes other than Coupled nitrification-denitrification, most likely connected with sedimentary N and P transformations, were significant. These results will be discussed in the framework of an isotopic model.

Branstrator, D. K., University of Minnesota Duluth, Duluth, USA, dbranstr@d.umn.edu;
Shannon, L. J., University of Minnesota Duluth, Duluth, USA, lshannon@d.umn.edu;
Brown, M. E., Hobart and William Smith Colleges, Geneva, USA, MBROWN@hws.edu;
Kitson, M. T., University of Minnesota Duluth, Duluth, USA, thab0002@d.umn.edu

SLOWING THE RATE OF RANGE EXPANSION OF THE INVASIVE ZOOPLANKTER BYTHOTREPHES LONGIMANUS (CRUSTACEA: CERCOPAGIDAE): LESSONS FROM BASIC RESEARCH.

Approximately 25 years after its initial invasion of the Laurentian Great Lakes, the predatory zooplankter, Bythotrephes longimanus, continues to invade inland lakes of North America. Circumstantial data point to human activity as a primary vector of its overland dispersal. Key findings from recent laboratory and field studies on the physiology and behavior of Bythotrephes provide direction for reducing the role that humans play in its dispersal network. Three years of experiments identified levels of salinity, chlorination, temperature, desiccation, pH, and oxygen tolerated by the resting egg (over wintering life stage) of Bythotrephes. Patterns of density and diel vertical migration of Bythotrephes across lakes suggest that populations are in low density and express minimal diel vertical migration in oligotrophic waters, but achieve higher density and are strongly migratory (in a typical diel fashion) in stained reservoirs. Together these studies provide a template for the development of policy to prevent range expansion of this non-native species.

Bravo, M. A., Univeristy of British Columbia, Vancouver, Canada, mbravo@eos.ubc.ca;
Therriault, T. W., Fisheries and Oceans, Nanaimo, Canada, therriaultt@pac.dfo-mpo.gc.ca;
DiBacco, C., Fisheries and Oceans, Dartmouth, Canada, dibaccoc@mar.dfo-mpo.gc.ca

RELATING ABIOTIC AND BIOTIC FACTORS TO THE DISTRIBUTION AND ABUNDANCE OF INTERTIDAL NON-NATIVE SPECIES IN THE STRAIT OF GEORGIA, CANADA

The Strait of Georgia (SoG) is inhabited by numerous non-native species whose abundance and distribution, as well as factors facilitating their establishment, remain largely unknown. A systematic intertidal survey was conducted at 20 soft-bottom sites around the SoG during the summer of 2006. The abundance and distribution of bivalve species was determined for low, mid, and high intertidal zones at each site. Five non-native and 17 native bivalve species were identified. The 2 most abundant species sampled, *Nuttallia obscurata* and *Venerupis philippinarum*, were non-native and represented the second and third most common species in the SoG. In contrast, the non-native species, *Musculista senhousia*, was few in numbers and found at only 1 site. Multivariate analyses investigating relationships between non-native species' abundance and distribution and biotic and abiotic site characteristics, including species composition and richness, sediment type and organic content, beach slope, salinity, temperature, and nearby anthropogenic activities, will be examined to identify which factors affect non-native species establishment. These findings may prove to be useful tools for risk assessment and the management and prevention of future invasions.

Breen, E. A., Dalhousie University, Halifax, Canada, eabreen@dal.ca;
Metaxas, A., Dalhousie University, Halifax, Canada, anna.metaxas@dal.ca

EFFECTS OF THE PRESENCE OF THE INVASIVE EUROPEAN GREEN CRAB, *CARCINUS MAENAS*, ON THE GROWTH AND CONDITION OF THE NATIVE *CANCER IRRORATUS*

Rock crab, *Cancer irroratus*, are a commercially important species and a critical prey item for the American lobster, *Homarus americanus*, in Atlantic Canada. The recent invasion of European green crab, *Carcinus maena*, may have significant effects on the growth and condition of native *C. irroratus*, because of spatial and temporal overlap between the two species in habitat use and access to resources. To examine these effects, we measured the growth of juvenile *C. irroratus* in the presence of juvenile *C. maenas*, under the following species combinations: (1) One *C. irroratus* (10-25 mm CW); (2) Two *C. irroratus* (10-25 mm CW); (3) One *C. irroratus* (10-25 mm CW) and one *C. maenas* (10-15 mm CW). Daily morphological measurements included pre- and post-molt carapace width, chela height, abdomen width (mm), weight (g), and intermolt duration (days). Analysis of the hepatopancreas for % lipid content at the end of the experiment provided an estimate of condition. If *C. maenas* can successfully inhibit access to food by *C. irroratus*, longer intermolt periods, reduced molt increments, and lower lipid content should be evident.

Brett, M. T., University of Washington, Seattle, USA, mtbrett@u.washington.edu;
Kainz, M., Danube University Krems, Lunz am See, Austria, martin.kainz@donau-uni.ac.at;
Seshan, H., University of Washington, Seattle, USA, hs9@u.washington.edu

THE IMPACT OF TERRESTRIAL LEAF LITTER POC ON *DAPHNIA* GROWTH, REPRODUCTION AND FATTY ACID COMPOSITION

We experimentally tested the hypothesis put forth by Cole, Pace and Carpenter that *Daphnia* directly utilize terrestrial leaf litter POC. This was done by milling naturally senesced leaves from red alder (*Alnus rubra*), which is the dominant riparian tree in much of the Pacific northwest, to a size of < 30 um and feeding this POC alone or with phytoplankton (*Microcystis*, *Scenedesmus* and/or *Cryptomonas*) to *Daphnia*. Our preliminary results indicate this terrestrial POC is by itself nutritionally inadequate to support *Daphnia* growth and reproduction. However, when combined with phytoplankton, terrestrial POC does not have a negative impact on *Daphnia*. We will also report the results of fatty acid biomarker analyses to show to what extent this terrestrial POC is incorporated into the lipids of *Daphnia*.

Brin, L. D., Boston University Marine Program / Marine Biological Laboratory, Woods Hole, MA, USA, lindsay.brin@gmail.com;
Valiela, I., Boston University Marine Program / Marine Biological Laboratory, Woods Hole, MA, USA, ivaliela@mbl.edu;
Goehringer, D., University of Massachusetts Dartmouth, New Bedford, MA, USA, dale@umassd.edu

NITROGEN RETENTION AND LOSS IN EXPERIMENTAL SALT MARSH PLOTS EXPOSED TO CHRONIC NUTRIENT ADDITION

Salt marshes are thought to remove and retain land-derived nitrogen (N) that could otherwise cause eutrophication in coastal waters. These processes need to be quantified at within-year and decadal time scales. To investigate the long-term nitrogen retention capacity of salt marshes, we measured nitrogenous materials in tidal water entering and leaving experimental plots that have been subject to several levels of fertilizer addition each growing season since 1970. Preliminary results, from sampling over both full tidal cycles and intensively-sampled ebb tides, indicate that tidal DIN export depends primarily on N input rate and tide height. While seasonal losses through tidewater increased substantially with increased N input, percent retention of added N remains at approximately 99-100% for all treatments, an increase as compared to estimates in 1973. This suggests that ecological changes that have occurred in each plot since establishment have not inhibited long-term N retention capacity, presenting a strong argument for salt marsh conservation.

Briski, E., Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Canada, briski@uwindsor.ca;
Bailey, S., Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, Canada, sarah.bailey@dfo-mpo.gc.ca;
Cristescu, M., Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Canada, mcris@uwindsor.ca;
MacIsaac, H., Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Canada, hughm@uwindsor.ca

COMPARATIVE ASSESSMENT OF INVERTEBRATE RESTING STAGES IN BALLAST SEDIMENT OF SHIPS ENTERING CANADIAN FRESHWATER AND MARINE PORTS

The introduction of non-indigenous species (NIS) is a potent agent of biodiversity change. Ballast water and hull fouling are recognized as the most important vectors for NIS introductions to marine habitats globally. In this study, we are collecting and identifying invertebrates and their diapausing stages in residual sediments of transoceanic vessels and vessels coming from the USA, to explore the relative risk of invasion to each coast and the Great Lakes. Eggs and active invertebrates were separated from sediment and counted. Using mitochondrial markers 16s and CO1, cladoceran, copepod, and rotifer taxa will be identified. Lab-based hatching experiments will be conducted to verify the viability of the eggs. The number of eggs hatched will be used to estimate the number of viable propagules, which will then be multiplied by the amount of sediment in the ship to estimate the total egg number. We will then test the hypothesis that increased propagule pressure leads to greater levels of invasion in areas of the country receiving the highest density of viable eggs and live invertebrates in ballast sediments.

Brown, M. E., Hobart and William Smith Colleges, Geneva, USA, mbrown@hws.edu;
Balk, M. A., William Smith College, Geneva, USA, mb9728@hws.edu

THE POTENTIAL LINK BETWEEN LAKE PRODUCITIVTY AND THE INVASIVE ZOOPLANKTER *CERCOPAGIS PENGOI*

The fishhook water flea (*Cercopagis pengoi*) is an invasive zooplankter that can decrease the abundance and diversity of cladocerans and rotifers, which theoretically could release phytoplankton from grazing pressure and increase primary productivity. We studied plankton density, primary productivity, and standard limnological conditions in Owasco Lake (New York, USA) to investigate the concurrent establishment of *Cercopagis* and primary productivity increases in this lake. Although the maximum abundance of *Cercopagis* observed (245 ind m^{-3}) far exceeded that of any native invertebrate predator, at most locations and dates unimodal density peaks between 35-60 ind m^{-3} were typical and comparable to *Leptodora kindti*, the most common native planktivore. We observed reciprocal trends between predacious cladoceran density and herbivorous cladoceran density, and between herbivorous cladoceran density and Chlorophyll *a* concentration. Although these trends are only corollary, they support the possibility that *Cercopagis* may affect the trophy of Owasco Lake by reducing grazing zooplankton beyond the level of the native planktivores. Further study is needed to quantify the relative contributions of *Cercopagis* and *L. kindti* to seasonal changes in the herbivorous cladoceran assemblage.

Bucklin, A., University of Connecticut, Avery Point, USA, ann.bucklin@uconn.edu;
Wiebe, P. H., Woods Hole Oceanographic Institution, Woods Hole, USA, pwiebe@whoi.edu;
Jennings, R. M., University of Connecticut, Avery Point, USA, robert.jennings@uconn.edu;
Ortman, B. D., University of Connecticut, Avery Point, USA, brian.ortman@huskymail.uconn.edu;
Nigro, L. M., University of Connecticut, Avery Point, USA, lisa.nigro@uconn.edu;
Copley, N. J., Woods Hole Oceanographic Institution, Woods Hole, USA, ncopley@whoi.edu

NORTH ATLANTIC ZOOPLANKTON SPECIES DIVERSITY AND COMMUNITY STRUCTURE: BASIN-SCALE ANALYSIS USING DNA BARCODES

Taxonomic analysis of collections of marine holozooplankton, with 7,000 described species of 15 phyla, is complex and time-consuming. A growing database of DNA barcodes (i.e., short sequences for species recognition and discovery) for holozooplankton is providing a new tool for rapid assessment and comparison of species diversity and community structure of the pelagic realms of the North Atlantic Ocean and marginal seas. Recent expeditions to the Sargasso Sea in the Northwest Atlantic (April 2006) and the Eastern Atlantic (November 2007) have provided valuable collections for DNA barcoding, with a focus on mesopelagic and abyssopelagic zones. New methods for DNA barcode data analysis and interpretation will accelerate

their use in community and ecosystem studies. The DNA barcode database can be used to confirm identifications of individual specimens, reveal cryptic species, describe biogeographical distribution, discover new species, and characterize species diversity through environmental sequencing.

Budge, S. M., Dalhousie University, Halifax, Canada, suzanne.budge@dal.ca;
Wooller, M. J., University of Alaska Fairbanks, Fairbanks, USA, ffmjw@uaf.edu;
Springer, A. M., University of Alaska Fairbanks, Fairbanks, USA, ams@ims.uaf.edu;
Iverson, S. J., Dalhousie University, Halifax, Canada, sara.iverson@dal.ca;
McRoy, C. P., University of Alaska Fairbanks, Fairbanks, USA, mcroy@ims.uaf.edu;
Divoky, G. J., University of Alaska Fairbanks, Fairbanks, USA, divoky@cooperisland.org

TRACING CARBON FLOW IN AN ARCTIC MARINE FOOD WEB USING FATTY ACID-STABLE ISOTOPE ANALYSIS

Global warming and the loss of sea ice threaten to alter patterns of productivity in arctic marine ecosystems because of a likely decline in primary productivity by sea ice algae; however, the importance of ice algae to higher trophic levels is unknown. To estimate the contribution of ice algae to total primary production, we investigated a novel approach to food web studies by determining the carbon isotopic composition of individual diatom FA and tracing these biomarkers in consumers. Samples were collected near Barrow, Alaska and included ice algae, pelagic phytoplankton, zooplankton, fish, seabirds, pinnipeds and cetaceans. Ice algae and pelagic phytoplankton had distinctive overall FA signatures and clear differences in $\delta^{13}C$ for two specific diatom FA biomarkers, 16:4n-1 and 20:5n-3. A mass balance equation indicated that FA material derived from ice algae, compared to water column diatoms, averaged 71% (44-100%) in consumers based on $\delta^{13}C$ values of 16:4n-1, but only 24% (0-61%) based on 20:5n-3. These preliminary results demonstrate the potential value of compound-specific isotope analysis of marine lipids to trace carbon flow through marine food webs.

Bukaveckas, P. A., Virginia Commonwealth University, Richmond, USA, pabukaveckas@vcu.edu;
Aufdenkampe, A., Stroud Water Research Center, Avondale, USA, aufdenkampe@gmail.com

PHYTOPLANKTON CONTRIBUTIONS TO SUSPENDED PARTICULATE ORGANIC MATTER IN RIVERS WITH COMPARISONS TO OTHER FRESHWATER ENVIRONMENTS

A central challenge to understanding zooplankton nutrition is the need to identify dietary factors that constrain production and the environmental processes that regulate their availability. Dietary restrictions may arise in part due to variable contributions from algal and non-algal sources of particulate matter. Non-algal sources act to dilute the intake of nutritionally important dietary factors and may reduce ingestion rates through mechanical interference. As part of a comparative study of the Ohio, upper Mississippi and Missouri Rivers (EMAP GRE), the quantity and quality of food resources was characterized based on bulk properties of suspended particulate matter (CHLa, POC). Results suggest that phytoplankton constitute a significant fraction of the POM pool during periods when zooplankton were most abundant. Phytoplankton contributions to POM were determined by inter-river differences in light availability arising from channel morphometry, water transparency and transit time. Cross-system comparisons show that the relationship between CHLa and POC in these rivers was similar to those observed among lakes and reservoirs in this region.

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@u.washington.edu;
Finney, B. P., University of Alaska Fairbanks, Fairbanks, USA, Finney@ims.uaf.edu;
Gregory-Eaves, I., McGill University, Montreal, Canada, Irene.gregory-eaves@mcgill.ca;
Selbie, D. T., McGill University, Montreal, Canada, selbied@biology.queens.ca;
Chen, G., McGill University, Montreal, Canada, guangje.chen@mail.mcgill.ca;
Pellatt, M. G., Parks Canada, Vancouver, Canada, mpellatt@sfu.ca;
Bos, D. G., Parks Canada, Vancouver, Canada, dbos@sfu.ca

CONTINENTAL GRADIENTS IN THE EFFECTS OF MARINE DERIVED NUTRIENTS FROM SALMON ON LAKE PRIMARY PRODUCTION

Recent research in Alaskan salmon nursery lakes demonstrates that variation in fisheries escapement and the associated influx of marine-derived nutrients (MDN) regulates primary production of natal ecosystems. However, less is known about the relationship between MDN influx and algal production in lakes south of Alaska (AK). To address this shortcoming, historical changes in nitrogen (N) input (as sedimentary del15N) and algal abundance (as fossil pigments) were compared with nutrient mass balances for 31 lakes with salmon and 15 reference sites from AK, British Columbia (BC) and Washington (WA) to quantify the spatial and temporal variability of lake primary production and the relationship between historical changes in salmon and algal abundance. Sedimentary del15N signatures increased from coastal to inland sites at low latitudes independent of salmon presence or density. Unlike nursery lakes in AK, MDN accounted for <10% of total ecosystem nutrient influx in BC and WA lakes, and past algal production varied independently of salmon escapement in both these regions. Further, in these natal lakes, the diversion of MDN subsidies to commercial harvest had no measurable effect on ecosystem productivity.

Burlakova, L. E., Buffalo State College, Great Lakes Center, Buffalo, USA, burlakle@buffalostate.edu;
Karatayev, A. E., Buffalo State College, Great Lakes Center, Buffalo, USA, karataay@buffalostate.edu;
Vander Zanden, M. J., University of Wisconsin - Madison, Center for Limnology, Madison, USA, mjvanderzand@wisc.edu;
Lathrop, R. C., Wisconsin Dept. of Natural Resources, University of Wisconsin- Madison Center for Limnology, Madison, USA, rlathrop@wisc.edu

TEMPORAL AND SPATIAL VARIABILITY IN ZOOBENTHOS: APPLICATION TO LONG-TERM COMMUNITY CHANGES

We used a quantitative approach to analyze the spatial and temporal variability of the benthic invertebrate community sampled during 2002-2007 in Lake Mendota near Madison, Wisconsin, USA. Lake Mendota has been subject to a variety of anthropogenic impacts, including cultural eutrophication from sewage discharges and agricultural/urban nonpoint pollution, pesticides, habitat modification, and the introduction of non-native species such as carp and Eurasian watermilfoil. Using our data and the lake's extensive historical record, we reconstructed zoobenthic community responses to environmental disturbances over the last century. We found a significant difference in zoobenthic community structure among different lake zones that was consistent in all years of our study. Due to non-significant changes in each zone among years, we used 2002-2007 data as replicates to detect significant changes in the lake's benthic community over the last century. Changes were associated with complete disappearance of some species (e.g. *Chaoborus punctipennis*), and sharp decrease in the density of other species (e.g. *Pisidium* sp.) that previously dominated in the zoobenthos community of Lake Mendota. Possible reasons may include: cultural eutrophication, fish predation, and pollution.

Busch, S., Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, busch@igb-berlin.de;
Mehner, T., Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, mehner@igb-berlin.de

PRECISION OF HYDROACOUSTIC ESTIMATES AT INCREASINGLY LONGER TEMPORAL SCALES: DIEL VERTICAL MIGRATIONS OF COREGONID FISH AS AN EXAMPLE

To assess the precision of fish abundance and population depth estimates, hydroacoustic surveys were conducted which repeated sampling within the same day, during subsequent nights within a week, and over four months of a year. Volumetric densities and population depths were calculated for vertically migrating sympatric fish species (*Coregonus* spp.) in Lake Stechlin (Germany). The precision of the hydroacoustic method, determined by the coefficient of variance of volume density and population depth of fish, decreased with increasingly longer time scales. The precision within nights was high for population depths, but lower for density. The variance

further increased within weeks and was highest between months for both parameters. The depth distribution of the coregonids was correlated to light intensities at the surface. Changes in illumination strength at dusk and dawn triggered the upward and downward migration of coregonids supporting the idea of light as the proximate factor. Our findings showed that single hydroacoustic surveys reliably reflect the depth distribution of the population, but hardly produce reliable fish density estimates.

Butron, A., University of the Basque Country, Leioa, Spain, ainhize.butron@ehu.es;
Madariaga, I., Bizkaiko Foru Aldundia, Bilbao, Spain, iosu.madariaga@bizkaia.net;
Orive, E., University of the Basque Country, Leioa, Spain, emma.orive@ehu.es

HETEROSIGMA AKASHIWO AS BLOOMING SPECIES IN AN ESTUARINE TEMPERATE HARBOUR

The raphidophyte *Heterosigma akashiwo* reaches densities of 10^8> cells l^{-1} in the NerviÃ³n River estuary during summer when temperature is 20ºC or higher. The estuary includes a very active harbour with international connections which has probably influenced the introduction of some phytoplankton species, among them the bloom-forming *Heterosigma akashiwo*. Previous studies performed with two clonal strains of this species isolated from the estuary showed maximum growth rates when exposed to light intensities of 700 μE m^{-2} s^{-1} or higher and salinities between 15 and 25. To know to what extent both strains tolerance to elevate light intensities could be due to their capability to adjust cellular pigment content, the effect of a broad range of light intensities (from 100 to 750 μE m^{-2} s^{-1}) on the concentration of the main photosynthetic and photoprotective pigments has been measured. In this study we discuss the implications of this physiological response on the successful growth of this cosmopolitan raphidophyte in certain estuarine environments.

Cáceres, C. E., University of Illinois, Urbana, USA, caceres@life.uiuc.edu;
Knight, C. J., University of Illinois, Urbana, USA, cknight3@uiuc.edu;
Becker, C., Indiana University, Bloomington, USA;
Hall, S. R., Indiana University, Bloomington, USA, sprhall@indiana.edu

DOES CHAOBORUS INFLUENCE DISEASE SPREAD IN DAPHNIA?

Why are epidemics of microparasites in zooplankton so highly variable among lakes? In a long-term study of 19 lake populations of Daphnia dentifera, the parasitic fungus (Metschnikowia bicuspidata) becomes common in only nine populations. Visually-orienting fish predators can inhibit epidemics in some lakes by selectively culling infected hosts. Invertebrates such as Chaoborus are also effective predators in lakes, but their potential role in disease transmission is unknown. We hypothesized that Chaoborus may facilitate disease transmission by liberating spores from infected hosts. However, this potential effect depends on the degree of preference with which Chaoborus consumes infected hosts. We combine field sampling and laboratory experiments to investigate the potential role of Chaoborus in Daphnia-Metschnikowia interactions. Areal abundances of Chaoborus were higher in lakes that experienced Metschnikowia epidemics. In the laboratory, we are completing experiments that test the role of Chaoborus feeding in disease transmission and the selectivity of Chaoborus on infected prey. Although vertebrate predators can reduce disease in Daphnia by "keeping the herds healthy", it is not clear if the same can be said for predatory invertebrates.

Callahan, A. G., Ocean Sciences Centre, Memorial University, St. John's, Canada, callahan.ashley@gmail.com;
Deibel, D., Ocean Sciences Centre, Memorial University, St. John's, Canada, ddeibel@mun.ca;
Rise, M. L., Ocean Sciences Centre, Memorial University, St. john's, Canada, mrise@mun.ca;
Hall, J. R., Ocean Sciences Centre, Memorial University, St. john's, Canada, jrlong@mun.ca;
McKenzie, C. H., Northwest Atlantic Fisheries Centre, Department of Fisheries and Oceans Canada, St. John's, Canada, McKenzieC@dfo-mpo.gc.ca

DEVELOPMENT OF SPECIES-SPECIFIC PRIMERS TO AID IN THE IDENTIFICATION AND MONITORING OF POTENTIALLY INVASIVE ASCIDIANS IN NEWFOUNDLAND

Non-indigenous ascidians are a significant biofouling problem for the aquaculture industry in Canada. Given the high level of vessel traffic between Newfoundland and the Maritime Provinces, harbour surveys were carried out in 2006 and 2007. Two non-indigenous ascidian species have been found, Botrylloides violaceous and Botryllus schlosseri. Sequence analysis of the cytochrome oxidase I gene (COI) of mitochondrial DNA is being used to confirm taxonomic identity and to develop species-specific primers for early detection of larvae and juveniles of indigenous (Halocynthia pyriformis & Boltenia echinata) and non-indigenous ascidians (B. violaceous & B.schlosseri). Ascidian eggs and larvae are difficult to identify anatomically, requiring much time. Species-specific molecular markers will enable a quick and cost-effective method to assess Newfoundland's risk for invasive ascidians. There are no COI sequence data currently available in GenBank for B. violaceous, H. pyriformis or B. echinata. COI sequence data will be presented for these four species from multiple geographic locations around the island of Newfoundland and from the larger region. Variability in sequences among species and locations will be compared to aid in future species-specific probe development.

Campbell, D. A., Mount Allison University, Sackville, NB, Canada, dcampbell@mta.ca;
Key, T. M., Mount Allison University, Sackville, NB, Canada, tmky@mta.ca;
Finkel, Z. V., Mount Allison University, Sackville, NB, Canada, zfinkel@mta.ca;
Six, C., Laval University, Laval, Canada, csix@mta.ca

CELL SIZE ALTERS PHOTOPHYSIOLOGY IN DIATOMS

Diatoms, like all oxygenic photoautotrophs, face ongoing photoinactivation of photosystem II during photosynthesis. To counter this photoinactivation a repair cycle rebuilds photoinactivated reaction centres using newly synthesized D1 (PsbA) protein. If the rate of photoinactivation exceeds repair the cells lose photosynthetic capacity, over diel cycles or during mixing. Rates for metabolic processes, including protein turnover, scale with cell size, as do optical packaging effects. We therefore exposed a panel of centric diatoms, with diameters from 3 to 200 μm, to an upward light shift and characterized their photosynthetic performance. All the diatoms showed comparable susceptibilities to primary photoinactivation, with target sizes for photoinactivation of 3-5 x 10^-4 A^2. Interestingly, diatoms consistently show lower susceptibility to primary photoinactivation than other phytoplankters of comparable size. In contrast, the diatoms showed a wide range of photosystem II repair capacities, and the capacities for this metabolic process correlated negatively with cell size. To compensate for lower repair capacities, large centric diatoms show greater induction of non-photochemical quenching and possibly other mechanisms to alter their internal excitation field. We discuss these findings in terms of selective advantages to diatoms with comparativley lower costs for photosystem II repair.

Carman, M. R., Woods Hole Oceanographic Institution, Woods Hole, USA

THE VIABILITY OF FRAGMENTS OF THE INVASIVE COLONIAL TUNICATE DIDEMNUM SP. IN SUSPENSION AND IMPLICATIONS FOR LONG DISTANCE TRANSPORT OF THE SPECIES

Fouling by invasive species of tunicates, including Didemnum sp., is causing economic hardship for commercial shellfishers. Didemnum sp. attaches to hard substrates and economically important shellfish, including blue mussels (Mytilus edulis), green mussels (Perna canaliculus), oysters (Crassostrea virginica), bay scallops (Argopecten irradians irradians), and sea scallops (Placopecten magellanicus). Didemnum sp. first appeared in Atlantic North American waters in the 1980's at Damariscotta, Maine and has subsequently spread along the coast from Eastport, Maine to eastern Long Island, New York, and is present offshore on Georges Bank. It is expected to spread into Atlantic Canada waters. Didemnid species can propagate by fragmenting and dividing into daughter colonies that grow by asexual reproduction. Artificially cut pieces of Didemnum sp. reattach in the wild in New England waters and in the laboratory. When a fragment of Didemnum sp. settles on a suitable substrate, it is capable of reattaching within one or two days. Colonies of Didemnum sp. are fragmented when they are removed from boats hulls, floating docks, and aquaculture equipment. Fish and scallop trawls pulled through areas infested with Didemnum sp. (as occurs at Georges Bank in water depths of 45m to 60m) likely fragment the colonies and suspend them in the water column. If viable fragments of Didemnum sp. can survive in suspension for sufficient

time, they may be transported via ocean currents into uninhabited habitats. However, the amount of time that a fragment of Didemnum sp. can survive without attaching was previously unknown. We conducted an experiment to suspend fragments of Didemnum sp. for up to one month to test their survival. At the start of the suspension period, fragments were flat and square, measuring about 2cm x 1.5cm. During suspension, the fragments adapted to the water habitat by changing their gross morphology into spheres. Smaller, lightweight fragments took longer to settle in a one-meter vertical tube of seawater than larger, heavier fragments. We found that 60% of fragments were capable of surviving suspension for 18 days; and 15% survived in suspension for 30 days. Thus, fragments are viable for a considerable amount of time and may tolerate being transported great distances before settling and reattaching. These results can assist resource managers in developing strategies for reducing the spread of the species.

Carter, G. A., The University of Southern Mississippi, Gulfport, MS, USA, greg.carter@usm.edu;
Otvos, E. G., The University of Southern Mississippi, Ocean Springs, MS, USA, ervin.otvos@usm.edu;
Criss, G. A., The University of Southern Mississippi, Gulfport, MS, USA, alan.criss@usm.edu;
Blossom, G. A., The University of Southern Mississippi, Gulfport, MS, USA, gabriel.blossom@usm.edu;
Lucas, K. L., The University of Southern Mississippi, Gulfport, MS, USA, kelly.lucas@usm.edu

CHANGES IN LAND AREA AND VEGETATIVE COVER ON THE MISSISSIPPI-ALABAMA BARRIER ISLANDS DURING HURRICANE KATRINA AND THE ONSET OF RECOVERY

The Mississippi-Alabama barrier islands, which from west-to-east include Cat, West Ship, East Ship, Horn, Petit Bois and Dauphin, were impacted dramatically by Hurricane Katrina in August, 2005. Maximum sustained wind speed and surge elevation for Cat and western Dauphin were 200 and 120 km per hour, and 8 m and 3.5 m, respectively. Satellite image data acquired before Katrina and during the first six months afterward (IKONOS and QuickBird) were compared to determine the immediate storm impact on land area and vegetation cover plus the onset of island re-building. Aerial LIDAR data acquired pre- and post-storm were used to determine changes in island elevations. Immediate loss in vegetation cover, which was greatest on Horn (about 136 ha), was caused primarily by erosive shore retreat, washover erosion and burial by sand sheets and washover lobes. LIDAR elevations demonstrated an unprecedented lowering of the highest (3-7 m) island ridges. Waves removed the upper 1-2 m or more of extensive relict dunes. By early 2006, significant natural rebuilding of land area due to westward sediment transport was evident on the Ship islands.

Castellani, C., British Oceanographic Data Centre , Liverpool, United Kingdom, cxc@bodc.ac.uk;
Licandro, P., Sir Alister Hardy Foundation for Ocean Science, Plymouth, United Kingdom, prli@sahfos.ac.uk;
Jossi, J. W., National Marine Fisheries Service, Narragansett, USA, jjossi@mola.na.nmfs.gov;
Edwards, M., Sir Alister Hardy Foundation for Ocean Science, Plymouth, United Kingdom, MAED@sahfos.ac.uk

DO DIFFERENCES IN LIFE STRATEGIES AND PHYSIOLOGY CONTRIBUTE TO MULTI-DECADAL VARIABILITY IN COPEPOD PHENOLOGY AND ABUNDANCE ACROSS THE NORTH ATLANTIC BASIN?

Trans-Atlantic studies indicate that climate change can have different impact on the western and eastern side of the Atlantic resulting in opposite trends in the multi-decadal variability in copepod species abundance. Copepods can be characterised by very different species-specific eco-physiology and life strategies. Therefore, interannual and long-term changes in their abundance and life cycle should reflect how individual species and/or their meta-populations respond to regional environmental and climatic variability. Here we investigate how climate and environmental change interact with the life cycle and eco-physiological characteristics of dominant copepods species in the north Atlantic to determine multi-decadal variability in their phenology and abundance over basin scale. We analyse the Continuous Plankton Recorder survey data from 1945 to 2006 using the Eigen Vector Filtering method to examine changes in monthly mean data and compare the phenology of the different species. The results are viewed in relation to published literature on the biology of each species to elucidate the mechanisms determining the basin scale multi-decadal variability in their life cycles and abundance and to make predictions about the effect of future environmental changes.

Chang, R. Y., Florida International University, Miami, USA, richard.chang@fiu.edu

POPULATION STRUCTURE IN THE CALANOID COPEPOD *PARACALANUS QUASIMODO* ALONG THE SOUTHEASTERN COAST OF THE UNITED STATES

An understanding of phylogeography in planktonic species will provide insight to regional patterns and which factors influence dispersal. Previous studies along the eastern United States coast have either concentrated on specific areas of this region or were broad in scale, covering the entire coast, but with widely separated sampling sites. This study examines the population structure of the neritic calanoid copepod *Paracalanus quasimodo* at an intermediate scale of the Gulf of Mexico and Florida peninsula. Samples were obtained from eight sights. *P. quasimodo* populations were surveyed for genetic types in the ITS-1 region through denaturing gradient gel electrophoresis. Significant differences in population structure were detected and suggest a large influence by oceanic currents.

CHASSAGNE, R., BORDEAUX 1, BORDEAUX, France, r.chassagne@epoc.u-bordeaux1.fr;
Lecroart, P., BORDEAUX 1, BORDEAUX, France, p.lecroart@epoc.u-bordeaux1.fr;
Beaugendre, H., BORDEAUX 1, BORDEAUX , France, Heloise.Beaugendremath.u-bordeaux1.fr;
Anschutz, P., BORDEAUX 1, BORDEAUX , France, p.anschutz@epoc.u-bordeaux1.fr

NUMERICAL STUDY OF COUPLING BETWEEN RICHARDS AND TRANSPORT-DIFFUSION EQUATIONS IN PERMEABLE SEDIMENT AFFECTED BY TIDAL OSCILLATION

We have developed a 2D numerical model that couples Richards' equation with transport-diffusion equations of silica and oxygen in beach permeable sediment submitted to tides influence. The flow into the sediment is described by the Richards' equation which generalizes the Darcy's law for variably-saturated porous media. The velocity field and the watertable location, deduced from the numerical resolution of the Richards'equation, are introduced into the transport diffusion-equation of silica and oxygen. Tidal oscillations are modeled as a sinusoidal pressure boundary condition along the beach slope. Both flow characteristics and concentration are solved by finite element method. Numerical results have been compared with concentration measured in the Truc Vert beach located along the Atlantic coast. Our study shows that the residence time of silica in tidal permeable sediment is equal to 7 tidal cycles. The model allows us to test the oxygen demand sensitivity to parameters that govern the properties of the permeable sediment and the tide (permeability, lability of the organic matter, beach slope, tidal amplitude).

Chen, B., Hong Kong University of Science & Technology, Hong Kong, Hong Kong POC, elanchen@ust.hk;
Liu, H., Hong Kong University of Science & Technology, Hong Kong, Hong Kong POC, liuhb@ust.hk;
Dai, M., Xiamen University, Xiamen, China, mdai@xmu.edu.cn

COMPARISON OF PHYTOPLANKTON GROWTH AND MORTALITY RATES IN DIFFERENT TROPHIC ENVIRONMENTS IN THE WESTERN SOUTH CHINA SEA DURING THE SUMMER OF 2007

We conducted 28 dilution experiments to assess the phytoplankton growth and microzooplankton grazing rates in the western South China Sea during the summer of 2007 when upwelling was found most pronounced. *Prochlorococcus* was numerically dominant in this area, but its relative abundance declined in mesotrophic environments where the abundance of *Synechococcus* became comparable with *Prochlorococcus*. In the

oligotrophic area, *Prochlorococcus* was the most important contributor to total phytoplankton biomass and productivity, while *Synechococcus* was the most important in mesotrophic area. Growth rates of total chlorophyll, *Synechococcus*, and ultraeukaryotes increased in mesotrophic areas compared with oligotrophic areas, while the growth rates of *Prochlorococcus* were approximately the same in both areas. *Synechococcus* had the highest growth rates compared with *Prochlorococcus* and ultraeukaryotes in both oligotrophic and mesotrophic areas. Mortality rates of *Prochlorococcus*, *Synechococcus*, ultraeukaryotes, and total chlorophyll were all enhanced in mesotrophic areas. Our results showed that *Synechococcus* was a very important group of phytoplankton in response to nutrient input due to upwelling and river discharge.

Chen, F., University of Maryland Biotechnology Institute, Baltimore, USA, chenf@umbi.umd.edu;
Zhao, Y., University of Maryland Biotechnology Institute, Baltimore, USA, ylzhao@umbi.umd.edu;
Wang, K., University of Maryland Biotechnology Institute, Baltimore, USA, wangk@umbi.umd.edu;
Jiao, N., Xiamen University, Xiamen, China, jiao@xmu.edu.cn

VIRAL TRANSDUCTION MACHINERIES IN ROSEOBACTERS: PHAGE, PROPHAGE AND GTA

Roseobacters are a group of abundant bacteria in marine environments. Among more than 20 completed genome sequences of marine roseobacters, 95% contains a conserved genetic transfer agent (GTA) structure, and nearly 50% harbors prophage-like genome(s). Lytic phages infecting roseobacters were also reported previously. This group of bacteria appears to possess a wide range of phage related machineries which provide them a variety of capabilities in the natural environment to acquire necessary genes via horizontal gene transfer. However, very little is known the role and interaction of these phage-related structures in roseobacters. In this study, we provide the evidence showing interactive functions of GTA, prophages and lytic phages based on our studies on four selected marine roseobacters (Silicibacter pomeroyi DSS-3, Sulfitobacter sp. EE-36, Silicibacter sp. TM1040 and Roseovarius nubinhibens ISM). Our results include: 1) isolation of several lytic phages from roseobacters; 2) induction of prophages in roseobacters; 3) size characterization of DNA fragments from GTA; 4) production of GTA in various roseobacter strains under different growth conditions. Our data showed that the production of GTA, the size and number of DNA fragments contained by GTA vary with strains. Variable sensitivity to lytic infection, inducible prophages and variable GTA production implies that viral transduction rates may vary greatly among different strains of roseobacters.

Chen, G. J., McGill University, Montreal, Canada, guangjie.chen@mail.mcgill.ca;
Selbie, D. T., McGill University, Montreal, Canada;
Finney, B. P., University of Alaska, Fairbanks, USA;
Schindler, D. E., University of Washington, Seattle, USA;
Bunting, L., University of Regina, Regina, Canada;
Leavitt, P. R., University of Regina, Regina, Canada;
Gregory-Eaves, I., McGill University, Montreal, Canada

ZOOPLANKTON DYNAMICS IN PACIFIC SALMON NURSERY LAKES OF ALASKA - A LIMNOLOGICAL AND PALEOLIMNOLOGICAL PERSPECTIVE

As a function of their anadromous and semelparous life histories, Pacific salmon (Oncorhynchus spp.) transfer marine-derived nutrients (MDN) to terrestrial ecosystems. In some systems, MDN account for a large proportion of the total nutrient load. MDN can enhance zooplankton production in their nursery lakes, but the cascading effect of planktivorous salmon fry could also negatively alter zooplankton biomass and size structure. Therefore, resolving the zooplankton-salmon interactions are key to understanding community dynamics in nursery lakes. Building on a preliminary study which showed that zooplankton abundances scaled positively with increased abundances of salmon spawners, we are evaluating the generality of this response across a gradient of five nursery lakes (currently 1,000 Ã¢â‚€œ 40,000 sockeye/km2) using both modern and paleolimnological data. Zooplankton estimates derived from net tows show that zooplankton production does increase with increasing sockeye salmon escapement across numerous lakes. Our paleolimnological analyses demonstrate that past zooplankton production in most nursery lakes was also strongly correlated with sedimentary $\delta^{15}N$ signals, an indicator of past salmon escapement. However, no such relationship was observed in the most productive Red Lake. Overall, our results will quantify the importance of MDN across nursery lakes representing a large salmon spawner and nutrient gradient.

Chen, I. C., University of Hawaii, Honolulu, USA, inchieh@hawaii.edu;
Glazer, B. T., University of Hawaii, Honolulu, USA, glazer@hawaii.edu

CONNECTING AN IN-SITU ELECTROCHEMICAL ANALYZER TO THE KILO NALU NEARSHORE OBSERVATORY FOR REAL-TIME AND CONTINUOUS VOLTAMMETRIC MEASUREMENTS IN SANDY SEDIMENTS

Transport and transformations of redox-reactive chemical species (including oxygen) in sandy sediments occurs via a combination of diffusive, biological, and, particularly in nearshore environments, physical mechanisms. Waves and currents can carry and redistribute sand, altering the bottom topology over relatively short periods of time. A power and ethernet communication interface was designed for an in-situ electrochemical analyzer (ISEA-III, Analytical Instrument Systems, Inc.), and a benthic lander was constructed for deploying the system at a depth of 10 m to the Kilo Nalu cabled observatory network, located off of Kewalo Basin on Oahu's south shore. Voltammetric measurements were obtained using the ISEA and four gold amalgam working electrodes that were mounted on a micromanipulator to provide capability for profiling across the sediment-water interface to a depth of 15 cm. A video camera was also positioned to provide images of electrode positions relative to the sediment-water interface. The cabled network enables electrochemical sampling parameters and micromanipulations to be controlled over an internet connection. We will be able to observe changes in the concentration of redox-reactive chemical species resulting from temporal and topographical variations.

Chiandet, A. S., Trent University, Peterborough, Canada, aishachiandet@trentu.ca;
Xenopoulos, M. A., Trent University, Peterborough, Canada, mxenopoulos@trentu.ca;
Woolnough, D. A., Trent University, Peterborough, Canada, daelynwoolnough@trentu.ca;
McAlister, L. S., Trent University, Peterborough, Canada, lindseymcalister@trentu.ca;
Frost, P. C., Trent University, Peterborough, Canada, paulfrost@trentu.ca

URBANIZATION, CONTAMINANTS AND ELEVATED NUTRIENT LOADS AS MULTIPLE STRESSORS OF PLANKTON AND FISH COMMUNITIES IN URBAN PONDS

Urbanization is increasing on a global scale at an unprecedented rate and is strongly affecting water quality. One approach to mitigating water quality degradation is the construction of stormwater management ponds (SWMPs), which retain urban runoff. This retention leads to the accumulation of contaminants and nutrients in concentrations greater than surrounding waters. The objective of this project was to characterize plankton and fish communities as they relate to pond physical and chemical properties and pond catchment properties. In 60 SWMPs located in urban areas of southern Ontario, we found zooplankton biomass was variable (2±1 mg/L) and was higher in older, shallow and warmer ponds. Fish were present in 75% of ponds sampled with up to 3 species per pond. Ponds had high total phosphorus and suspended solids (137±32 µg/L and 23±5 mg/L, respectively), extremely high conductivity (888±215 µS/cm) and low dissolved oxygen levels (7±1 mg/L), especially in thermally stratified ponds (n=47). Pond age and the presence of sediment forebays were important determinants of water quality. These results will help us understand how we are changing aquatic ecosystems in urban environments.

Christie, A. E., U. Hawaii at Manoa and Mt. Desert Island Biological Laboratory, Honolulu, USA, crabman@pbrc.hawaii.edu;
Lenz, P. H., U. Hawaii at Manoa, Honolulu, USA, petra@pbrc.hawaii.edu;
Hassettt, R. P., Ohio U., Athens, USA, hassett@ohio.edu;
Smith, C. M., Mt. Desert Island Biological Laboratory, Salsbury Cove, USA, cmsmith@mdibl.org;
Ãœnal, E., U. Connecticut, Groton, USA, ebru.unal@uconn.edu;
Bucklin, A., U. Connecticut, Groton, , ann.bucklin@uconn.edu;
Towle, D. W., Mt. Desert Island Biological Laboratory, Salsbury Cove, , dtowle@mdibl.org

CALANUS FINMARCHICUS CDNA LIBRARY: NEW ENVIRONMENTAL GENOMIC TOOLS FOR STUDIES OF ZOOPLANKTON PHYSIOLOGICAL ECOLOGY

Zooplankton ecologists have long sought the underlying drivers of physiological condition/life history stages of copepods. For example, *Calanus finmarchicus* populations undergo seasonal cycles including growth, reproduction, lipid storage, and diapause. These physiological state changes are regulated by multiple processes, and are undoubtedly under environmental control. Currently, the underlying regulators of these processes are being sought at the molecular level. We report the development of a new tool for addressing these questions. A normalized, whole organism cDNA library was created, analyzed, and approximately 6,000 expressed sequence tags (ESTs) generated. Functional analysis was done to sort the ESTs by putative physiological function(s) and to identify transcripts that encode proteins involved in the generation/regulation of population dynamics. The library includes ESTs involved in metabolism (684 contigs), development (338 contigs), biological regulation (281 contigs), growth (53 contigs), reproduction (31 contigs), rhythmic activities (11 contigs) and locomotion (20 contigs). With these data, we are positioned to begin environmental genomic studies of *C. finmarchicus*, using a new approach to address the persistent question of the environmental factors regulating observed population cycles. Supported by INBRE P20 RR-016463.

Church, C. D., USDA-ARS, University Park, PA, USA, Clinton.Church@ars.usda.gov;
Bryant, R., USDA-ARS, University Park, PA, USA, Ray.Bryant@ars.usda.gov;
Kleinman, P., USDA-ARS, University Park, PA, USA, Peter.Kleinman@ars.usda.gov;
Feyereisen, G., USDA-ARS, University Park, PA, , Gary.Feyereisen@ars.usda.gov

REDUCTION OF AGRICULTURAL NON-POINT SOURCE PHOSPHORUS AND TRACE METAL POLLUTION USING INDUSTRIAL MATERIALS

Loss of phosphorus (P) from agricultural lands to water bodies is an environmental concern. Ditch drainage from lands with heavy poultry manure application on the Eastern Shore of the Chesapeake Bay provides a pathway to deliver P and trace metals (arsenic, copper, nickel, zinc) to the bay. Best management practices designed to reduce particulate P losses or nitrogen losses are ineffective in reducing dissolved P or dissolved trace metal losses. In-ditch filtration systems using two different materials and designs were installed on Maryland's Eastern Shore. After a few months in the field, the first system, a metal housing containing an acid mine drainage residual, failed to conduct enough drainage effluent to successfully reduce dissolved P levels. The second system consists of a bed of flue gas desulphurization gypsum laid over a series of perforated pipes in the bottom of a 1.5 m deep drainage ditch. The filtration system reduced dissolved P by 67% for runoff events in 2007. The system offers potential as a low-cost method to remove dissolved P from ditch drainage systems, and preliminary data also show that these structures have the potential to reduce concentrations of trace metals. Additional research planned include laboratory studies, testing of the in-field system, and chemical modeling to estimate the long-term efficacy of P and trace metal removal.

Clapsadl, M., Buffalo State College/Great Lakes Center, Buffalo, USA, clapsamd@buffalostate.edu

THE DIET OF STEELHEAD TROUT IN LAKE ERIE

Steelhead trout (Oncorhynchus mykiss) are a top level piscivore (fish predator) and are the most numerous salmonine in Lake Erie. This status is maintained by stocking programs conducted in US and Canadian waters that place approximately 2 million steelhead per year into the lake. Despite the status of this fish as the most numerous salmonine in the lake, relatively little is known about the composition of their diet, and therefore about the demands they place on the forage base. In order to better understand the composition of steelhead diet we collected stomach samples from a variety of sources from June Ã¢â‚¬â€œ October 2004. Analysis of these collections showed that emerald shiners and rainbow smelt accounted for approximately 46 and 38 % of the diet. Through the use of a fish bioenergetic model (Bioenergetics 3.0) we estimated total summer time prey consumption of 2 and 3 year old steelhead to be approximately 5,200 tonnes. These estimates can be used by fisheries managers when trying to assess total demands placed upon the Lake Erie forage base by piscovirous fishes.

Cole, S. B., St. Francis Xavier University, Antigonish, Canada, swbcole@gmail.com;
Scrosati, R. A., St. Francis Xavier University, Antigonish, Canada, rscrosat@stfx.ca

SPATIAL SCALES OF VARIABILITY OF INTERTIDAL INVERTEBRATES AND SEAWEEDS ON THE GULF OF ST. LAWRENCE COAST

Ecological indicators are organisms used to quickly assess environmental conditions and to diagnose causes of environmental change. Indicators respond over different spatial scales, so the context of these scales must be explicitly identified. Our study tested the null hypothesis that the horizontal spatial pattern of abundance in intertidal seaweeds and invertebrates was invariant to scale for wave/ice-exposed and sheltered habitats. Rejection of this hypothesis led to identification of relevant scales of spatial variation at which sampling effort should be concentrated for environmental monitoring. We implemented a hierarchical sampling design, including 3 scales (region, location, and site) spanning 6 orders of magnitude in resolution over 400 km of coastline to sample abundance of candidate indicator species (*Semibalanus balanoides*, *Mytilus edulis*, *Fucus* spp., *Ascophyllum nodosum*, *Chondrus crispus*) within the southern Gulf of St. Lawrence. Results suggest that monitoring indicators in exposed areas requires a multi-scale design with larger sample sizes than for sheltered habitats. *Fucus* spp. in exposed and *A. nodosum* in sheltered areas may be good indicators among regions since most of their variation was explained by regional differences.

Coll Monton, M., Dalhousie University, Halifax, Canada, martacoll@dal.ca;
Schmidt, A. L., Dalhousie University, Halifax, Canada, aschmidt@dal.ca;
Lotze, H. K., Dalhousie University, Halifax, Canada, hlotze@dal.ca

MODELLING CHANGES IN THE STRUCTURE AND FUNCTIONING OF EELGRASS COMMUNITIES (ZOSTERA MARINA) UNDER DIFFERENT LEVELS OF EUTROPHICATION IN ATLANTIC CANADA

Nutrient loading into estuaries negatively affects eelgrass plants (Zostera marina) through increasing algal overgrowth, turbidity and oxygen depletion. Here we quantify how the structure and functioning of eelgrass food webs change across a gradient of eutrophication along the coasts of New Brunswick and Prince Edward Island (Gulf of St. Lawrence, Atlantic Canada). A large-scale field survey in 2007 was carried out to collect community-level data at low, medium and high impacted sites. We then constructed food-web models combining field data with published information to quantify changes in community structure (e.g. trophic levels, omnivory index) and functioning (e.g. transfer efficiency, keystone species). To derive general patterns in community changes that don't rely on a single model approach, we compared different modelling techniques: network models and mass-balance models. The food-web models were validated by comparing (1) results between the two different methodologies, and (2) model-predicted trophic levels with stable isotope data analyzed from field samples. Stable isotopes were also used to differentiate the source of primary production at different trophic levels.

Colman, J. A., U.S. Geological Survey, Northborough, USA, jacolman@usgs.gov;
Lee, K. D., National Park Service, Wellfleet, USA, Krista_Lee@nps.gov;
Bothner, M. H., U.S. Geological Survey, Woods Hole, USA, mbothner@usgs.gov;

Batdorf, C. A., Massachusetts Department of Environmental Protection, Lawrence, USA, carol.batdorf@state.ma.us;
Pancorbo, O. C., Massachusetts Department of Environmental Protection, Lawrence, USA, oscar.pancorbo@state.ma.us

MERCURY IN ATMOSPHERIC DEPOSITION, SEDIMENT CORES, AND FISH ON THE EAST AND WEST COASTS OF NORTH AMERICA: EFFECTS OF REGIONAL AND GLOBAL ATMOSPHERIC EMISSIONS

Mercury at 3 wet-deposition sites, in 10 age-dated sediment cores, and in 170 fish was compared for pristine dune lakes of coastal Oregon; drainage lakes of the Olympic Peninsula, Washington; and kettle lakes of Cape Cod National Seashore, Massachusetts during 2006-2007 to assess effects of regional emission sources. Regional mercury emission sources are few, distant, and downwind on the west coast, but upwind sources are abundant for Cape Cod, although none are known within 65 km of the Cape Cod lakes that were investigated. Mercury wet deposition rates and mercury accumulation rates in cores were similar on the two coasts: in wet deposition, 5.5-6.5 µ g/m2/yr west, and 5.2-6.3 µg/m2/yr east; in cores, 35-63 µg/m2/yr west and 55-70 µg/m2/yr east. Absolute concentrations of mercury in skinless filets of largemouth bass and yellow perch were higher on Cape Cod, 0.27-3.0 µg/g ww, than on the west coast, 0.10Ã¢â‚â€œ2.5 µg/g ww; but when normalized for fish size and lake pH, fish mercury concentrations were nearly equal. Results support a hypothesis that global, rather than regional, sources dominate accumulation on both coasts.

Comeau, A. J., Dalhousie University, Halifax, Canada, adam.comeau@dal.ca;
Cullen, J. J., Dalhousie University, Halifax, Canada, john.cullen@dal.ca

NEW METHOD TO ESTIMATE A PARAMETER OF PHYTOPLANKTON PHYSIOLOGY RELATED TO PRIMARY PRODUCTIVITY MODELS

Accurate estimates of global primary productivity require knowledge of both physical conditions and the physiological response of phytoplankton to the environment. Algal physiology is commonly quantified using two parameters: the maximum rate of photosynthesis normalized to biomass (P^B_{max}) and the light saturation parameter (E_k). Some progress has been made on understanding the environmental factors influencing the variability of P^B_{max}, however the environmental variability of E_k needs further study. A new approach was developed to estimate E_k from vertical profiles using conventional fluorometers and radiometers. Near-surface decreases in fluorescence yield have been commonly observed in fluorescence profiles, and have been attributed to energy dissipation mechanisms that are triggered when irradiance saturates photosynthesis. The light level where this energy dissipation begins, E_{fopt}, is a useful index of the acclimation state of phytoplankton and directly approximates E_k in lab studies. An algorithm was developed to measure E_{fopt} from routine profiles of irradiance and fluorescence yield. The simple requirements of this method will allow estimates of E_{fopt} from most oceanographic cruises, and some autonomous profiling instruments such as gliders and moored profilers.

Comte, J., Université du Québec à Montrèal, Montreal, Canada, comte.j@gmail.com;
Guillemette, F., Université du Québec à Montrèal, Montreal, Canada, guillemette.francois@gmail.com;
del Giorgio, P. A., Université du Québec à Montrèal, Montreal, Canada, del_giorgio.paul@uqam.ca

BACTERIOPLANKTON COMPOSITION, FUNCTION AND C METABOLISM ALONG THE WATER FLOW PATH IN A TEMPERATE WATERSHED : THE IMPORTANCE OF INTERFACES

Bacterial community metabolism, function and composition are known to change over broad trophic, salinity, and other major environmental gradients in aquatic systems. Here we explore how freshwater bacterioplankton communities react to environmental change at much smaller spatial and temporal scales. We followed bacterioplankton composition, function and C metabolism along the water flow path in a southern Québec catchment, composed of a network of lakes, rivers and marshes. In this network there are distinct and consistent differences in both composition (DGGE profiles) and function (BIOLOG profiles) between the main system types, and yet there is little or no correlation between the actual patterns in composition and function. However, the magnitude of change in composition and function at the interfaces between systems is highly correlated, suggesting that these attributes are indeed connected but in a dynamic rather than deterministic manner. The zones of greatest change in bacterial composition and function correspond to sites with large shifts in DOC properties, and in bacterial C processing and metabolism, highlighting the strong link that exists between bacterial community structure and the organic C resource field.

Cooke, S. L., Illinois Natural History Survey, Champaign, USA, slcooke@uiuc.edu;
Hill, W. R., Illinois Natural History Survey, Champaign, USA, whill@inhs.uiuc.edu;
Hogue, J. L., University of Nebraska - Lincoln, Lincoln, USA, jenhogue@bigred.unl.edu

USING A BIOENERGETICS MODEL TO PREDICT THE INVASION POTENTIAL OF PLANKTIVOROUS SILVER CARP IN THE LAURENTIAN GREAT LAKES

We developed a bioenergetics model for silver carp *Hypophthalmichthys molitrix*, an invasive planktivorous fish native to Asia now found in the Mississippi River basin, including waterways connected to the Laurentian Great Lakes. Parameter values for the respiration function were experimentally derived, and consumption, egestion, and excretion parameters were used from the literature. Our primary purpose was to use the model to predict the basic metabolic requirements of a silver carp under various body sizes, temperatures, swimming speeds, and reproductive stages. We then use these requirements to predict when and where silver carp may survive in the Great Lakes. We found that a 2400 g non-reproducing, non-swimming adult requires 97.2 kJ d^{-1} to maintain its body mass at 20 °C, approximately equivalent to a consumption rate of 43 g *Daphnia* per day. When silver carp energy and consumption requirements are compared to plankton densities in the Great Lakes, the results suggest that the establishment of silver carp in these oligotrophic ecosystems will be limited by plankton availability.

Cooper, R. N., University of Regina, Regina, Canada, cooper3r@uregina.ca;
Wissel, B., University of Regina, Regina, Canada, bjoern.wissel@uregina.ca

TROPHIC STRUCTURES AND ENERGY PATHWAYS IN SALINE PRAIRIE LAKES AS DETERMINED BY STABLE ISOTOPES.

Saline lakes are common worldwide, and while their food-web compositions have been previously described, trophic interactions are generally unknown. To determine food-web structure with special focus on dietary preferences of fish (pelagic vs. benthic), we collected fish, zooplankton, benthos, algae, and water from 20 lakes covering a large salinity gradient. Overall, biodiversity decreased with salinity, and fishes were only present in fresh to sub-saline lakes. Zooplankton communities shifted from freshwater to halotolerant species as salinity increased, and smaller zooplankton species were favored in the presence of fish. Yet, stable isotope analyses indicated that piscivorous fish foraged primarily in littoral habitats, suggesting the benthic/littoral pathways were dominant, supported by the fact that benthos was ubiquitous to all lakes and species compositions did not change dramatically. Planktonic prey was predominantly used by juvenile fishes, which could cause a dietary bottleneck effect in sub-saline lakes due to absence of defense-mechanisms of halotolerant zooplankton. This research will establish in which lakes fish are at risk of (plankton-)resource or habitat loss, and develop management strategies to sustain fishes in lakes despite the predicted salinity increases.

Cory, R. M., University of Minnesota, St. Paul, USA, cory@chem.umn.edu;
McNeill, K., University of Minnesota, Minneapolis, USA, mcneill@chem.umn.edu;
Cotner, J. B., University of Minnesota, St. Paul, USA, cotne002@umn.edu

SINGLET OXYGEN UPTAKE BY AQUATIC FULVIC ACID LEADS TO PRODUCTION OF HYDROGEN PEROXIDE AND OXIDIZED ORGANIC COMPOUNDS

Singlet oxygen (1O2, 1ÃŽâ€ g) is a reactive oxygen species produced by the interaction between photo-excited dissolved organic matter (DOM) and dissolved oxygen. Singlet oxygen is capable of oxidizing several compound classes that comprise DOM and thus may play a role in photochemical

transformations of DOM. We studied the uptake of 1O2 by Suwannee River and Pony Lake fulvic acids, the terrestrial and microbial end-member aquatic humic substances, respectively. Labeling experiments (18O2) demonstrated that 1O2 is involved in the photochemical weathering of fulvic acids, yielding both stable oxidized products as well as hydrogen peroxide (H2O2). Our results suggest that at DOM concentrations measured in freshwaters (1-100 mg-C L-1), the 1O2 pathway accounts for <1 to > 50% of the total H2O2 formed photochemically by the fulvic acid fraction of DOM. Employing the van Krevelen approach to ultra-high resolution mass spectrometry analysis of the fulvic acids revealed that lignin-like compounds were the preferred 1O2-substrate for Suwannee River fulvic acid. For Pony Lake fulvic acid, 1O2 preferentially reacted with relatively saturated compounds low in oxygen.

Cottenie, K., University of Guelph, Guelph, Canada, cottenie@uoguelph.ca

CRYPTIC DISPERSAL IN ZOOPLANKTON: INSIGHT FROM A METACOMMUNITY PERSPECTIVE

Dispersal is a key structuring force in structuring communities. The cryptic nature of the extent, rates, and mechanisms of freshwater zooplankton dispersal, however, has puzzled limnologists for the last 200 years. My main goal is to reassess this problem from a metacommunity perspective. I compared observational results from empirical metacommunity systems, spanning the range of highly connected to isolated, with a heuristic theoretical model and experiment that relates different metacommunity types to dispersal rates and environmental heterogeneity within a metacommunity. Both the experimental and observational results show that species sorting is the main determinant of zooplankton communities, or that dispersal is in general not limiting in freshwater zooplankton communities with some evidence for dispersal limitation and mass effects. Thus dispersal in zooplankton is not only cryptic because it is difficult to observe the dispersing stages, but it is also difficult to observe the results in community structure because it is efficient enough, relative to environmental heterogeneity, to result in strong species sorting dynamics.

Crooks, J. A., Tijuana River National Estuarine Research Reserve, Imperial Beach, USA, jcrooks@tijuanaestuary.org;
Rilov, G., Oregon State University, Corvallis, USA, rilovg@science.oregonstate.edu

FIFTY YEARS AFTER ELTON: THE SCIENCE OF MARINE INVASIONS IN THE SEA

Five decades ago, Charles Elton described an ecological explosion occurring in the world. Therein he began to paint a picture of how biological invasions were reshaping a seemingly inviolate sea. We continue to paint that picture today, and it reveals a largely-unchecked explosion that has left many marine environments dramatically changed. With the increased recognition of the extent of invasion the sea, however, has come a better understanding of marine invasion processes. In some cases, these dynamics are similar to those in better-studied systems (such as on land), which leads to the development of unifying principles in invasion biology. Invasions in the sea also differ in a number of key respects, including the nature of the medium, modes of invader reproduction, vector operation, and management options. Further, a growing area of concern is the incursion of non-marine invaders into marine systems, such as occurs along estuarine and wetland ecotones. Importantly, we have also begun to identify key gaps in our knowledge related to invader ecology and management, which should help steer future research efforts.

Cross, I. D., University of Nottingham, Nottingham, United Kingdom, lgxic1@nottingham.ac.uk;
McGowan, S., University of Nottingham, Nottingham, United Kingdom, suzanne.mcgowan@nottingham.ac.uk;
Metcalfe, S., University of Nottingham, Nottingham, United Kingdom, sarah.metcalfe@nottingham.ac.uk;
Field, R., University of Nottingham, Nottingham, United Kingdom, richard.field@nottingham.ac.uk

RESPONSE OF SHALLOW LAKE PHYTOPLANKTON TO HYDROLOGY AND NUTRIENT INTERACTIONS

Future climate change will affect the hydrology of shallow lakes and interact with existing eutrophication problems. We used a series of semi-natural shallow lakes in the lowlands of the UK to determine how interactions between hydrology and nutrients affected phytoplankton communities. The lakes spanned a gradient of nutrient loading, connectivity to rivers and ecosystem state (with or without aquatic plants). Multivariate analyses indicated that the phytoplankton communities of lakes connected to nutrient-rich rivers were distinct from those of isolated lakes, irrespective of ecosystem state or nutrient loading. R-strategists dominated the phytoplankton in river-fed lakes whereas C- and CS-strategists were more abundant in isolated lakes. Comparison of wet and dry years in river-fed lakes confirmed these patterns and showed increased abundance of R-strategists. The phytoplankton community structure of river-fed lakes tended to be more predictable than in isolated lakes, reflecting the importance of internal food-web processes in isolated lakes in both ecosystem states. Our results suggest that reducing inflows to lakes restricts our ability to predict phytoplankton communities and may favour the development of problem species.

Currie, W. J., Ohio University, Athens, USA, curriew@ohio.edu

AN ODE TO ODUM: LACUSTRINE ESTUARIES REVISITED

After a period of resistance and soul-searching W.E. Odum concluded that the time was right to accept Herdendorf's concept of a lacustrine estuary. However his 1990 proposal has not caught on, and is often viewed with distain by traditional estuarine scientists. I suggest that this concept should not only be revisted, but expanded to include impounded reservoirs. These systems are mixing regions where the littoral dominated fluvial zone meets a distinctly dissimilar lacustrine zone. Using examples from southeastern Ohio reservoirs, I will demonstrate that these systems exhibit the variability of salty estuarine systems, with the different zones manifesting divergent zooplankton, phytoplankton and fish communities. Futhermore, the differing physical and chemical properties of these zones vertically mix in a very similar fashion to those of coastal marine estuaries and show distinct gradients along the axis of the reservoirs. As a result, it is important to treat reservoirs as complex, heterogeneous systems with distinct zones, which differs from most lacustrine systems.

Curtis, K. A., Acadia University, Wolfville, Canada, Alexandra.Curtis@acadiau.ca;
Pepin, P., Department of Fisheries and Oceans Canada, St. John's, Canada, PepinP@dfo-mpo.gc.ca

INTERPOLATING FISH EGGS: CAN WE GET UNCERTAINTY RIGHT FOR NON-GAUSSIAN DATA?

Estimation of plankton populations, such as for stock assessment of fish with pelagic eggs, requires unbiased best estimates and appropriate uncertainty bounds. One source of bias may be significant advection relative to the spatial and temporal scales of a survey. High-resolution underway biological and physical measurements can, in theory, be linked to a circulation model to enable effective adaptive sampling. Interpolation techniques for data assimilation routinely assume a Gaussian error structure. The skewed distributions of most plankton abundance data violate this assumption, resulting in mischaracterization of uncertainty. We compare the performance of linear kriging and a nonparametric local density estimation method to interpolate data from surveys of the eggs of American plaice (Hippoglossoides platessoides) in Trinity Bay, Newfoundland. The eggs were collected using a Continuous Underway Fish Egg Sampler and a Bongo net. We evaluate accuracy of point estimation and of uncertainty estimation using cross-validation for CUFES data and for Bongo data. We also examine the effect of degrading the data (i.e. omitting 10%, 25%, or 50% of the data) on the estimation error.

Cyr, H., University of Toronto, Toronto, Canada, helene@zoo.utoronto.ca

PHYSICS CONSTRAINS THE DEPTH DISTRIBUTION OF THE ABUNDANT NATIVE MUSSEL *ELLIPTIO COMPLANATA* IN LAKES

Unionid mussels are among the largest and longest-lived invertebrates in shallow freshwater ecosystems. They often account for a large portion of benthic biomass and contribute to nutrient cycling and sediment processes, but are thought to be limited to shallow areas (< 2-3 m). In this study, I compare the depth distribution of *Elliptio complanata* in seven lake basins of different sizes to test what factors determine the upper and lower limit of their depth range. Mussels were larger, grew more slowly and their

maximum density was deeper at more exposed sites. The maximum depth at which they were found in different lakes was closely related to thermocline depth ($r^2 = 0.89$). I conclude that physical forces set the upper limit of mussel distribution in lakes and the thermocline limits their lower range by limiting food availability and water temperature. These results suggest that comparisons of mussel populations between lakes are biased when they do not consider their full depth distribution. Also, long-term changes in the thermal structure of lakes are expected to affect the range of unionid mussels in lakes.

Dagg, M. J., Louisiana Universities Marine Consortium, Chauvin, USA, mdagg@lumcon.edu;
Semmler, C. M., Louisiana Universities Marine Consortium, Chauvin, USA, csemmler@lumcon.edu;
Roberts, B. J., Louisiana Universities Marine Consortium, Chauvin, USA, broberts@lumcon.edu;
Powell, R. T., Louisiana Universities Marine Consortium, Chauvin, USA, rpowell@lumcon.edu

TIME SCALES OF DOC INPUTS FROM LOUISIANA MARSHES TO THE COASTAL OCEAN IN THE NORTHERN GULF OF MEXICO

Local marsh flooding occurs on about 75% of the days each year. Water at the marsh edge is continuously net heterotrophic and our sampling on the time scale of hours during a flood-relaxation cycle suggested the marsh is a DOC source for channel water. Twenty km away, at a bay station, water varies between net heterotrophy and net autotrophy. We hypothesize that event scale processes lead to the net ecosystem metabolism being dominated either by nearshore water (DOC) or offshore water (inorganic nutrients). However, the NEM state of the coastal ocean outside the bay may itself vary on longer (seasonal) times scales associated with Mississippi River discharge cycles. During high discharge, the coastal ocean is likely to be dominated by riverine inorganic nutrients. During low discharge, the DOC fueled microbial food web contributes significantly to coastal production and POM vertical flux. We propose a general lengthening of the time scale of marsh DOC impact with distance from the source, from hours at the marsh edge to days within the bay and to a seasonal scale outside the bay.

Daigle, R. M., Fisheries and Oceans, Dartmouth, Canada, daigler@mar.dfo-mpo.gc.ca;
DiBacco, C., Fisheries and Oceans, Dartmouth, Canada, dibaccoc@mar.dfo-mpo.gc.ca;
Bravo, M. A., University of British Columbia, Vancouver, Canada, mbravo@eos.ubc.ca;
Therriault, T. W., Fisheries and Oceans, Nanaimo, Canada, therriaultt@pac.dfo-mpo.gc.ca;
Brauner, C. J., University of British Columbia, Vancouver, Canada, brauner@zoology.ubc.ca;
Gillespie, G. E., Fisheries and Oceans, Nanaimo, Canada, GillespieG@pac.dfo-mpo.gc.ca

PHYSIOLOGICAL AND ECOLOGICAL INTERACTIONS OF NATIVE *CANCER* SPP. AND *CARCINUS MAENAS* IN BRITISH COLUMBIA, CANADA

This study characterizes ecological interactions between populations of two native *Cancer* spp. and the invasive green crab, *Carcinus maena*, in Barkley Sound, British Columbia. Laboratory salinity tolerance tests demonstrated that *C. maenas* had a higher mean tolerance to osmotic stress when compared to *Cancer productu*s and *C. gracilis* with the latter being the least tolerant. Trapping surveys revealed depth segregated populations of *C. gracilis* and *C. maenas* - depth distributions for both spp. fluctuated over time and were significantly related to salinity and ultimately regional rainfall. It is suggested that osmoconforming *C. gracilis* retreats to deeper waters at times corresponding to a depressed halocline coinciding with heavy freshwater input. Co-occurrence of *C. maenas* and *C. productus* was extremely rare. The smaller sized osmoregulating *C. maenas* seem relegated to areas of high freshwater discharge due to biotic resistance by larger native crabs. These findings suggest that halotolerance may have facilitated the establishment of green crab populations on Canada's west coast. Salinity tolerance data are valuable for assessing the risk of further invasions in estuaries along British Columbia's coast and similar environments.

Davies, K. T., Dalhousie University, Halifax, Canada, kim.davies@dal.ca

THE ROLE OF OCEANOGRAPHY AND ZOOPLANKTON IN CONTROLLING THE SPATIOTEMPORAL DISTRIBUTION OF A PREDATOR ACRROSS FOUR ORDERS OF MAGNITUDE

In my 25 years of life, the list of endangered species has grown, and commercial fisheries continue to decline. Consequently, the goal of many marine science initiatives has become development of effective and functional recovery strategies founded on explained variation in the ecology of endangered species. This goal prompted a shift in focus from single-species research to the examination of food web interactions among trophic levels and oceanographic forcing mechanisms; especially where variability in plankton abundance and energy content can exert a bottom-up control. Here, I use a model system to study zooplankton control over the ecology of a critically endangered species. I test the hypothesis that spatiotemporal variability in feeding-habitat occupancy of North Atlantic right whales in the Scotia-Fundy region can be explained by spatiotemporal variability in their zooplankton prey where the latter is a function of variation in regional water mass characteristics. This is achieved through analyses of a unique 20-year set of historical zooplankton samples coupled with contemporary zooplankton measures (abundance, size, biomass, energy content) and historical and contemporary measures of the regional oceanography and whale occupancy.

De Meester, L., University of Leuven, Leuven, Belgium, Luc.DeMeester@bio.kuleuven.be;
Van Doorslaer, W., University of Leuven, Leuven, Belgium, Wendy.VanDoorslaer@bio.kuleuven.be;
Duvivier, C., University of Leuven, Leuven, Belgium, Cathy.Duvivier@bio.kuleuven.be;
Rousseaux, S., University of Leuven, Leuven, Belgium, Sarah.Rousseaux@bio.kuleuven.be

FROM EVOLUTIONARY ECOLOGY TO EVOLVING METACOMMUNITIES - THE CHALLENGE TO LINK EVOLUTION TO COMMUNITY PROCESSES

The past decades there has been major progress in evolutionary ecology of zooplankton. The waterflea Daphnia has been recognized as a key model organism for evolutionary ecological research, and "resurrection ecology" has provided us with an elegant tool to document micro-evolutionary responses to environmental changes in natural populations. Moreover, linking genomic approaches to resurrection ecology holds the promise of substantial progress in our mechanistic understanding of micro-evolutionary responses. In this contribution, we will focus on the challenge to quantify the relevance of evolutionary responses to the ecology of organisms, communities and ecosystems. Given the increasing number of reports on rapid evolutionary responses, these dynamics are increasingly recognized to potentially have important ecological consequences. We will present data on experiments that explore the impact of genetic differentiation and micro-evolution on community composition in zooplankton, and identify the challenges of this line of research. Using the responses of local communities to global change as an example, we dill argue that it is crucial that this interaction is viewed at the metacommunity level, taking dispersal and landscape connectivity into consideration.

DeAngelis, D. L., U. S. Geological Survey, Miami, USA, ddeangelis@bio.miami.edu;
Trexler, J. C., Florida International University, Miami, USA, trexlerj@fiu.edu;
Donalson, D. D., Everglades National Park, Homestead, USA, doug_donalson@nps.gov

MODELING TEMPORAL VARIABILITY AND SPATIAL HETEROGENEITY ON A WETLAND HYDROSCAPE

Models used in applied aspects of ecology, such as dealing with specific questions of environmental conservation, assessment, and restoration, are usually far different from models used to elucidate theoretical issues. Temporal variability and spatial heterogeneity characterize the environments of most real ecological problems, whereas theory has tended to use models that avoid such complexities and are kept as simple as possible to reveal theoretical insights. However, as ecological theory

is extended to more and more complex phenomena in which spatial heterogeneity and temporal fluctuations play a role, its potential application to real ecosystems and to specific applied issues are increasing. In this tutorial, we review current developments in theory of temporal variability and spatial heterogeneity related to community and food web dynamics. These are applied to the dynamics the community of small fishes of the Everglades and their food base. A combination of analysis and simulations reveal mechanisms for the coexistence of many trophically similar species.

Deborde, J., University Bordeaux I, Talence, France, j.deborde@epoc.u-bordeaux1.fr;
Abril, G., University Bordeaux I, Talence, France, g.abril@epoc.u-bordeaux1.fr;
Poirier, D., University Bordeaux I, Talence, France, d.poirier@epoc.u-bordeaux1.fr;
Mouret, A., University Bordeaux I, Talence, France, a.mouret@epoc.u-bordeaux1.fr;
Anschutz, P., University Bordeaux I, Talence, France, p.anschutz@epoc.u-bordeaux1.fr

METHANE SOURCES, SINKS, AND ATMOSPHERIC FLUXES IN A TEMPERATE TIDAL LAGOON (ARCACHON BAY, FRANCE)

The Arcachon Bay is a 156 km² mesotidal lagoon dominated by tidal flats (66% of the surface area). Methane sources, sinks and fluxes were computed from water and pore water concentrations, from chamber flux measurements at the sediment-air (low tide), sediment water and water-air (high tide) interfaces and from oxidation and production rate measurements in sediments. Methane concentrations in waters were maximal (500 Ãƒ Æ'¢Ã¢Â¢â‚¬Å¡Ã¢Ã¢â€šÂÃ…â€œ 1000 nM) in river waters and in tidal creeks at low tide and minimal in the whole lagoon at high tide (<50nM). The major methane sources are the river inputs and the tidal pumping of sediment pore water at low tide. Beside the predominance of sulphate reduction, methanogenesis occurred in the tidal flat sediments, and pore water concentrations were high (10 Ãƒ Æ'Ã¢â‚¬Å¡Ã ƒâ€šµM). Nevertheless, the sediment was a minor methane source for the water column and the atmosphere because of a high degree of anaerobic and aerobic methane oxidations in sediments. CH4 atmospheric flux at high and low tide were low compared to freshwater wetlands. Tidal lagoons appear as very minor contributor to global atmospheric methane.

DeBruyn, J. M., University of Tennessee, Knoxville, USA, jdebruyn@utk.edu;
Sayler, G. S., University of Tennessee, Knoxville, USA, sayler@utk.edu

PAH BIODEGRADATION POTENTIAL IN LAKE ERIE MICROBIAL COMMUNITIES: EVIDENCE FOR BROAD DISTRIBUTION OF PYRENE-DEGRADING MYCOBACTERIA

Despite a long history of contamination of Lake Erie sediments, little work has been done to understand the role of microbial biodegradation in organic contaminant cycling in Lake Erie. Pyrene-degrading Mycobacterium are prevalent in many polycyclic aromatic hydrocarbon (PAH)-contaminated fresh water sediments, and are of interest for their ability to degrade environmentally recalcitrant high molecular weight PAHs. Pyrene biodegradation potential of indigenous Lake Erie Mycobacterium populations was assessed through quantification of pyrene dioxygenase genes (nidA) and Mycobacterium biomass (16S rDNA genes). nidA was detected at all seven sampling sites, with abundances ranging from 2.09 to 70.4 x10^6 copies per gram sediment, corresponding to pyrene concentrations in the sediments. This is in contrast to naphthalene dioxygenase genes: proteobacteria dominate Lake Erie sediment 16S clone libraries (>50% of clones), however nahAc (from gamma-proteobacteria) was not detected anywhere, and nagAc (from beta-proteobacteria) was detected only at the most contaminated site (Cleveland Harbor). The prevalence of Mycobacterium nidA genotypes corroborate previous studies indicating that PAH-degrading Mycobacterium have a cosmopolitan distribution and suggests they play an important but overlooked role in natural attenuation and cycling of PAHs in Lake Erie.

Decker, J. K., Fordham University Louis Calder Center- Biological Station, Armonk, USA, jismith@fordham.edu;
Richardson, W., USGS Upper Midwest Enironmental Research Center, La Crosse, USA, wrichardson@usgs.gov;
Houser, J. N., USGS Upper Midwest Enironmental Research Center, La Crosse, USA, jhouser@usgs.gov;
Wehr, J. D., Fordham University Louis Calder Center- Biological Station, Armonk, USA, wehr@fordham.edu

THE IMPORTANTANCE OF NUTRIENT RATIOS IN DETERMINING POTAMOPLANKTON DOMINANCE IN THE UPPER MISSISSIPPI RIVER NEAR LA CROSSE, WI

Physical factors such as discharge, turbulence, temperature, and light are thought to be the primary control on algal growth in large rivers. An analysis of potamoplankton assemblages taken from the Upper Mississippi River near La Crosse, WI suggests that nutrient ratios, particularly N:P, Si:P, and N or P:Fe ratios, may be important in determining species dominance when physical characteristics are equal. For example, when the diatom Asterionella formosa was dominant, the mean Si:P ratio was twice that of the ratio on dates when small centric diatom assemblages were dominant. Determining the nutrient niche of different species is especially important when the resulting species are functionally different. For instance, the nitrogen fixing cyanobacterium Anabaena circinalis was dominant at lower N:P ratios (< 20) than the non-heterocystous cyanobacteria Pseudanabaena catenata and P. limnetica. The latter species were especially abundant during very high N:P ratios (> 50). Identifying differences in apparent nutrient preferences among potamoplankton is important not only for water quality, as certain species of cyanobacteria produce toxins, but also for understanding the dynamics of riverine nutrient cycling and food web interactions.

Del Angel-Rodríguez, J. A., Centro de Investigaciones Biológicas del Noroeste, La Paz, Mexico, jangel@ipn.mx;
Carreón-Palau, L., Centro de Investigaciones Biológicas del Noroeste, La Paz, Mexico, lcarreon@cibnor.mx;
Band-Schmidt, C. J., Centro Interdisciplinario de Ciencias Marinas, La Paz, Mexico, cbands@ipn.mx;
Pacheco-Chávez, R., Centro Interdisciplinario de Ciencias Marinas, La Paz, Mexico, rpacheco@ipn.mx

LIPID SOURCE IDENTIFICATION IN KEY SPECIES OF BAHIA DE LA PAZ, GULF OF CALIFORNIA, MEXICO

Bahía de La Paz supports several species of fish, birds and marine mammals. Primary productivity in winter and spring (16.02 $mg \times cm^{-3} \times h^{-1}$) is attributable to diatom blooms sustaining higher zooplankton densities (626.13 $mL \times 1000m^{-3}$), whereas summer productivity (2.17 $mg \times cm^{-3} \times h^{-1}$) depends on diatoms, dinoflagellates, silicoflagellates and nanoplankton, sustaining lower zooplankton densities (146.22 $mL \times 1000m^{-3}$). The copepod *Acarthia lilljeborgi* and the subtropical neritic euphausiid *Nyctiphanes simplex* are among the most abundant zooplankters in the area. The fatty acid profile of local-isolated diatoms and dinoflagellates, together with feeding experiments in *A. lilljeborgi* show that 14:0, 16:1 ω-7 and 20:5 ω-3 are good diatom biomarkers; whereas 18:4 ω-3 and 18:5 ω-3 but not 22:6 ω-3 are good dinoflagellate biomarkers. Seasonal energy content of males of *N. simplex* (2000-2001) was analyzed trough proteins, carbohydrates, and structural and storage lipids. Fatty acids were analyzed on each lipid fraction. The lowest energy content occurred at the end of the winter-spring diatom bloom, when fatty acids of storage lipids suggest a diatom-based trophic chain. The highest energy content occurred in autumn, when fatty acids suggest a more diverse diet.

Delaney, M. P., NASA Goddard Space Flight Center/Univ MD, Baltimore County, Greenbelt, USA, marci.delaney@nasa.gov

OPTIMIZING THE USE OF EDUCATIONAL TECHNOLOGY TO PROMOTE AWARENESS OF SCIENCE CAREERS TO THE 21ST CENTURY DIGITAL NATIVE

Today's students are losing interest in science careers because either they are not exposed to the breadth of careers available or else have misconceptions of what encompasses a career in science. A student is likely unaware that studying plankton in a drop of pond water today in class could later mean studying the extremophiles of hydrothermal vents, which may lead to a career in astrobiology. The NASA Exploring Space Challenges is working to bridge that gap. By utilizing synchronous and asynchronous interactive learning, secondary school students interact with scientists in real-time to complete a project under a competitive setting. Often undertaken by students outside the normal curriculum, such as elective classes or after-school programs,

students are encouraged to explore science with methods that emulate the daily operations of a research scientist, while discovering the relevance of their work as it applies to further exploration of our planet as well as others. Through individual interviews and pre/post assessments, we have found that students show a greater understanding of scientific inquiry and demonstrate an attraction to a science career not previously considered.

Devred, E., Dalhousie University, Dartmouth, Canada, devrede@mar.dfo-mpo.gc.ca;
Sathyendranath, S., Plymouth Marine Laboratory, Plymouth, United Kingdom, shubha@dal.ca;
Platt, T., Fisheries and Oceans, Dartmouth, Canada, tplatt@dal.ca

SEASONALITY OF DIATOMS IN ECOLOGICAL PROVINCES OF THE NORTH WEST ATLANTIC REVEALED BY SATELLITE OBSERVATIONS

A statistically-based approach (Devred et al., 2007) to identify ecological provinces (Longhurst, 2006) in the North West Atlantic is applied to satellite data (ocean-colour derived Chlorophyll-a and Sea-Surface Temperature) over a 10-year time series with a two-week temporal resolution. Locations of several provinces ranging from high-latitude Arctic waters to the warm oligotrophic waters of the Gulf Stream and including the Scotian Shelf are studied and related to the development of the spring bloom and occurrence of diatoms. The latter is inferred by ocean colour radiometry measured by the SeaWiFS sensor (Sathyendranath et al., 2004), also at a two-week temporal resolution. Occurrence of diatoms in relation to the spring bloom and secondary blooms is discussed for each ecosystem and generalised at the scale of biomes.

Dewey, R., VENUS Project, Victoria, Canada, rdewey@uvic.ca;
Vervynck, J., VENUS Project, Victoria, Canada, jverv@uvic.ca;
Macoun, P., VENUS Project, Victoria, Canada, pmacoun@uvic.ca;
Tunnicliffe, V., VENUS Project, Victoria, Canada, verenat@uvic.ca;
Round, A., VENUS Project, Victoria, Canada, around@uvic.ca

THE VENUS CABLED OBSERVATORY: TWO YEARS AND COUNTING

The Victoria Experimental Network Under the Sea (VENUS) is a cabled ocean observatory, with arrays near southern Vancouver Island, in both Saanich Inlet and the Strait of Georgia. The first leg was deployed in Saanich Inlet in February 2006 with a node at 100m. The second, deeper (nodes at 300 and 170m) cable was laid in the Strait of Georgia in May 2007, with instruments coming on-line in February 2008. The fibre optic cable provides unprecedented power and bandwidth to and from instruments connected to the observatory "nodes", allowing real-time, interactive marine experiments. Data is retrieved and available at the project web site (http://www.venus.uvic.ca/) in real-time. Preliminary instruments include standard oceanographic devices such as CTDs and ADCPs, as well as inverted echo-sounders, broadband hydrophones, dissolved gas sensors, settling traps, and a user controllable pan and tilt digital camera. Advanced systems under development include a dedicated sediment and delta dynamics laboratory studying the slope stability of the Fraser River Delta. An overview of the observatory infrastructure, some of the challenges we've faced, preliminary scientific results from the first two years, and how new users can access the facility will be presented.

Diehl, S., Ludwig-Maximilians University Munich, Munich, Germany, diehl@zi.biologie.uni-muenchen.de;
Anderson, K. E., University of California, Riverside, USA, kurt.anderson@ucr.edu;
Nisbet, R. M., University of California, Santa Barbara, USA, nisbet@lifesci.ucsb.edu

POPULATION RESPONSES OF DRIFTING STREAM INVERTEBRATES TO SPATIAL ENVIRONMENTAL VARIABILITY: WHY EMPIRICAL CORRELATION PATTERNS SHOULD OFTEN BE WEAK

Stream communities are shaped by environmental influences operating at multiple spatial scales. The detection of general distributional relationships among benthic organisms and environmental parameters has, however, proven difficult. One possible explanation is that drift creates downstream lags in population responses to local environmental signals. Recent theoretical advances confirm this possibility. Typically, long-distance environmental variation affecting demographic rates is tracked by model populations, whereas short-distance variation is averaged. Environmental variation affecting drift rates produces opposite patterns: short-distance variation is tracked and long-distance variation is averaged. 'Long' and 'short' are defined relative to the 'response length' (= approximately the average individual lifetime drift distance). Examples illustrate that distributions of organisms with different response lengths may correlate only weakly with each other and with the environment even if the local environment affects them identically. While the theory thus suggests that environmental influences on the distribution of drifting invertebrates cannot be reliably inferred from spatial correlations, the reverse approach is promising. Based on knowledge of response lengths and local responses to the environment, the prediction of population responses to arbitrary patterns of spatial environmental variability becomes possible.

Dillon, K. S., University of Southern Mississippi, Ocean Springs, USA, kevin.dillon@usm.edu;
Kelley, C. A., University of Missouri, Columbia , USA, KelleyC@missouri.edu;
Carpenter, K. G., University of Southern Mississippi, Ocean Springs, USA, katie.carpenter@usm.edu;
Coffin, R. B., Naval Research Lab, Bethesda, USA, rcoffin@onr.navy.mil

BACTERIAL PRODUCTION RATES IN TWO DON RICH NORTHERN GULF OF MEXICO ESTUARIES

Bacterial growth, production and oxygen uptake of heterotrophic bacterial incubations were measured in Apalachicola Bay, FL (AB) and Mississippi Sound (MS) to determine biogeochemical limitations on bacterial production and what effect amendments of nutrients and organic matter would have on bacterial production rates (BPR, ug C L-1 d-1), oxygen utilization rates (OUR, ug O2 L-1d-1) and growth efficiencies (GE). AB is a N limited system while bacterial nutrient limitation is not well understood in MS. Both are characterized by high concentrations of dissolved organic nitrogen (DON). BPR in controls ranged from 0 to 76 in AB and 1 to 37 in MS. Controls OURs were 0 to 76 in AB while MS had OURs over 800. At AB, oak/elm amendments had BPRs of 7.9-28.4 and OURs of 0Ã¢â‚â€œ114 with the highest GE. Vallisnaria extract stimulated bacterial metabolism (BPR=49-167, OUR=125-650) and had intermediate GEs while phytoplankton extract had the largest effect (BPR=252-520, OUR=5506Ã¢â‚â€œ5718) with the lowest GE. In MS, ammonium and phosphate stimulated BPR however OURs were similar between control and amendments while BPRs increased to 103 and 127 with a significantly greater effect from PO4. In AB, it appears that BGEs are highest in the river and decreases into the Bay. In MS, results suggest that PO4 allow bacterial to access a portion of the DON pool. BGE in AB are much greater than in MS suggesting different controls on bacterial metabolism in these two systems.

Dionne, K., Université du Québec à Rimouski, Rimouski, Canada, kaven.dionne@uqar.qc.ca;
Nozais, C., Université du Québec à Rimouski, Rimouski, Canada, christian_nozais@uqar.qc.ca;
Vergilino, R., Université du Québec à Rimouski, Rimouski, Canada, roland.vergilino@uqar.qc.ca

DO CRYPTIC SPECIES OF *HYALELLA* AMPHIPODS COEXIST VIA TIMESHARE PROPERTY?

The coexistence of cryptic species of *Hyalella* amphipods living in sympatry seems to challenge our traditional views of species coexistence. Their quasi-identical morphologies are likely to be paired with similar needs, and according to the ecological niche concept, species exhibiting such properties should exclude each other unless they occupy different niches. We examined the structure of a community of *Hyalella* amphipods living in the littoral zone of a temperate lake to evaluate if such species could coexist through different temporal niches throughout a season. During the open-water season, we sampled amphipods monthly at three different sites. Morphological analyses were conducted to see any differences among amphipods throughout the season, and nominal species were distinguished using the mitochondrial CO1 gene locus. Preliminary results suggest there are no visible morphological differences among all individuals sampled, except for the size. These results will be analyzed in the light of the molecular analyses.

Dittmann, S., Flinders University, Adelaide, Australia, sabine.dittmann@flinders.edu.au;
Rolston, A. N., Flinders University, Adelaide, Australia, alec.rolston@flinders.edu.au;
Keuning, J., Flinders University, Adelaide, Australia, keun0001@flinders.edu.au

NO FLOW: DROUGHT AND BARRAGES AFFECT FOOD WEBS IN THE ESTUARY OF THE RIVER MURRAY, AUSTRALIA'S LARGEST RIVER

The Murray-Darling is the largest river system in Australia, with a watershed under extensive agricultural use. Where the Murray River meets the Southern Ocean, barrages established in the 1930's block the link between freshwater and coastal waters. The former estuary now consists of freshwater lakes, a relatively small estuarine area, and a hypersaline lagoon (the Coorong). As a result of increased water usage by irrigation farming and years of drought, water flows over the barrages have been reduced in the past decade, and water levels in the lakes are at record lows. Here, we report on our studies on how these changes in connectivity have affected benthic communities and shorebird foraging. The environmental changes in the system are reflected in the benthic distribution pattern, with highest diversity, abundances and biomass near the river mouth, whereas the Coorong and lake shores are almost devoid of benthic fauna. Decreasing shorebird numbers reflect the reduced food availability compared to other estuaries along the flyway. With no restoration of water flows in sight, trophic interactions in the estuary are likely to be substantially modified.

Dittmar, T., Florida State University, Tallahassee, USA, dittmar@ocean.fsu.edu;
Paeng, J., Florida State University, Tallahassee, USA;
Gihring, T. M., Florida State University, Tallahassee, USA;
Suryaputra, I. G., Florida State University, Tallahassee, USA;
Huettel, M., Florida State University, Tallahassee, USA

TIDAL PULSING OF DISSOLVED BLACK CARBON IN A FIRE-IMPACTED COASTAL WATERSHED

Abstract not available

Domine, L. M., University of Minnesota, St. Paul, USA, lauri050@umn.edu;
Cotner, J. B., University of Minnesota, St. Paul, USA, cotne002@umn.edu

MECHANISMS INFLUENCING CARBON SEQUESTRATION IN PRAIRIE SHALLOW LAKES

Lakes play a disproportionately large role in global carbon cycling relative to their size. Estimates on the degree of carbon sequestration and mechanisms that influence carbon sequestration in shallow lakes are needed to improve carbon budgets. This study will evaluate 1) the influence of carbon inputs, export, net ecosystem production, and decomposition on carbon sequestration in 10 shallow lakes in the Prairie Pothole Region, and 2) how alternative regimes affect these aforementioned mechanisms. This region is intensively managed and contains lakes in either a clear-water, plant dominated regime, or a turbid-water, algae-dominated regime. Intensive measurements of groundwater input and export, lake-atmospheric exchange, NEP, and decomposition in laboratory experiments and the field are used to identify mechanism correlations with carbon sequestration, and to determine whether a specific mechanism is influenced by lake regime. We hypothesize that lake regimes have significantly different decomposition rates which predominantly influence the rate of carbon sequestration. Comprehensive knowledge of the mechanisms driving carbon sequestration is needed in carbon cycling models, and will provide information needed if these systems are to be managed for carbon sequestration.

Downing, J. A., Iowa State University, Ames, Iowa, USA, downing@iastate.edu

ORGANISM AND ECOSYSTEM SIZE IN THE UP-SCALING OF SPECIFIC RATES TO GLOBAL PROCESSES

Size permits predictive analysis of traits ranging across scales from individuals, populations, ecosystems, communities, and biomes, up to the global scale. The pervasive influence of size on function and rates of processes is a fundamental tenet derived from first principles of physics and physiology. Even automobiles and inanimate objects obey these fundamental scaling rules, and an example of this is offered. Thus, it is misguided to suggest that such rules should be ignored because they lack full explanatory power or fail to integrate consideration of phylogenetic hierarchies. An example of the misuse of phylogenetic vs body-size scaling is offered to illustrate the predictive superiority of size over phylogenetic analyses as well as pathways ecologists can use to stem this counter-productive critique of size-based theory. Finally, the need for aquatic scientists to provide a global understanding of the importance of their study systems in global concepts and budgets is reviewed through a global analysis of stream-size and its relationship to the global carbon budget.

Dröscher, I., University of Regina, Regina, Canada, droschei@uregina.ca;
Patoine, A., University of Regina, Regina, Canada, alain.patoine@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

CLIMATE CONTROL OF SPRING CLEAR-WATER PHASE DEVELOPMENT THROUGH THE TRANSFER OF ENERGY AND MASS TO LAKES

We sought to distinguish between pathways by which climate affects lake structure and function by using the clear-water phase (CWP) as a model system. We compared decade-long time series of water transparency, algal abundance and zooplankton density to identify the CWP in six polymictic lakes of the Northern Great Plains and to determine how energy and mass transfer interact in regulating lake structure. Analysis of ecosystem synchrony revealed that CWP timing was highly variable among lakes, but could be predicted from the rate of energy transfer from the atmosphere ($r^2 = 0.984$, $p = 0.0001$). CWP occurred when water overlying the sediments reached 16oC and Daphnia populations reached sufficient density to clear the water column of diatoms. However, during years of elevated winter NAO indices, increased river discharge reduced the effect of heat influx on CWP timing and intensity. Taken together, these analyses reveal that differences in CWP characteristics among lakes are due to site-specific variation in the rate of energy accumulation, whereas inter-annual variability in mass transfer can obscure this relationship within individual lakes and among years.

Droppo, I. G., Environment Canada, Burlington, Canada, ian.droppo@ec.gc.ca

MICRO-SCALE SEDIMENT DYNAMICS: INFLUENCE ON POM TRANSPORT

Individual particle (floc) structure, both at a whole particle-scale (e.g. size, shape) and micro-scale (e.g. porosity, microbial content, extracellular polymeric substances), is shown to have a profound effect on river basin POM transport (erosion, transport, and settling). An in-depth assessment of floc structure and associated POM is provided using correlative microscopy (conventional microscopy, environmental scanning electron microscopy, transmission electron microscopy and confocal scanning laser microscopy) and how these structural attributes will influence the behaviour of both the suspended and bed sediment POM compartments within riverine systems. Emphasis is placed on the role of the microbial community in influencing bed sediment stability and floc strength as this structural characteristic is influential in controlling erosion and particle integrity. Both field and laboratory flume experiments (wave and annular) are carried out to provide samples for suspended and eroded floc structural assessment coupled with flow dynamic attributes (e.g. shear stress). The results demonstrate the need to understand micro-scale (floc) sediment dynamics for a better appreciation of the basin-scale POM dynamics.

Duarte, C. M., IMEDEA (CSIC-UIB), Esporles, Spain, carlosduarte@ifisc.uib.es;
Agustí, S., IMEDEA (CSIC-UIB), Esporles, Spain, sagusti@uib.es;
Tovar, A., IMEDEA (CSIC-UIB), Esporles, Spain, antonio.tovar@uib.es;
Arrieta, J. M., IMEDEA (CSIC-UIB), Esporles, Spain, jesus.arrieta@uib.es;
Lasternas, S., IMEDEA (CSIC-UIB), Esporles, Spain, sebastien.lasternas@uib.es;
Lacorte, S., IIQAB - CSIC, Barcelona, Spain, slbqam@cid.csic.es;
Tauler, R., IIQAB - CSIC, Barcelona, , rtaqam@cid.csic.es;
Dachs, J., IIQAB - CSIC, Barcelona, Spain, jdmqam@cid.csic.es

EXPERIMENTAL EVALUATION OF THE IMPACTS OF ARCTIC ICE MELTING

Evidence that Arctic ice melting suppresses primary production was tested experimentally by ammending Arctic planktonic communities with melted

ice water from two horizons differing in age and comparing the responses with those of control communities ammended with a similar amount of high purity water. Results confirmed the suppresion of primary production by ice melting and provided evidence of this effect to be attributable to the release of ice-bound pollutants.

DUFLOS, M. R., Centre d'Océanologie de Marseille, Marseille, France, marie.duflos@univmed.fr;
GOUTX, M. M., Centre d'Océanologie de Marseille, Marseille, France, madeleine.goutx@univmed.fr

RECENT ADVANCES IN METHODOLOGY FOR LIPIDS DEGRADATION INVESTIGATION

The degradation rates of marine lipids are essential parameters of the carbon cycle. Thus, we developed methodologies in order to better estimate these degradation rates: The TLC/FID Iatroscan existing protocols have been optimized to separate the degradation metabolites (FFA, ALC, 1.2 DG, 1.3 DG, MG) from hydrolysable acyl-lipids (WE, TG, GL, PL) and quantify them (Striby et al. 1999). Then, measurements of hydrolysis rates impacting on those acyl-lipids have been improved thanks to the development of a specific and sensitive methodology based on the use of a tritium labelled natural substrate (Bourguet et al. 2003). Finally, tests were conducted to estimate the bacterial fraction of microbial community responsible for the measured activities. With the substrate "ELF-palmitate", whose product of hydrolysis is insoluble (Nedoma et al. 2007), targeted cells (7%) were observed in pure cultures of "lipase +" bacteria (Duflos et al. 2005). These methods (validated or ongoing validation) may be useful tools for a better understanding of the marine lipids cycling and identification of pathways through aquatic food webs. Striby et al. J Chrom A (849)1999; Bourguet et al. App. Environ Microbiol (69) 2003 ; Nedoma et al. Mar Fresh Res (58)2007 ; Duflos M. EDSE (2007).

Dugas, K. E., Acadia University, Wolfville, Canada, 063178d@acadiau.ca;
O'Driscoll, N. J., Acadia University, Wolfville, Canada, nelson.odriscoll@acadiau.ca

QUANTIFYING THE KINETICS OF MERCURY PHOTO-OXIDATION AND PHOTO-REDUCTION IN NOVA SCOTIA WATERS

While we know much about the input of mercury to lakes and marine areas in Canada we know relatively little about how much of that mercury remains in the ecosystem and is available for uptake in the food chain. The majority of mercury deposited to waters is quickly volatilized to air, however there is no predictive model based on quantitative data to describe the fundamental processes involved. This research is filling this critical gap in the literature. Surface waters from several lakes and ocean water near Kings County, Nova Scotia were sampled in December 2007 and filter sterilized using a 0.2 µm filter. A temperature controlled photo-reactor was used to irradiate samples with UV-A and UV-B radiation while simultaneously analyzing for elemental mercury (OÃƒÆ'¢Ã¢Ã¢â‚¬Å¡Ã¢Ã¢â‚¬Å¾¢Driscoll et al, 2007). Continuous elemental mercury analysis was used to quantify gross photo-reduction and repeated batch analysis over a 24h period was used to quantify net photo-reduction. Rate constants were derived for gross photo-reduction and gross photo-oxidation using a reversible pseudo-first-order curve fit. Given these values a predictive model for mercury photo-reduction dynamics is under development.

Easton, J., University of Oklahoma Biological Station, Kingston, USA, jeaston@ou.edu;
Hambright, K. D., University of Oklahoma Biological Station, Kingston, USA, dhambright@ou.edu;
Zamor, R. M., University of Oklahoma Biological Station, Kingston, USA, rmzamor@ou.edu;
Easton, A., University of Oklahoma Biological Station, Kingston, USA, anne@ou.edu;
Looper, K. G., University of Oklahoma Biological Station, Kingston, USA, klooper@ou.edu

BLOOMS OF TOXIGENIC PRYMNESIUM PARVUM IN LAKE TEXOMA: WHAT CAN WE LEARN FROM ENVIRONMENTAL MONITORING?

Toxigenic golden algae, Prymnesium parvum, first appeared and bloomed in Lake Texoma, Oklahoma-Texas, during winter 2003-04 causing massive fish kills around the lake. They have been permanent winter residents since, blooming again in 2005-06, 2006-07 and 2007-08. Lake Texoma, an impoundment of the Red and Washita Rivers, is a complex dendritic system with many diverse habitats, including extensive wetlands and shallow coves, flooded tributary mouths, semi-enclosed and isolated bays, and marinas, as well as riverine and pelagic habitats. While Lake Texoma is the largest impoundment yet to be affected by P. parvum, blooms have thus far been restricted to western shallow habitats associated with the Red River. Intense monitoring for over two years has revealed significant differences in temperature, pH, salinity, nutrients, and microbial and crustacean zooplankton populations between areas of the lake with and without P. parvum blooms. Analysis of these patterns in light of recent experimental results has yielded testable hypotheses regarding potential management scenarios aimed at curbing blooms and fish kills.

Echeveste, P., CSIC, Esporles, Spain, pedro.echeveste@uib.es;
Agusti, S., CSIC, Esporles, Spain, sagusti@uib.es;
Tovar, A., CSIC, Esporles, Spain, antonio.tovar@uib.es

LETHAL LEVELS OF CADMIUM AND LEAD TO NATURAL MARINE PHYTOPLANKTON

Metals at the ocean may play a different role, acting as a nutrient (e.g. Fe) or as a toxic (e.g. Pb). Present in the ocean at very low concentrations are constituents of phytoplankton cells, although increased levels of concentrations in the environment could have a negative effect for phytoplankton. The goal of this study was to evaluate the levels of the metals Cd and Pb required to induce a substantial cell death in oceanic phytoplankton communities. To analyze this goal, we performed experiments with natural phytoplankton communities sampled from different oceanic areas (Mediterranean and Black Seas, Atlantic Ocean) to which we added an increased gradient in metal concentration (from 0.01 to 1000 ppm) to calculate the levels needed to decimate the populations to the half (L50) and to lower reductions (e.g. L10). Different results were obtained for each metal: while picophytoplanktonic communities were the most sensitive to Pb, the geographical origin of the community appeared to be as important as cell size in the Cd treatments.

Edinger, E. N., Geography Dept. & Biology Dept., Memorial University, St. John's, Canada, eedinger@mun.ca;
Brown, T. M., Biology Dept., Memorial University, St. John's, Canada, e67tmb@mun.ca;
Bell, T. J., Geography Dept., Memorial University, St. John's, Canada, tbell@mun.ca;
Belliveau, K. D., Environmental Science Program, Memorial University, St. John's, Canada, karissa@mun.ca;
Catto, N. R., Geography Dept., Memorial University, St. John's, Canada, ncatto@mun.ca;
Copeland, A. C., Geography Dept., Memorial University, St. John's, Canada, acopeland@mun.ca;
Forbes, D. L., Geological Survey of Canada, Natural Resources Canada, Dartmouth, Canada, dforbes@nrcan.gc.ca;
St-Hilaire-Gravel, D., Geography Dept., Memorial University, St. John's, Canada, dominique.sthilaire@hotmail.com;
Tarasov, L., Physics and Physical Oceanography Dept., Memorial University, St. John's, Canada, lev@physics.mun.ca

VARIATION IN CLIMATE CHANGE IMPACTS ON COASTAL MARINE SYSTEMS ACROSS THE CANADIAN ARCTIC

Interactions between climate change, surficial geology, isostatic sea level trends, and human activities can yield dramatically different outcomes for coastal marine systems across the Canadian Arctic. Inceasing air and ground temperatures and decreasing sea-ice cover are common though variable factors across the Arctic. Western Arctic sites with ice-rich surficial deposits, unlithified bedrock, and isostatic submergence suffer rapid coastal erosion, driven by wave action, thermal erosion, thaw consolidation, and surface runoff following summer rains. Associated nearshore mobile sand sheets have low biodiverstiy. Frequent ice scour of the seabed may play a role. An emergent Central Arctic site on coarse ice-contact Quaternary sediments exhibited no erosion. Muddy nearshore habitats there contained enough coarse gravel to support diverse epibenthic biotic communities, particularly of macroalgae, as well as diverse infauna. Some slightly subsiding Eastern Arctic fjords exhibit local coastal erosion, and landslide

risk associated with active-layer deepening and gelifluction on steep slopes, potentially causing impacts on nearshore benthic biodiversity. Labrador fjords, without extensive soft sediments surrounding the fjords and with permafrost discontinuous or absent, display less evidence of impacts on benthic communities.

Eggleston, C. M., University of Wyoming, Laramie, USA, carrick@uwyo.edu;
Shankle, A. J., University of Wyoming, Laramie, USA, ashankle@uwyo.edu;
Borman, C. J., University of Wyoming, Laramie, USA, cjborman@uwyo.edu;
Moyer, A. J., University of Wyoming, Laramie, USA, amoyer@uwyo.edu

FROM LABORATORY TO FIELD: IRON OXIDE PROPERTIES, PHOTOCATALYTIC WATER OXIDATION, AND FE(III) PHOTOREDUCTION

Iron redox-cycling is key to many chemical processes relevant to environmental chemistry as well as to deep-time events like the origin of life and the deposition of banded iron formations. Hematite has been the subject of much recent study with regard to solar energy conversion. Photocurrents generated by water oxidation on hematite are 5 to 10 times greater when illuminating crystal edges (perpendicular to the [001] direction) than when illuminating parallel to the [001] direction. Hematites grown in the presence of water generate less photocurrent by water oxidation than "dry grown" hematites, probably because of an impurity-induced "intragap" state that mediates recombination. Finally, our work in a watershed in Wyoming (relatively high pH) shows elevated Fe(III) concentrations during periods of high light intensity. Isolation experiments reveal a substantial non-photochemical Fe reduction rate that is able to maintain steady-state Fe(II) concentrations against rapid oxidation in the dark. Exposure to sunlight results in more rapid Fe(II) release to solution (most likely from organic complexes) and very rapid oxidation by aqueous oxygen, resulting in elevated afternoon Fe(III) concentrations.

Ellis, B. K., The University of Montana Flathead Lake Biological Station, Polson, Montana, USA, bonnie.ellis@umontana.edu;
Stanford, J. A., The University of Montana Flathead Lake Biological Station, Polson, Montana, USA, jack.stanford@umontana.edu;
Goodman, D., Montana State University Environmental Statistics Group, Bozeman, Montana, USA, goodman@rapid.msu.montana.edu;
Craft, J. A., The University of Montana Flathead Lake Biological Station, Polson, Montana, USA, jim.craft@umontana.edu

NONNATIVE SPECIES INTRODUCTIONS, TROPHIC CASCADE AND ALTERNATE STABLE STATES IN A LARGE OLIGOTROPHIC LAKE

Approximately monthly measurements of primary production, nutrients, and other physical and biological variables in Flathead Lake, Montana, were made during 1977-2004. This time spanned increasing development in the watershed, a prolonged drought and warming episode, and introduction and population explosion of the nonnative opossum shrimp, *Mysis relicta*. Trends and interactions were evaluated for statistical significance using frequentist and Bayesian analyses. Aerosol and riverine loading of nitrogen increased while phosphorus declined over the period of record. *Anabaena flos-aquae* blooms occurred several times and hypolimnetic oxygen concentrations decreased. Mysids exploded to 129 m^2 in 1984-86 then declined rapidly with increasing profundal lake trout predation and stabilized around 40 m^2. Their intense foraging on zooplankton caused an 83% reduction in the biomass of large zooplankton. Lake trout expansion and zooplankton changes corresponded with extirpation of established nonnative Kokanee salmon and a decline in native salmonid fishes. Coincident with the *Mysis* upheaval there was a step increase in primary production. The limnological legacy of Flathead Lake is a story of changing quasi-stable states mediated by a strong interaction between nutrient loading and mysid foraging.

Engelen, A., CCMAR / University of Algarve, Faro, Portugal, aengelen@ualg.pt;
Santos, R., CCMAR / University of Algarve, Faro, Portugal, rosantos@ualg.pt

WHICH DEMOGRAPHIC TRAITS DETERMINE INVASIVENESS IN MARINE ALGAE?

We used matrix modelling to assess which demographic traits are important for the population growth of one of the most successful invading seaweeds, Sargassum muticum. The vital rates were investigated in an early phase of invasion (intertidal pools dominated by the native Cystoseira humilis) and in a progressed stage (pools where S. muticum excluded C. humilis). Population growth rates were significantly higher in the early than the progressed phase, suggesting an initial lag phase. The variability of population growth rates and of reproductive and elasticity values was higher during the early than the progressed invasion phase, suggesting that the ecosystem was bioengineered by the invader. The most important demographic trait for the population growth rate in both stages of invasion was the stasis (persistence) of the non reproductive adult fronds. The low importance of r-selected traits (reproduction and growth) for S. muticum population growth and the increase in population growth rate when the invader became dominant suggests that competition with the native species is the main process that determines the invasiveness of this species in the southwest coast of Portugal.

Enrich-Prast, A., University Federal of Rio de Janeiro, Rio de Janeiro, Brazil, aeprast@biologia.ufrj.br;
Marotta, H., University Federal of Rio de Janeiro, Rio de Janeiro, Brazil, humbertomarotta@gmail.com;
Santoro, A. L., University Federal of Rio de Janeiro, Rio de Janeiro, Brazil, analusantoro@gmail.com;
Calheiros, D., Embrapa/Pantanal, Corumbá, Brazil, debora@cpap.embrapa.br;
Bastviken, D., Stockholm University , Stockholm, Sweden, david.bastviken@geo.su.se

EVIDENCE OF METHANE AS ENERGY SOURCE FOR THE FOOD CHAIN OF A TROPICAL FLOODPLAIN LAKE (PANTANAL, BRAZIL)

The aim of this study was to evaluate the relative importance of methane in the food chain of a floodplain lake located in the Pantanal, Brazil. Samples from primary producers and consumers were collected on November 2006 and their stable C and N isotopic ratios content determined with an IS/MS Delta Plus Finnigan. The carbon isotopic signature of chironomids, chaoborids, polychaetes and ephemeropterans (-35 to -40 ÃƒÆ'¢Ã¢â‚¬Å¡Ãƒâ€š°) and the most negative carbon signature found for zooplankton (-42 ÃƒÆ'¢Ã¢â‚¬Å¡Ãƒâ€š°) collectively suggested that methanotrophic bacteria might be an important food source for the benthic and pelagic compartments. The carbon isotopic composition of different species of fish varied from -27 to -37 ÃƒÆ'¢Ã¢â‚¬Å¡Ãƒâ€š°, indicating that the range of their diet vary from aquatic macrophytes to insects and zooplankton. These results suggest that the energy fixation by methane oxidation might support higher consumer levels in the food chain and that the importance of methanotrophy as energy source for food chains in aquatic systems may be more relevant than previously thought.

Epelbaum, A., Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, Canada, EpelbaumA@pac.dfo-mpo.gc.ca;
Pearce, C. M., Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, Canada, PearceC@pac.dfo-mpo.gc.ca;
Therriault, T. W., Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, Canada, TherriaultT@pac.dfo-mpo.gc.ca

EFFECTS OF BIOTIC AND ABIOTIC FACTORS ON NON-NATIVE TUNICATES IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA: IMPLICATIONS FOR ERADICATION AND CONTROL

There currently are at least four tunicate species in the Strait of Georgia, British Columbia, whose adverse environmental and/or economic effects (e.g., on shellfish aquaculture) have been documented globally: Styela clava, Botryllus schlosseri, Botrylloides violaceus, and Didemnum sp. A. We conducted a series of laboratory experiments to assess environmental tolerances and potential predation effects on survival and growth of these species. Broad environmental tolerances of botryllid tunicates (5-25ÃƒÆ'Ã¢â‚¬Å¡Ãƒâ€šºC, 14-38ÃƒÆ'¢Ã¢â‚¬Å¡Ãƒâ€š°) suggest that physical methods of control, such as sinking or raising aquaculture gear to make use of different layers of seawater, are unlikely to be efficient. A number of benthic species native to BC were found to prey on non-native tunicates of concern. Green sea urchins were found to be the most efficient grazers, consuming 4.4 cm2 of adult colonial tunicates and 31.5 juvenile colonies per day. Using sea urchins as biological control organisms on shellfish aquaculture gear may significantly help to reduce tunicate fouling. Chemical control methods, such as the use of biocidal agents, need to be evaluated carefully in terms of their environmental impacts and effects on cultured species.

Eppley, R. W., Scripps Institution of Oceanogrphy, UCSD, La Jolla, CA, USA, deppley1@san.rr.com;
Peterson, B. J., Ecosystems Center, MBL, , Woods Hole, MA, USA, peterson@mbl.edu

JOHN MARTIN AWARD PAPER. PARTICULATE ORGANIC MATTER FLUX AND PLANKTONIC NEW PRODUCTION IN THE DEEP OCEAN

This paper was published in 1978 by Dick Eppley (of Scripps) and Bruce Peterson (Marine Biology Lab. Woods Hole). It developed out of Dugdale and Goering's New Production concept based on nitrate and ammonium uptake measurements and the ratio of new production to total primary production. We found a relation between this ratio and primary production that allowed Coblenz-Mishke's and other summaries of global primary production to be used to estimate global new production. Over the years, such a simple idea has run into real world problems, of course, such as iron limitation regions and nitrification within the photic zone.

Fagan, W. F., University of Maryland, College Park, MD, USA, bfagan@umd.edu

RIVERINE LANDSCAPES: EXPLORING CONNECTIVITY, EXTINCTION RISK, AND BIOGEOGRAPHY IN AN ALTERNATIVE GEOMETRY

Riverine landscapes differ in fundamental ways from terrestrial ones. Of particular note is that the dendritic patch geometry and downstream flow of river networks lead to inherently asymmetrical opportunities for connections among parts of a landscape. My colleagues and I have been exploring what happens when spatial ecological processes such as dispersal play out in riverine systems, with a particular emphasis on understanding how these processes influence species' biogeography and extinction risks. Here I will discuss how critical spatial features, such as branching hierarchical geometry, upstream-downstream sequencing of habitat units, and habitat fragmentation, are important to species ecology and conservation in riverine landscapes. To illustrate these points, I will discuss recent research drawing upon detailed empirical datasets for the biogeography of fishes. Results from these datasets make clear that 1) the degree to which a species' riverine distribution was fragmented historically is a strong predictor of the extent of extinctions that species has suffered over the last few decades and 2) considerations of river network geometry, coupled with a neutral metacommunity model, recapitulate important large-scale biogeographic patterns for freshwater fish.

Fairchild, W. L., Fisheries and Oceans Canada, Moncton, Canada, fairchildw@dfo-mpo.gc.ca;
Hanson, J. M., Fisheries and Oceans Canada, Moncton, Canada, hansonm@dfo-mpo.gc.ca;
Cook, A., Environment Canada, Moncton, Canada, art.cook@ec.gc.ca;
Locke, A., Fisheries and Oceans Canada, Moncton, Canada, lockea@dfo-mpo.gc.ca

COULD INSECTS IN NEUSTON ACT AS VECTORS FOR PESTICIDE EXPOSURE OF LOBSTER POSTLARVAE IN THE NEARSHORE MARINE ENVIRONMENT?

Previous studies in the Southern Gulf of St. Lawrence have shown that there is potential for movement of pesticides into coastal marine waters. However, the pathways and likelihood of such an occurrence causing measurable effects remain to be determined. One consideration is the potential for dietary exposure of postlarval American lobster (*Homarus americanus*) through ingestion of contaminated insects. Insects are a common item in the diet of postlarval lobsters. Moreover, insects are often present in neuston samples, particularly in summer, when extensive pesticide treatments are underway and postlarval lobster are present in nearshore waters. Summer storms after extended dry periods may enhance pesticide runoff and increase fluvial contribution to the neuston. In July and August 2007, neuston and sea water were sampled within and off the mouths of several estuaries. These samples were analyzed for a suite of high use, high risk base-neutral pesticides that are used on adjacent land. If these pesticides are present in the nearshore neuston and become part of the lobster diet, the potential for negative biological effects exists.

Farley, R. A., University of Wisconsin-Milwaukee, Milwaukee, USA, rannfar@gmail.com;
Berges, J. A., University of Wisconsin-Milwaukee, Milwaukee, USA, berges@uwm.edu

SULFUR CONTENT OF MARINE AND FRESHWATER PHYTOPLANKTON: TAXONOMIC AND ENVIRONMENTAL VARIATIONS

Sulfur (S) is a macronutrient essential in phytoplankton proteins, lipids and redox metabolites, but S is rarely measured and seldom appears in ratios of C, N and P. On a molar basis, S is approximately as abundant as P, but little is known about how S varies among marine and freshwater species of different taxa, or what environmental variables change S content. We used CNS elemental analysis (Flash EA 1112 Series) to measure S in 7 species of freshwater and marine phytoplankton including diatoms, dinoflagellates, chlorophytes, crytophytes and haptophytes. S was measured in species grown in batch culture in nutrient- and light-saturated conditions to assess taxonomic variations, and then at different irradiances, under nutrient- (N or P) replete or deplete conditions, and at different pH's to determine which variables changed S content. Problems encountered included CNS sensitivity and interference from constituents of artificial media; cell washing protocols had to be developed. We are now using cell-fractionation to examine whether marine and freshwater species allocate S differently to protein, lipid or metabolite pools, and under what conditions the allocations changes.

Febria, C. M., University of Toronto Scarborough, Toronto, Canada, catherine.febria@utoronto.ca;
Williams, D. D., University of Toronto Scarborough, Toronto, Canada, williamsdd@utsc.utoronto.ca

CHARACTERIZATION OF DISSOLVED ORGANIC CARBON AND MICROBIAL COMMUNITIES IN THE HYPORHEIC ZONE OF TWO HEADWATER STREAMS IN SOUTHERN ONTARIO

Microbial communities in hyporheic zones are influenced by the fluxes of inorganic and organic nutrients that travel through the sediments. Dissolved organic carbon (DOC) serves as the main source of energy for microbes and transfers to higher trophic levels via grazing by protozoans. To better understand and characterize the interaction between DOC and microbial community composition in the hyporheic zone, we are assessing two temperate streams with contrasting hydroperiods: intermittent and permanent. These streams were instrumented with cores containing passive samplers that collect DOC at natural abundance and autoclaved sediment that allow microbes to colonize. Here we present preliminary results including seasonal trends in DOC composition using H-1 NMR spectroscopy together with microbial community composition obtained by terminal-restriction fragment length polymorphism (T-RFLP). NMR spectra from the permanent stream reveal seasonal differences between upwelling and downwelling zones, between the streambed surface and 1-metre into the substratum. Microbial community composition appears to be significantly different between the streams and within stream, from one season to the next. Community shifts may be seasonal and linked to predictable changes in DOC structure and concentration.

Feely, R. A., Pacific Marine Environmental Laboratory/NOAA, Seattle, USA, Richard.A.Feely@noaa.gov;
Sabine, C. L., Pacific Marine Environmental Laboratory/NOAA, Seattle, USA, Chris.Sabine@noaa.gov;
Greeley, D., Pacific Marine Environmental Laboratory/NOAA, Seattle, USA, Dana.Greeley@noaa.gov

DECADAL CHANGES IN THE CARBONATE SYSTEM AND PH OF THE OCEANS

The addition of fossil fuel carbon dioxide to the atmosphere is rapidly changing seawater chemistry and the calcium carbonate saturation state of the world's oceans as a result of the acidifying effects of CO_2 on seawater. This acidification makes it more difficult for marine organisms (e.g., corals, plankton, calcareous algae, and mollusks) to build skeletons, tests, and shells of calcium carbonate. Impacts on these calcifying organisms will lead to cascading effects throughout marine ecosystems. Repeat hydrographic cruises in the Atlantic and Pacific show direct evidence for ocean acidification. The dissolved inorganic carbon increases, of about 10-

15 µmol kg-1 in surface and intermediate waters over the past 10-15 years, are consistent with corresponding pH decreases of approximately 0.020 Ã¢â‚¬Å“ 0.025 units over large sections of the Atlantic and Pacific. These dramatic changes can be attributed, in most part, to anthropogenic CO_2 uptake by the ocean over the past two decades. These data verify earlier model projections that the oceans are undergoing ocean acidification as a result of the uptake of carbon dioxide released as a result of the burning of fossil fuels.

Fellman, J. B., University of Alaska Fairbanks, Fairbanks, USA, fsjbf6@uaf.edu;
Hood, E., University of Alaska Southeast, Juneau, USA, eran.hood@uas.alaska.edu;
Edwards, R. T., USDA Forest Service Pacific Northwest Research Station, Juneau, USA, rtedwards@fs.fed.us;
Jones, J. B., University of Alaska Fairbanks, Fairbanks, USA, ffjbj@uaf.edu;
Norberg, E. C., USDA Forest Service Pacific Northwest Research Station, Juneau, USA, enorberg@fs.fed.us

SEASONAL VARIATION IN DISSOLVED ORGANIC CARBON UPTAKE IN THREE COASTAL TEMPERATE STREAMS, SOUTHEAST ALASKA

We evaluated the temporal variation in DOC uptake from three streams draining a bog, forested wetland and upland forest sub-catchment. DOC slug injections were conducted once during the spring runoff, summer growing season and fall wet season using DOC collected by leaching soils from each sub-catchment. DOC uptake velocities ranged from 0.014 to 0.039 mm/s and were significantly lower ($p<0.001$) in the bog compared with the forested wetland and upland forest streams. DOC uptake velocities in the forested wetland and upland forest streams were not significantly different for all three seasons ($p>0.05$). DOC uptake velocities were also greatest during the spring and fall injections compared with the summer injection. We used fluorescence excitation-emission matrices in conjunction with PARAFAC modeling to evaluate downstream changes in the fluorescent properties of DOM during injections. During all injections, the relative contribution of protein-like fluorescence decreased downstream and suggests that DOM leached from sub-catchment soils is readily used as a substrate by heterotrophic microbes and at the same time modified in composition by the selective degradation of the protein-like fraction of DOM.

Fennel, W., Institute for Baltic Sea Research, Rostock, Germany, wolfgang.fennel@io-warnemuende.de

A THEORETICAL MODEL OF MARINE FOOD WEBS

This contribution describes and explores the coupling of a NPZD-model with a fish production model to form a NPZDF-model that interactively links biogeochemical and fish-production models. As example system, the Baltic Sea was chosen, where the bulk fish dynamics is covered by two prey species (sprat and herring) and one predator (cod). However. the general theoretical approach can also be applied to other systems. The linkage of the model components is established through feeding of prey fish on zooplankton and recycling of fish biomass to nutrients and detritus. The fish dynamics is driven by size dependent predator-prey interactions, reproduction and mortality. The model is mass conserving and, in its current stage, a box model. Series of experimental runs with fishing and nutrient loads provide scenarios of how fish catches respond to nutrient inputs. From the viewpoint of a full NPZDF-model, we can learn how realistic parameterizations of unresolved processes in truncated NPZD models are. Model truncation affects both zooplankton mortality and the dynamics of nutrients and detritus.

Ferland, J., Institut des sciences de la mer de Rimouski,Université du Québec à Rimouski, Rimouski, Canada, joannie.ferland@uqar.qc.ca;
Gosselin, M., Institut des sciences de la mer de Rimouski, Université du Québec à Rimouski, Rimouski, Canada, michel_gosselin@uqar.qc.ca;
Starr, M., Maurice Lamontagne Institute, Ocean and Environmental Science Branch, Fisheries and Oceans Canada, Mont-Joli, Canada, StarrM@dfo-mpo.gc.ca;
Saucier, F. J., Institut des sciences de la mer de Rimouski,Université du Québec à Rimouski, Rimouski, Canada, francois_saucier@uqar.qc.ca

ENVIRONMENTAL CONTROL OF SUMMER PHYTOPLANKTON PRODUCTION IN THE HUDSON BAY COMPLEX

Phytoplankton production and biomass were measured in the Hudson Bay Complex during August-September of 2004 to 2006. Production and biomass in the euphotic zone were similar during the three years, but showed large horizontal variability. They were generally lower in Hudson Bay-Foxe Basin (HBFB) (51 to1218 mgC m-2 d-1; 5.4 to 86.9 mg chla m-2) than in Hudson Strait (412 to 3132 mgC m-2 d-1; 28.0 to 202.4 mg chla m-2). On average, the upper water column of HBFB was more stratified than HS (the difference in sigma-t between 80 and 5 m being 3.53 and 1.21 kg m-3, respectively) and was characterized by a deeper nitracline (48 m and 33 m, respectively) and euphotic zone (56 m and 38 m, respectively). In HBFB, phytoplankton production was higher at stations with a weaker stratification index and a higher nitrate+nitrite concentration. In Hudson Strait, south shore stations, which are influenced by Hudson Bay surface water, showed more productive waters than north shore stations. These results indicate that vertical mixing and advection are major factors controlling primary production in the Hudson Bay Complex. Therefore, future enhancement of surface water column stratification by warming and freshwater input from precipitation may affect carbon fluxes and food web dynamics of this subarctic marine system.

Ferland, M., Université du Québec à Montréal, Montréal, Canada, marie.eve.ferland@gmail.com;
Yves Prairie, Y. T., Université du Québec à Montréal, Montréal, Canada, prairie.yves@uqam.ca;
del Giorgio, P. A., Université du Québec à Montréal, Montréal, Canada, del_giorgio.paul@uqam.ca

CARBON STORAGE IN BOREAL QUEBEC LAKES

We studied system-wide carbon accumulation in 13 lakes in the boreal region northern of Québec, with the aim of assessing regional patterns in lake C storage linked to lake and watershed properties. We quantified whole-lake carbon storage with a combination of sub-bottom profiling and estimates of sediment carbon content from surface cores. The approach allows to map the bedrock, inorganic and organic deposits, and the water-sediment interface throughout the lake, and thus to create a three-dimensional perspective of the sediment. The whole-lake carbon storage was then calculated by combining these 3-D sediment maps with sediment C contents obtained from the cores. Here we present the resulting estimates of boreal lake C storage, and explore the patterns with lake and watershed properties. On a per unit surface area basis, lake sediments represent a much larger sink of organic C than boreal soils, and because of the local abundance of lakes, these represent a major regional sink of organic C. We further discuss relationships between lake C storage and lake properties, in particular with a positive relationship between storage, mean depth and lake and basin area.

Filstrup, C. T., Baylor University, Waco, USA, Christopher_Filstrup@baylor.edu;
Scott, J. T., University of Arkansas, Fayetteville, USA, jts004@uark.edu;
Lind, O. T., Baylor University, Waco, USA, Owen_Lind@baylor.edu

PRE- AND POST-BURIAL ALTERATION OF C:N, $\delta^{13}C$, AND $\delta^{15}N$ IN A POLYMICTIC RESERVOIR

Understanding pre- and post-burial alteration of paleolimnological signals is requisite for accurate interpretation of sediment cores. We compared C:N, $\delta^{13}C$, and $\delta^{15}N$ differences between surface and bottom sediment traps with sediment core values from Waco Reservoir (McLennan County, Texas, USA). Preliminary analyses revealed that %C, %N, C:N, $\delta^{13}C$, and $\delta^{15}N$ differed significantly between surface and bottom traps. %C and %N decreased while C:N increased in the bottom trap, thus suggesting greater remineralization of N in the water column. Denitrification likely caused increased C:N with increasing core depth. $\delta^{13}C$ was "heavier" in the bottom trap and became "heavier" with increasing core depth, which suggests selective respiration of ^{12}C. $\delta^{15}N$ was "lighter" in the bottom trap and became "lighter" with increasing core depth. We have not identified the mechanism of $\delta^{15}N$ alteration, but suspect it is driven by the complexity of N cycling in this reservoir. While paleolimnological signals can be compared on relative sediment scales, understanding their pre- and post-burial alteration will allow us to compare these variables on absolute water column scales.

Findlay, s., Cary Institute of Ecosystem Studies, Millbrook, USA, findlays@ecostudies.org;
Tockner, K., Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB), , Berlin, Germany;
Arrigoni, A., University of Montana, Missoula, USA;
Fischer, D., Cary Institute of Ecosystem Studies, Millbrook, USA

PREDICTING CARBON AND NUTRIENT TRANSFORMATIONS IN TIDAL FRESHWATER WETLANDS OF THE HUDSON RIVER

Ten representative wetlands were assessed for their ability to alter quantities of inorganic nutrients, suspended particles, dissolved organic carbon (DOC) and dissolved oxygen during tidal exchange. The majority of sites acted as sinks for oxygen and nitrate and as sources of DOC. For other variables such as phosphate and pigments, individual wetlands varied broadly in both the direction and magnitude of change. For some variables (oxygen, DOC) we found mechanistically plausible predictors for the magnitude of alteration. The proportional coverage of submerged vegetation or intertidal marsh graminoid vegetation was related to the degree of change in oxygen and DOC. For most cases however, we did not find strong predictors and we attribute this to the spatial positioning of "hot spots" or redundancy in the processes actually responsible for the transformation. Our ability to predict ecosystem performance from whole-ecosystem attributes may be impeded by lack of consideration of within-system spatial contingencies or lack of knowledge of which process is actually responsible for the observed alteration in material flux.

Finkel, Z. V., Mount Allison University, Sackville, Canada, zfinkel@mta.ca

ENVIRONMENTAL CONTROL OF DIATOM COMMUNITY SIZE STRUCTURE VARIES ACROSS AQUATIC ECOSYSTEMS

In the ocean and large lakes there is often an increase in the relative proportion of total biomass and an increase in numerical abundance of larger phytoplankton with increasing limiting nutrient concentrations. In creeks and streams, the size structure of diatom communities shows no significant relationship with limiting nutrient concentrations. To confirm that the relationship between community size structure and nutrient concentration varies across different aquatic systems we quantified the size structure of diatom assemblages from a set of twenty-eight southeastern Ontario alkaline lakes characterized by a wide range of limiting nutrient concentrations. We found the median size of the diatoms in a community is inversely related to limiting nutrient concentration. The across system pattern supports the hypothesis that sinking rate is a relatively more important process shaping diatom size structure in lakes of small and intermediate size than in larger deeper lakes and the ocean where the size scaling of nutrient uptake and growth is the primary determinate of community size structure and sinking is more likely to be generally disadvantageous.

Finlay, K., University of Regina, Regina, Canada, kerri.finlay@uregina.ca;
Leavitt, P. R., University of Regina, Regina, Canada, peter.leavitt@uregina.ca

INORGANIC AND ORGANIC CARBON SEQUESTRATION IN LAKES OF THE NORTHERN GREAT PLAINS

Freshwater lakes are important sources of CO2 to the atmosphere because a large fraction of allochthonous dissolved organic carbon (DOC) is mineralized to gas before C is deposited in sediments or exported downstream. However, saline and hard-water lakes with high pH and high productivity may not conform to this model, as elevated pH (>8) can rapidly convert CO2 to HCO3- and CO3=, and algal sedimentation may be high. We evaluated the carbon inputs (watershed inflows, CO2 influx from the atmosphere) and outputs (sedimentation and outflow) for six hard-water lakes in the Northern Great Plains from 1994-2007. Unlike soft-water sites, atmospheric flux accounted for <10% of the lake carbon budgets, and equal amounts of organic and inorganic carbon were buried in the sediments. Export rates of C to rivers and sediments were regulated by water residence time. Together, our findings demonstrate that lake-atmospheric transfers are less important in hardwater and saline lakes than in dilute systems, and suggest that chemical controls of pH may play an important role in C sequestration.

Fisher, J. A., Queen's University and Bedford Institute of Oceanography, Dartmouth, Canada, jonathan.fisher@queensu.ca;
Frank, K. T., Bedford Institute of Oceanography, Dartmouth, Canada, frankk@mar.dfo-mpo.gc.ca;
Leggett, W. C., Queen's University, Kingston, Canada, wleggett@queensu.ca;
Shackell, N. L., Bedford Institute of Oceanography, Dartmouth, Canada, shackelln@mar.dfo-mpo.gc.ca;
Petrie, B., Bedford Institute of Oceanography, Dartmouth , Canada, petrieb@mar.dfo-mpo.gc.ca

NORTH ATLANTIC OSCILLATION VARIABILITY INFLUENCES LATITUDINAL TRENDS IN MARINE FISH SPECIES RICHNESS

Poleward declines in species richness (latitudinal diversity gradients (LDGs)) remain among the oldest and most ubiquitous of biogeographic patterns. However, their temporal dynamics remain largely unexplored but may change in response to climate variation. We explored temporal variation within a marine fish LDG using 31 years of fisheries-independent trawl survey data from the northwest Atlantic continental shelf. Annual LDGs were examined in the context of the winter North Atlantic Oscillation (NAO), which is known to alter northwest Atlantic shelf bottom water temperatures. Positive (negative) NAO anomalies induce cooler (warmer) than normal temperatures in the north and warmer (cooler) than normal temperatures in the south across the surveyed region. Annual LDG slopes were negatively related to both the sign and strength of the NAO, and influenced by changes in species richness at both low and high latitudes, illustrating rapid, reversible species responses to changing climate. Future amalgamations of existing survey data from both the eastern and western Atlantic will enable basin-scale evaluations of NAO effects.

Folkard, A. M., Lancaster University, Lancaster, United Kingdom, a.folkard@lancaster.ac.uk;
Serra, T., University of Girona, Girona, Spain, teresa.serra@udg.es;
Colomer, J., University of Girona, Girona, Spain, jordi.colomer@udg.es

COMPARISONS OF VERTICAL PHYTOPLANKTON DISTRIBUTIONS AND THERMAL MICROSTRUCTURE-DERIVED TURBULENCE PROFILES IN SAU RESERVIOR, NE SPAIN

In lakes, phytoplankton populations typically respond to spatio-temporally variable physical forcing by exhibiting patchiness in their distributions. This may be caused by basin scale processes such as seiching or other basin scale wave motions, or by more localised phenomena such as inflow dynamics. In the vertical, spatial structure is dominated by seasonal and diurnal stratification and mixing. This paper presents reports field studies which aimed to elucidate the characteristics of the interplay between short time scale (daily and sub-daily) changes in vertical stratification and turbulent mixing intensity, and the vertical distribution of phytoplankton. Results show that wind mixing, nocturnal convective cooling and local effects of basin scale internal seiching all have discernable influences on phytoplankton distributions, and that the interaction and superposition of their roles in determining the mixing and stratification climate need to be understood to predict the phytoplankton populations' response.

Forget, M. H., Dalhousie University, Halifax, Canada, mforget@dal.ca;
Sathyendranath, S., Plymouth Marine Laboratory, Plymouth, United Kingdom, Shubha@dal.ca;
Platt, T., Bedford Institute of Oceanography, Dartmouth, Canada, tplatt@dal.ca;
Devred, E., Dalhousie University, Halifax, Canada, devrede@mar.dfo-mpo.gc.ca;
Fuentes-Yaco, C., Dalhousie University, Halifax, Canada, fuentes-yacoc@mar.dfo-mpo.gc.ca;
Pommier, J., Université du Québec à Trois-Rivière, Trois-Rivière, Canada, julien.pommier@uqtr.ca

ESTIMATION OF PRIMARY PRODUCTION FROM TIME-SERIES OF REMOTE SENSING OF OCEAN COLOUR IN TWO ECOLOGICALLY-DIFFERENT REGIONS OF THE NORTH ATLANTIC

Phytoplankton community structure and primary production were studied in two ecologically-different regions of the North Atlantic: the tropical Caribbean waters and the temperate North-West Atlantic. The short time-series in the North-West Atlantic covered the decline of a large diatom spring bloom whereas the multi-annual time-series in the Caribbean waters encompassed el nino events. In both cases, methods of assignment of the photosynthetic parameters to compute primary production from remote

sensing of ocean colour were assessed. Under tropical conditions, where the phytoplankton community structure is mainly composed of nano and pico-phytoplankton, the assignment of photosynthetic parameters was accomplished successfully using the Nearest Neighbour Method. By contrast, under the dynamic conditions of the declining diatom bloom in the North-West Atlantic, better agreement between in situ measurements of primary production and estimates from satellite data was found after development and application of an intelligent algorithm accounting for the community structure and the physiological state of the phytoplankton community.

Forrest, R. W., Cawthron Institute, Nelson, New Zealand, reid.forrest@cawthron.org.nz;
Gillespie, P. A., Cawthron Institute, Nelson, New Zealand, paul.gillespie@cawthron.org.nz;
Peake, B. M., University of Otago, Dunedin, New Zealand, Bpeake@chemistry.otago.ac.nz

IDENTIFICATION OF A NATURAL CATCHMENT SOURCE OF METALS ENRICHED SEDIMENTS DELIVERED TO THE MOTUEKA RIVER PLUME REGION OF TASMAN BAY, NEW ZEALAND.

As part of an integrated catchment management research programme, sediment physico-chemical and biological characteristics were used to delineate the spatial extent of river influences within a large oceanic embayment. We provide evidence for a strong terrestrial signature of elevated sediment trace metals extending several kilometres offshore in the river outwelling plume. The source was traced to an upper-catchment alpine mineral belt with river margin sediments containing up to 1200 mg Ni per kg (~20 times the ANZECC 2000 guideline ecological effects threshold). Ni concentrations in bay sediments were up to 7 times the guideline effects threshold, while a range of other metals were elevated above ambient, but to a lesser degree. Infaunal communities within the plume showed decreased diversity and decreased total abundance and were strongly correlated with sediment Ni, Cr and Cu concentrations. Synoptic surveys of sediment characteristics provided a depositional footprint generally consistent with predictive model simulations. These results provide (in part) the basis for development of a river plume ecosystem concept for management of commercial fishing and aquaculture industries in the bay.

Fortin, N., Biotechnology Research Institute, National Research Council Canada, QC, Montreal, Canada, nathalie.fortin@cnrc-nrc.gc.ca;
Rodriguez, R. A., Environmental Health Center, Health Canada, ON, Ottawa, Canada, rocio_aranda-rodriguez@hc-sc.gc.ca;
Jing, H., Biological Sciences, University of Quebec at Montreal, QC, Montreal, Canada, hongmeijing@hotmail.com;
Pick, F., Biology Department, University of Ottawa, ON, Ottawa, Canada, frances.pick@uottawa.ca;
Bird, D., Biological Sciences, University of Quebec at Montreal, QC, Montreal, Canada, bird.david@uqam.ca;
Greer, C. W., Biotechnology Research Institute, National Research Council Canada, QC, Montreal, Canada, charles.greer@cnrc-nrc.gc.ca

DEVELOPMENT OF A QUANTITATIVE-PCR METHOD FOR THE EARLY DETECTION OF TOXIC CYANOBACTERIAL BLOOMS

Toxic cyanobacterial blooms, and their increasing global occurrence, pose a serious threat to human health, domestic animals and livestock. In Missisquoi Bay, Lake Champlain, public health advisories were issued from 2000 to 2006, and local microcystin concentrations often exceeded the Canadian drinking water guideline of 1.5 µg/L. A quantitative PCR (Q-PCR) approach was developed for the early detection of blooms formed by microcystin-producing cyanobacteria. Primers were designed for the polyketide synthase and the first dehydratase domain of the *mcyD* gene, involved in microcystin synthesis. Two toxic bloom events were detected by Q-PCR during the summer of 2006: more than 60,000 copies of the *mcyD* gene/mL were detected in August, and an average of 40,000 copies/mL were detected in September, when microcystin levels were more than 4 µg/L and approximately 2 µg/L respectively. There was a good correlation between gene copy number and microcystin concentrations. The Q-PCR method was more sensitive than standard chemical methods and allowed the detection of microcystin-producing cyanobacteria as early as June. This technique could be used for the efficient monitoring of the most at-risk water bodies.

Fortino, K., University of North Carolina at Chapel Hill, Chapel Hill, USA, kfortino@email.unc.edu;
Whalen, S. C., Universtiy of North Carolina at Chapel Hill, Chapel Hill , USA, steve_whalen@unc.edu

BURIAL EFFICIENCY IN THREE SHALLOW ARCTIC LAKES: THE EFFECT OF TEMPERATURE, OXYGEN AVAILABILITY, AND ORGANIC MATTER QUALITY

Factors affecting organic matter burial efficiency in lakes are poorly understood. We measured sediment organic matter content (loss on ignition at 550d C) in 1 cm slices of 10 cm cores taken from three oligotrophic arctic lakes near Toolik Lake, Alaska. The lakes have organic rich surface sediments (25.3 to 53.0 %) and high retention (60 and 70 %) of surface organic matter down to 10 cm. Organic matter mineralization rate was measured as the dark sediment oxygen demand (SOD) of laboratory incubated cores. SOD ranged between 8.4 and 20.6 mmol O_2 m^{-2} d^{-1} and incubation temperature and oxygen availability explained 64 % of the variation in SOD. A portion of the unexplained variation in SOD was accounted for by differences in the source of sediment organic matter. Proxies of sediment organic matter autochthony (Chlorin Index and $SUVA_{254}$) show that the lake with the highest SOD independent of temperature and oxygen availability has the most autochthonous organic matter. Our results show that organic matter breakdown in these lakes is limited by temperature, oxygen availability, and labile organic matter.

Fowler, W. A., Memorial University, St. John's , Canada, wf@physics.mun.ca;
Zedel, L., Memorial University, St. John's, Canada, zedel@physics.mun.ca

BOUNDARY LAYER VELOCITY STRUCTURE IN A COLDWATER CORAL AREA OF HADDOCK CHANNEL, SOUTHWEST GRAND BANKS

Coldwater coral habitat is characterized in Haddock Channel using two 2 MHz doppler current profilers. Instruments were deployed from CCGS Hudson using the ROPOS remotely operated submersible. The profilers were deployed for 85 hours, at a depth of 700 m, beginning July 17th, 2007. The vertical profiling range was 4 meters, with 1 meter depth resolution, sampling every 2.7 minutes. One instrument was placed in an area where bamboo corals (*Keratoisis ornata*) extend approximately 1 meter in height and occur with a density on the order of 1 colony per square meter. The second instrument was deployed 60 meters away in an area containing no corals but having visually similar sea floor characteristics. Observed currents showed some evidence of tidal forcing but other processes clearly influence the current regime: speeds remained below 10 cm/s. Comparison of profiles between the two sites indicates that in this environment the presence of bamboo coral modifies the boundary layer structure: at 1 meter above the bottom velocities are reduced by 13% with the presence of coral.

Fox, S. E., The Ecosystems Center and Boston University Marine Program, Marine Biological Laboratory, Woods Hole, USA, sefox@mbl.edu;
Valiela, I., The Ecosystems Center and Boston University Marine Program, Marine Biological Laboratory, Woods Hole, USA, ivaliela@mbl.edu

DEFORESTATION OF TROPICAL WATERSHEDS ALTERS MANGROVE ESTUARINE FOOD WEBS

Tropical forests are rapidly being converted to pastures and agriculture. This widespread deforestation has biogeochemical and ecological effects on mangrove estuaries, which are located at the interface of land and sea. To examine effects of watershed deforestation on mangrove estuarine ecosystems, we measured salinity and nutrients, and collected mangroves, algae, and fauna for stable isotopic analysis from a set of estuaries with forested and deforested watersheds in the Pacific coast of Panama. Salinity measurements taken during wet and dry seasons were significantly lower during the wet season, and deforested watersheds contributed more freshwater during the wet season. Fresher water flowing from deforested watersheds had higher concentrations of NO_3 than water from forested watersheds. Stable isotopic signatures differed in producers from deforested compared to forested watersheds. Signatures of biota from estuaries receiving inputs from deforested and forested watersheds also differed. This stable isotopic evidence suggests that deforestation of watersheds altered energy flow through the mangrove food webs. These alterations also have implications for adjoined ecosystems that depend on mangrove estuaries as a carbon and nutrient source and nursery habitat.

Frank, K. T., Bedford Institute of Oceanography, Dartmouth, Canada, frankk@mar.dfo-mpo.gc.ca;
Fisher, J. A., Queen's University, Kingston, Canada, fisherjad@mar.dfo-mpo.gc.ca;
Leggett, W. C., Queen's University, Kingston, Canada, wleggett@queensu.ca

MACROECOLOGICAL ANALYSES OF TEMPORAL CHANGE IN AQUATIC ECOSYSTEMS: PROGRESS AND OUTLOOK

Macroecology is a rapidly growing branch of ecology, focused initially on terrestrial systems, that is now being used for retrospective analyses of aquatic assemblages across diverse systems. Since its inception, macroecology has been suggested as useful for predicting large-scale, community-level responses to environmental change. General relationships are frequently developed from the inter-comparison of mean states across different areas or systems to infer dynamic processes. However, equating a time-series average with an ensemble average (a concept known as ergodicity), appears to be a central, but un-tested assumption of current and earlier approaches in macroecology. We attempt to address the quesion of the validity of generalizations derived from recent, aquatic macroecological studies through an evaluation of the ergodic assumption. In addition, since components of many aquatic ecosystems experience anthropogenic disturbances, the resulting directional change in size, abundance, geographic ranges and species numbers provide particularly strong tests of macroecological predictions on how these variables should change through time. Ongoing attempts to unify spatial and temporal patterns, particularly in terms of species richness and trophic dynamics, have benefited from tests using aquatic data.

Franke, D., Memorial University of Newfoundland, St. John's, Canada, dfranke@mun.ca;
Ziegler, S., Memorial University of Newfoundland, St. John's, Canada, sziegler@esd.mun.ca

DISSOLVED ORGANIC CARBON PROCESSING FROM A HEADWATER STREAM THROUGH THE LAKE OF A LARGE BOREAL WATERSHED IN WESTERN NEWFOUNDLAND, CANADA

This study is part of a project aimed at investigating how the cycling and fate of dissolved organic carbon (DOC) is linked with hydrology in the Humber River watershed to provide predictive knowledge of the potential impact of climate change on C cycling in boreal watersheds of the region. The Humber River drains 4400 sq km in western Newfoundland where its upper and lower reaches are divided by Deer Lake. Samples were collected along a continuum of sites including first through third order streams, the Humber River and Deer Lake to assess variation in watershed DOC processing. DOC concentrations decreased, relative to chloride, from first to second order streams and along Deer Lake. However, DOC normalized UV absorptivity decreased and del13C-DOC increased downstream within the streams only, suggesting losses of photochemically labile DOC. Decreases in dissolved inorganic carbon (DIC) and increases in del13C-DIC, relative to chloride, only occurred across Deer Lake suggesting CO2 evasion may have been important. These results suggest differences in the role of headwater streams versus lakes in regulating the fate of DOC in this watershed.

Frey, J. W., U.S. Geological Survey, Indianapolis, USA, jwfrey@usgs.gov

ALGAL BIOMASS IN INDIANA STREAMS

In the Midwest, especially in the heavily tiled agricultural areas of the Cornbelt, most nutrient export into streams occurs at high streamflow during winter and spring periods. This export of nutrients occurs rapidly with minimal nutrient uptake or mineralization and suggests that nutrients may be in short supply during the summer and fall. This rapid movement of nutrients may be more important in headwater (less than 20 square miles) streams. From 2001 through 2005 algal biomass and nutrient data were collected 2-3 times from May through October at 322 sites throughout Indiana; 151 were headwater sites. In headwater streams, periphyton chlorophyll a concentrations ranged from 1.00 to 1,010 mg/m2 with a median of 37.7 mg/m2. At wadeable sites, less than 1,000 square miles, concentrations ranged from 0.410 to 1,550 mg/m2 with a median of 48.8 mg/m2. The similarity in high algal biomass concentrations at headwater and wadeable sites suggests that even though nutrients may be rapidly transported in the winter and spring, a portion of the nutrients remains in the stream to support the algal growth, possibly through nutrient cycling.

Frisch, D., University of Oklahoma, Norman, USA, dfrisch@ou.edu;
Weider , L. J., University of Oklahoma, Norman, USA, ljweider@ou.edu

SEASONAL CHANGES IN THE GENETIC POPULATION STRUCTURE OF THE EXOTIC INVASIVE CLADOCERAN *DAPHNIA LUMHOLTZI*

Daphnia lumholtzi is a recent invader in North American lakes. Its native range includes portions of subtropical Africa, S.E. Asia and Australia, from which it dispersed to the United States, presumably via fish stocking. It was first recorded in the Southern USA (Texas) in the early 1990s and has since increased its geographical distribution, with populations found as far north as the Laurentian Great Lakes. Its persistence throughout the winter in more northerly populations (i.e. Missouri, Illinois), suggests its adaptation to cooler temperatures. We studied the seasonal changes in the genetic population structure of *Daphnia lumholtzi* in Lake Texoma, Oklahoma, at five sample stations on a west to east transect covering about 30 km total distance. Monthly samples were analyzed using allozyme electrophoresis and microsatellite markers. Our analyses show a distinct seasonal displacement of clones, indicating differential temperature preferences of genotypes. These results were confirmed in laboratory temperature tolerance experiments. Our results suggest that sufficient genetic variation is present in this species to allow its range expansion into much colder climates than implied by its native subtropical habitat.

Frost, P. C., Trent University, Peterborough, Canada, paulfrost@trentu.ca;
Marcus, M. A., Trent University, Peterborough, Canada;
Zalewski, A., Trent University, Peterborough, Canada;
Ebert, D., Universität Basel, Basel, Switzerland

VARIABLE EFFECTS OF PHOSPHORUS-POOR FOOD ON *DAPHNIA MAGNA*: IS THERE A MEDIATING ROLE OF MATERNAL ELEMENTAL NUTRITION?

Accumulating evidence shows strong but sometimes variable effects of dietary phosphorus on zooplankton metabolism. Here we tested the hypothesis that poor elemental nutrition of *Daphnia magna* mothers affects the sensitivity of their offspring to changes in diet quality. We grew *Daphnia* mothers on algal food of contrasting carbon:phosphorus (C:P) ratios and compared neonate responses to a similar range of food quality. We found neonates born to P-stressed mothers had less mass and lower body P content compared to neonates born to P-sufficient mothers. In addition, the relationships between neonate food C:P ratios and neonate growth rate, age of first reproduction, and susceptibility to bacterial infection were all affected by an increasing C:P ratio in the mother's diet. These results provide strong support for the maternal nutrition hypothesis that the effects of poor elemental food quality in *Daphnia* are passed from mother to offspring. Such maternal effects on neonate responses to food C:P ratios should be considered in future studies of the elemental nutrition of aquatic consumers.

Fulweiler, R. W., Louisiana State University, Baton Rouge, USA, wally1@lsu.edu;
Twilley, R. R., Louisiana State University, Baton Rouge, USA, rtwilley@lsu.edu

THE PULSING MISSISSIPPI RIVER AND DENITRIFICATION IN COASTAL LOUISIANA

Allowing freshwater from the Mississippi River to be diverted into the surrounding wetlands may solve two major problems in coastal Louisiana. First, returning the natural pulse of freshwater, sediment, and nutrients has great potential to build new wetlands thus mediating, at least in part, land loss. It may also create an environment that favors denitrification thereby removing nitrogen, decreasing phytoplankton production in the Gulf of Mexico, and ultimately reducing the size and duration of the dead zone. However, much controversy surrounds wetland restoration in Louisiana because the freshwater and sediment essential to land building also carries with it high concentrations of nitrogen. To date, the possible amount of nitrogen loss through denitrification in coastal Louisiana has been based mainly on indirect estimates and thus the actual amount is unknown. We present here the first direct estimates of denitrification using the N2/Ar technique. In addition, we examine how rates of denitrification change with variations in the amount and timing of freshwater discharge from the Mississippi River.

Gabriel, C. M., Memorial University, St. John's, Canada, g39cmkg@mun.ca;
Clarke, K. D., Fisheries and Oceans Canada, St. John's, Canada, clarkekd@dfo-mpo.gc.ca;
Campbell, C. E., Sir Wilfred Grenfall College, Memorial University, Corner Brook, Canada, ccampbel@swgc.mun.ca

INVERTEBRATE COMMUNITIES OF A MAN-MADE STREAM IN BOREAL NEWFOUNDLAND: INFLUENCE OF LARGE WOODY DEBRIS

Invertebrate communities were examined in Compensation Creek, a man-made stream, in south-central Newfoundland, Canada, to determine if large woody debris (LWD) would act as a specialized niche, increasing the overall richness and abundance of invertebrates in the stream. In successive years samples were taken from LWD structures and from benthic environments in the artificial stream, and from benthic habitats in a nearby reference stream. Taxa richness was higher in benthic habitats than on LWD, most likely influenced by the successional age of the stream. Reach scale factors had more influence on functional feeding group abundance than did microhabitat characteristics. During regular discharge collector-filterer abundance near the artificial stream inlet was six times greater than that of locations farther down the stream, but when discharge was reduced abundances were almost equal. Scrapers were almost completely absent from LWD. Riparian vegetation has not fully established around the artificial stream, resulting in a leaf-litter input difference from the reference stream. As the morphology of Compensation Creek progresses the invertebrate community will continue to develop and likely increase utilization of accumulated detritus at LWD.

Gaiser, E. E., Florida International University, Miami, USA, gaisere@fiu.edu;
Deyrup, N., Archbold Biological Station, Lake Placid, USA, NDeyrup@archbold-station.org;
Bachmann, R. W., University of Florida, Gainesville, USA, rbach@ufl.edu;
Battoe, L., St. John's River Water Management District, Palatka, USA, lbattoe@sjrwmd.org;
Swain, H. M., Archbold Biological Station, Lake Placid, USA, HSwain@archbold-station.org

EFFECTS OF CHANGES IN PRECIPITATION ON TRANSPARENCY AND THERMAL STRUCTURE IN SUBTROPICAL, MONOMICTIC LAKE ANNIE, FLORIDA.

Lake Annie is a small (37 ha), relatively deep (21 m) sinkhole lake in central Florida with a long history of study, including monthly limnological monitoring over the past 22 years. In this headwater lake, dry years are associated with minimal groundwater and overland allocthonous input, causing a deep photic zone (9-13 m). Sequential wet years increase water table height and import of dissolved organic materials from peripheral wetlands to the lake, reducing the photic zone to 1-3 m. By altering water color, an increase in precipitation of 20 cm per year causes a reduction the depth of the summer thermocline by 2 m and a 1-month reduction in the duration of winter mixing. We use infer a longer history of transparency from a 73-year lake stage and precipitation record, and resulting trends roughly correspond to the Atlantic Multi-decadal Oscillation which drives long-term precipitation patterns in Florida. Under climate scenarios predicting increased frequency of large rainfall events in the Southeastern U.S., deep, oligotrophic monomictic lakes will become darker and colder, and may be buffered against the effects of climate warming.

Gardner, W. S., The University of Texas, Port Aransas, Texas, USA, wayne.gardner@mail.utexas.edu;
McCarthy, M. J., The University of Texas, Port Aransas, Texas, USA, markm@mail.utexas.edu

IS ANAMMOX AN IMPORTANT PROCESS AFFECTING THE FATE OF NITROGEN IN TEXAS ESTUARIES?

A series of continuous-flow experiments were conducted in summer and winter on intact sediment cores from three Texas Estuaries with similar depths but different salinity regimes. The potential importance of anammox relative to total N2 production was examined in 2006 by adding 15NH4+ or 15NO3- to water passing over respective cores and observing the relative production rates of 28N2, 29N2, and 30N2. The total N2 production rate for cores exposed to 15NH4+ ranged from 25 to 63 µmol N m-2 h-1, with 29N2 (assumed to reflect anammox) constituting from 0.1 (Laguna Madre in June) to 11% (East Matagorda Bay in June) of total N2 production. Total N2 production for cores treated with 15NO3- ranged from 35 to 177 µmol N m-2 h-1, with 29N2, from denitrification or anammox, accounting for 6.5 to 17% of the total N2 production. Potential dissimilatory nitrate reduction to ammonium (DNRA) rates, reflecting 15NH4+ accumulation rates from cores exposed to 15NO3,- ranged from < 1 to 270 µmol N m-2 h-1 during years 2004 to 2006, with highest values occurring in the upper Laguna Madre under warm, hypersaline conditions. Overall, our results indicate that denitrification is the major process accounting for nitrate reduction in south Texas estuaries, except for the Laguna Madre, where DNRA is often a dominant process. Although measureable, anammox does not appear to be a dominant mechanism accounting for nitrate removal in these shallow subtropical estuaries.

Gentleman, W. C., Dalhousie University, Halifax, Canada, wendy.gentleman@dal.ca;
Neuheimer, A. B., Dalhousie University, Halifax, Canada, anna.neuheimer@phys.ocean.dal.ca

FUNCTIONAL RESPONSES AND ECOSYSTEM DYNAMICS: THE ROLES OF SATIATION, FOOD-LIMITATION AND ACCLIMATION

Modelers have long been aware that the form of zooplankton mortality, or closure scheme, significantly affects the dynamics of Nutrient-Phytoplankton-Zooplankton (NPZ) models. Far less attention has been paid to the formulation of the functional response, i.e. how ingestion rates change with prey density. Here, the behaviors governing the functional response are shown to have a pivotal role for ecosystem dynamics. By modifying the mathematical formulation for ingestion, we show results of oscillating vs. constant densities are not related to zooplankton satiation vs. non-satiation as has previously been asserted. Instead, the necessary condition for ecological stability is controlled by food-limited clearance rates as derived through analysis of a predator-prey model. Sensitivity studies demonstrate that zooplankton clearance rates have a strong influence on the dynamics of more complex models. Moreover, it is shown that acclimation time lags can dramatically alter results from those where zooplankton instantly adapt to changing prey densities. These results suggest that common modeling approaches may underestimate the influence of the functional response, and we discuss ways to decrease model uncertainty related to low-food and transient responses.

Gerbersdorf, S. U., St Andrews University, St Andrews, United Kingdom, sug@st-andrews.ac.uk;
Lubarsky, H. V., St Andrews University, St Andrews, United Kingdom, hb243@st-andrews.ac.uk;
Paterson, D. M., St Andrews University, St Andrews, United Kingdom, dp1@st-andrews.ac.uk

BACTERIAL ENGINEERING IN TERMS OF THE EROSION RESISTANCE OF SEDIMENTS

There is now a consensus, that microalgae - mainly diatoms - provide the ecosystem function of "biostabilisation" for many depositional habitats through the secretion of extracellular polymeric substances (EPS). The paper investigates the stabilisation potential of the largely overlooked natural benthic bacteria and compares it with axenic and non-axenic diatom assemblages. Stability was analysed by CSM (Cohesive Strength Meter) and MFPC (Magnetic Force Particle Capture). Stability was significantly enhanced after 3 days as compared to the controls. The bacterial assemblages (x 2.5) significantly surpassed the stabilisation potential of the axenic diatoms (x 2), while the bacteria + diatom assemblage showed the highest stabilisation (x 3.5). Nutrient addition to bacterial cultures resulted in an enhanced stabilisation effect (x 3.6) as compared with nutrient-depleted bacterial assemblages (x 1.8). This could imply that the synergistic stabilisation effect of the mixed assemblage (bacteria + diatom) was due to nutrient re-cycling, allowing for a higher biomass and larger amounts of EPS. Shifts in the diatom (microscope) and bacterial assemblages (in situ FISH hybridization) over time will be discussed. The data show the importance of bacterial assemblages for microbial sediment stabilization and secondly, that a change in abiotic conditions can affect their stabilization potential significantly.

Gergs, R., University of Konstanz, Konstanz, Germany, rene.gergs@uni-konstanz.de;
Rothhaupt, K. O., University of Konstanz, Konstanz, Germany, karl.rothhaupt@uni-konstanz.de

BIODEPOSITION BY *DREISSENA POLYMORPHA*: A FOOD SOURCE FOR NATIVE AND INVASIVE AMPHIPOD SPECIES

In the last decades the zebra mussel (*Dreissena polymorpha*) invaded many freshwater systems, resulting in a strong change of the benthic macroinvertebrate community. A corresponding effect was the increase in abundance of many benthic species, particularly of chironomids and gammarids. It is assumed that a detritus based food-web was established, based on the biodeposition of zebra mussels. However, the trophic effect of invading zebra mussels is understudied. In Lake Constance we found a low ^{13}C signal in the amphipods, indicating a feeding strategy on pelagic resources that are indirectly procured by Dreissena biodeposition. In laboratory experiments, the native *Gammarus roeselii* shifted their distribution towards the biodeposited material, whereas the invasive *Dikerogammarus villosu*s responded only to additional chironomids. Further experiments revealed that both species feed on the biodeposited material, especially *G. roeselii*. These results indicate that the omnivore *G. roeselii* benefits directly from the biodeposited material and *D. villosus* indirectly by predation on other benthic invertebrates like chironomids.

Gibson, R. J., Department of Fisheries and Oceans, St. John's, Canada, rjgibson@nf.sympatico.ca;
Erkinaro, J., Finnish Game and Fisheries Research Institute, Utsjoki, Finland, jaako.erkinaro@rktl.fi

THE INFLUENCE OF WATER DEPTHS ON COVER RESPONSES OF JUVENILE ATLANTIC SALMON

The responses of salmon parr (mean F.L. 12.6 cm) to instream cover related to water depths were tested in an ellipsoidal stream tank with recirculated water. The tank had a wide channel 5.8 m long and 1.2 m wide, a narrow channel 4.3 m long and 0.6 m wide, and a pool 1.5 m long and 3.1 m wide, and total fish use area of 14.7 m2. Depths in the channels were regulated from 20 cm deep to 40 cm. The pool was 30 cm deeper. Water velocities ranged from 3 Ã¢â‚â€œ 39 cm.s-1 in the wide channel, 20 Ã¢â‚â€œ 47 cm.s-1 in the narrow channel, and 0 Ã¢â‚â€œ 25 cm.s-1 in the pool. There was a gravel substrate. Opaque plastic covers, 15 cm in length and 16 cm high, were randomly placed through the tank, 19 in the wide channel, 13 in the pool and 9 in the narrow channel. Incandescent and fluorescent lights provided illumination of 8.03 to 3.36 µmol 18 cm above the substrate for a 12 hour photoperiod. Water temperature averaged 13.8° C. Six salmon parr were used for each experiment. In experiments with channel depths of 40 cm (n=6) salmon were observed in the open (away from covers) 65% of the time and under covers 35% of the time. At 30 cm (n=2) they were in the open 40% of the time, and under covers 60% of the time. At 20 cm (n=2) channel depth salmon were in the open areas only 17.7% of the time, and under covers 82.35% of the time. Although other variables influence depth distribution of salmon parr, our findings show that depth itself provides cover, possibly from avian predators.

Gillespie, R. B., Indiana University-Purdue University Fort Wayne, Fort Wayne, USA, gillespi@ipfw.edu;
Smiley, P. C., USDA-ARS, Soil Drainage Unit, Columbus, USA, rocky.smiley@ars.usda.gov;
King, K. W., USDA-ARS, Soil Drainage Unit, Columbus, USA, kevin.king@ars.usda.gov;
Huang, C., USDA-ARS, National Soil Erosion Research Laboratory, West Lafayette, USA, chi-hua.huang@ars.usda.gov

RELATIONSHIPS OF MACROINVERTEBRATE COMMUNITIES WITH NUTRIENTS, PESTICIDES, AND PHYSICOCHEMICAL PARAMETERS IN CHANNELIZED HEADWATER STREAMS IN INDIANA AND OHIO

Many headwater streams in the midwestern United States have been modified or constructed to transport agricultural runoff downstream. Effective implementation of agricultural conservation practices to reduce nutrient and pesticide loadings requires information about the influence of water chemistry on stream communities. We evaluated the relative influence of nutrients, pesticides, and physicochemical variables on macroinvertebrate communities in channelized headwater streams in Cedar Creek, Indiana and Upper Big Walnut Creek, Ohio. We sampled water chemistry and macroinvertebrates within 20 sites from July 2005 to November 2006. Preliminary multiple regression analyses suggested that macroinvertebrate communities were more strongly correlated with nutrients than pesticides or physicochemical variables. Specifically, taxa richness ($r^2 = 0.651$; $P < 0.05$) and percent Chironomidae ($r^2 = 0.507$; $P < 0.05$) were strongly correlated with mean nitrate-nitrite concentrations, while percentage EPT was strongly correlated ($r^2 = 0.894$; $P < 0.05$) with soluble reactive phosphorus concentrations. Our results suggest that conservation practices that alter nutrient loadings will have a greater influence on macroinvertebrate communities in channelized headwater streams in Indiana and Ohio than those practices that alter pesticide or physicochemical variables.

Gillette, J. P., SUNY College of Environmental Science and Forestry, Syracuse, NY, USA, jpgillet@syr.edu

USING STABLE CARBON ISOTOPE ANALYSIS TO QUANTIFY FEEDING BY THE MIXOTROPHIC PHYTOPLANKTON *DINOBRYON DIVERGENS*

Mixotrophic phytoplankton play a unique role in aquatic food webs, functioning both as photoautotrophic producers and consumers of bacteria, exogenous DOC compounds, and even other phytoplankton. Given the complexity of these relationships, it has thus far been difficult to quantify directly the degree to which mixotrophs function as either producers or consumers in natural systems. We report on a new technique using $\delta^{13}C$ as a tracer to quantify autotrophic vs. heterotrophic growth of mixotrophic phytoplankton. We grew the mixotrophic Chrysophyte, *Dinobryon divergens*, under conditions of strictly autotrophic growth ($\delta^{13}C$ = -29.1‰), and also grew the potential prey bacterium, *Pseudomonas fluorescens*, on glucose media ($\delta^{13}C$ of -11.6‰). By offering *P. fluorescens* as a food source to *D. divergens* under a variety of light and nutrient conditions, and measuring the $\delta^{13}C$ of the resulting algal growth, it is possible to quantify the degree to which *D. divergens* utilizes heterotrophic feeding to cope with light and nutrient limitation. This technique may be applicable to a variety of species, resulting in a more definitive understanding of the significance of mixotrophy in aquatic trophic dynamics.

Gladyshev, M. I., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences, Krasnoyarsk, Russian Federation, glad@ibp.ru;
Arts, M. T., National Water Research Institute - Environment Canada , Burlington, Canada, Michael.Arts@EC.GC.CA ;
Sushchik, N. N., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences, Krasnoyarsk, Russian Federation, labehe@ibp.ru

EXPORT OF OMEGA-3 POLYUNSATURATED FATTY ACIDS FROM AQUATIC TO TERRESTRIAL ECOSYSTEMS

Polyunsaturated fatty acids (PUFA) are known to be of physiological importance for all animals, including humans. Microalgae of some taxa are the main producers of long-chain PUFA in the biosphere. Once synthesized by algae, PUFA are transferred and accumulate, at progressively higher trophic levels, in the biomass of aquatic organisms. Therefore, aquatic ecosystems occupy the unique position on earth as the principal source of long-chain PUFA such as EPA (20:5n-3) and DHA (22:6n-3), for all animals (aquatic and terrestrial). Thus, the well established role of waterbodies as a source of drinking water should be augmented by an explicit recognition of their role in supplying terrestrial ecosystems with essential nutrients. We postulate that an attempt to quantify PUFA export from aquatic to terrestrial ecosystems in geographically and climatically diverse regions with different degrees of anthropogenic impact should be attempted. Based on the scant data currently available in the literature our first coarse global estimates suggest that at least some components of terrestrial ecosystems have the potential be limited by the supply of essential PUFA from adjacent aquatic ecosystems.

Glazer, B. T., University of Hawaii, Honolulu, USA, glazer@hawaii.edu;
Chen, I. C., University of Hawaii, Honolulu, USA, inchieh@hawaii.edu;
Briggs, R. A., University of Hawaii, Honoulu, USA, briggs@hawaii.edu;
Ricardo, A., University of Hawaii, Honolulu, USA, amandamc@hawaii.edu

BIOGEOCHEMICAL AND GEOMICROBIAL CHARACTERIZATIONS ACROSS REDOX GRADIENTS IN DIVERSE AQUATIC ENVIRONMENTS USING VOLTAMMETRIC (MICRO)ELECTRODES

Advances in ocean research sciences are intimately tied to technological capabilities. Electrochemical methods have often been used to study environmental processes, and in recent years there have been significant advances toward making real time geochemical measurements using these and other techniques. One particularly promising application is that of in situ voltammetry. In voltammetric work, current is measured while scanning the entire voltage range of the solid-state electrode, which allows the measurement of more than one chemical species at a given time in the same region of space. The presentation will detail recent successes and current capabilities for making in situ real-time redox species measurements within the context of biogeochemical and geomicrobial processes occurring at: (i) a coastal manmade aquaculture embayment (Kaneohe Bay, HI), (ii) a nearshore cabled observatory (Honolulu, HI), (iii) deep-sea hydrothermal microbial mats (Lohi Seamount, HI), and (iv) subseafloor borehole observatories (Juan de Fuca Ridge flanks).

Graeve, M., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, martin.graeve@awi.de;
Kattner, G., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, gerhard.kattner@awi.de

TRANSPORT OF LIPIDS THROUGH SPECIFIC FOOD CHAINS IN THE ARCTIC

The Arctic Kongsfjorden is dominated by the West Spitsbergen Current, water of polar origin and freshwater from glacial run-off. These water masses widely determine the ecosystem. Two distinct food chains are of special interest in lipid research of zooplankton in Kongsfjorden. Both play a key role due to the transfer of essential compounds and energy from algae via zooplankton to higher trophic levels. The pteropod Clione limacina feeds exclusively on Limacina helicina and exhibits very exceptional lipids. Up to 40% of the total lipids consist of diacylglycerol ethers (DAGE), a very unusual depot lipid in the marine zooplankton. The fatty acid composition of C. limacina lipids is also unique because of high percentages of odd-chain length components dominated by the 17:1(n-8) followed by 15:0 and 17:0. The ctenophore Mertensia ovum mainly ingests Calanus species and is characterized by high amounts of free fatty alcohols, being the second important fraction of neutral lipids and not yet found in other zooplankton. These free alcohols are predominated by the long-chain monounsaturated 22:1(n-11) alcohol and can also be found in the predator of M. ovum, Beroe cucumis.

Graham, E. S., Washington State University Vancouver, Vancouver, USA, grahame@vancouver.wsu.edu;
Bollens, S. M., Washington State University Vancouver, Vancouver, USA, bollens@vancouver.wsu.edu

MACROZOOPLANKTON COMMUNITY ASSOCIATIONS WITH ENVIRONMENTAL VARIABLES IN WILLAPA BAY, WA

Willapa Bay is a large, partially-mixed, tidally influenced estuary located between the Columbia River and Gray's Harbor estuaries on the coast of Washington. Macrozooplankton comprise a highly sensitive community that fluctuates in response to changes in the environment. Major sources of variation expected to affect the macrozooplankton community are prey availability, season and distance from the mouth of the estuary. In 2006 and 2007, six stations within Willapa Bay were sampled fortnightly for macrozooplankton, chlorophyll, and various abiotic variables. Results show an initial spring bloom in March consisting mostly of two copepod species: *Calanus pacificus* and *Centropages abdominalis*. A second, smaller bloom occurred two months later and consisted of mainly larval decapods, including *Neotrypaea californiensis*. Multivariate statistical analysis indicates water temperature is a major factor in defining two distinct temporal communities. Subsequent groupings are classified by additional environmental variables including chlorophyll *a* concentration and salinity. These and other possible factors underlying the temporal and spatial patterns of macrozooplankton in Willapa Bay are explored.

Graham, J. L., United States Geological Survey, Kansas Water Science Center, Lawrence, Kansas, USA, jlgraham@usgs.gov;
Loftin, K. A., United States Geological Survey, Kansas Water Science Center, Lawrence, Kansas, USA, kloftin@usgs.gov;
Meyer, M. T., United States Geological Survey, Kansas Water Science Center, Lawrence, Kansas, USA, mmeyer@usgs.gov;
Ziegler, A. C., United States Geological Survey, Kansas Water Science Center, Lawrence, Kansas, USA, aziegler@usgs.gov

CO-OCCURRENCE OF TOXINS AND TASTE-AND-ODOR COMPOUNDS IN CYANOBACTERIAL BLOOMS FROM THE MIDWESTERN UNITED STATES

During August 2006, twenty-three lakes in the Midwestern US with cyanobacterial blooms were sampled to determine the co-occurrence of toxins (anatoxin-a, cylindrospermopsins, microcystins, nodularin, and saxitoxins) and taste-and-odor compounds (geosmin and 2-methyliosborneol). Toxins were measured by LC/MS/MS and taste-and-odor compounds by GC/MS. Microcystins and cylindrospermopsins were also measured by ELISA. Saxitoxins were measured by ELISA only. Microcystins (range: undetectable to 18,000 µg/L; median: 1.2 µg/L) were detected in 100% of blooms and geosmin (range: undetectable - 0.9 µg/L; median: 0.01 µg/L) in 83%; 2-methylisoborneol (35%), anatoxin-a (26%), saxitoxins (17%), cylindrospermopsins (9%), and nodularin (9%) were less common. Toxins and taste-and-odor compounds co-occurred in 87% of blooms and anatoxin-a, cylindrospermopsins, and nodularin always co-occurred with geosmin. Forty-eight percent of blooms had co-occurring toxins but none had all measured toxins present. Although toxins and taste-and-odor compounds frequently co-occurred concentrations were not linearly related (all r2 Ã¢â€ Â¤ 0.32). This study indicates that cyanobacterial toxin and taste-and-odor compounds are common in Midwestern blooms, and that while multiple compounds frequently co-occur the concentration of most compounds appear to be independent.

Graham, M. H., Moss Landing Marine Laboratories, Moss Landing, USA, mgraham@mlml.calstate.edu;
Kinlan, B. P., University of California, Santa Barbara, USA, kinlan@lifesci.ucsb.edu;
Druehl, L. D., Bamfield Marine Sciences Center, Bamfield, Canada, ldruehl@island.net

ECOLOGY OF KELP FORESTS IN DEEP TROPICAL WATERS

Kelp forests are some of the most diverse, productive, and dynamic ecosystems on this planet, yet most ecologists consider kelp-based systems inherently temperate-boreal phenomena. Kelp forests can dominate eutrophic coastal waters of temperate-boreal regions, due to the presence of high nutrient, low temperature waters. However, we have recently completed a study that refutes the hypothesis that tropical and sub-tropical waters are incapable of supporting kelp-based systems. We used a Geographic Information System (GIS) to predict coastal regions between 30°N and 30°S in which enough light and nutrients are available at the sea floor to support kelp photosynthesis and growth. The results indicated extensive kelp-inhabitable regions throughout the tropics, down to depths exceeding 150 meters. Such regions were ubiquitous along the west coasts of Central America and North-Central Africa, the Philippine and Mediterranean Seas, and the coasts of Brazil and the Arabian Peninsula, totaling tens of 1000's of square kilometers of potential kelp habitat. We recently completed an exploration of the Galapagos Archipelago, predicted to be inhabitable by deep kelps, in which we found extensive new forests of *Eisenia galapagensis* , with associated kelp forest organisms. We suggest that extensive kelp populations likely exist in deep tropical waters worldwide and may provide hotspots of habitat and energy provision in otherwise oligotrophic systems.

Graham, T. B., University of North Carolina Wilmington, Wilmington, USA, tbg5311@uncw.edu;
Tobias, C. R., University of North Carolina Wilmington, Wilmington, USA, tobiasc@uncw.edu;
Song, B., University of North Carolina Wilmington, Wilmington, USA, songb@uncw.edu

NITRATE RECYCLING VS. REMOVAL IN THE CAPE FEAR RIVER ESTUARY

As an indicator of benthic estuarine nitrate recycling vs. removal, rates of denitrification, anaerobic ammonium oxidation (ANAMMOX) and dissimilatory nitrate reduction to ammonium (DNRA) were measured in the Cape Fear River Estuary (CFRE), North Carolina. The CFRE is typical of many estuarine systems in the southeastern United States in that it has experienced increased nitrogen loading and upstream salinity encroachment resulting from fresh drinking water withdrawals and sea level rise. Rates of denitrification, ANAMMOX, and DNRA were simultaneously measured in single sediment samples throughout the estuarine salinity gradient. Rates were assessed seasonally, as the salinity front migrated up and downstream. A combined approach of laboratory measurements and in situ sediment incubations were done in conjunction with geochemical monitoring of porewater analytes likely to influence these rates. Higher denitrification (up to 15.24 nmol N g wet sed. $^{-1}$) and ANAMMOX (up to 1.18 nmol N g wet sed. $^{-1}$) occurred upstream at lower salinities, while DNRA (up to 2.5 nmol N g wet sed. $^{-1}$) was highest downstream.

Gresswell, R. E., U.S. Geological Survey, NoRock, Bozeman, USA, bgresswell@usgs.gov;
Bateman, D. S., Oregon State University, Corvallis, USA;
Banks, M. A., Oregon State University, Corvallis, USA;
Burger, A. M., Oregon State University, Corvallis, USA;
Guy, T. J., Oregon State University, Corvallis, USA;
Wofford, J. E., Oregon State University, Corvallis, USA;
Torgersen, C. E., U.S. Geological Survey, FRESC, Seattle, USA

ASSESSING EFFECTS OF NETWORK CONNECTIVITY ON THE STRUCTURE OF FISH ASSEMBLAGES IN HEADWATER STREAMS OF WESTERN OREGON

There is a growing interest in the effects of watershed connectivity on the structure of fish assemblages. For research on headwater drainages in western Oregon, we have used spatially continuous data collection to assess spatial structure of coastal cutthroat trout in relation to geology, geomorphology, and land-management history. By studying movement at the watershed scale, it was possible to evaluate use of specific habitat patches and changes occurring among seasons and years. Individuals implanted with passive integrated transponder (PIT) tags have been monitored with fixed and mobile sensors to obtain temporally- and spatially-continuous relocation information over a 4-year period. These data have provided new insights concerning patterns of habitat use and the watershed-scale processes affecting population-level growth and survival. Genetic samples collected intensively in a single watershed and extensively for 27 watersheds across the region yielded important information concerning the effects of genetic and demographic isolation on genetic diversity and population persistence. This integrated approach for assessing relationships between salmonid distribution and physical habitat opens the door for continued methods development and innovation in the coming years.

Griffiths, N. A., University of Notre Dame, Notre Dame, USA, ngriffi1@nd.edu;
Tank, J. L., University of Notre Dame, Notre Dame, USA, tank.1@nd.edu;
Beaulieu, J. J., Environmental Protection Agency, Cincinnati, USA, Beaulieu.Jake@epamail.epa.gov;
Johnson, L. T., University of Notre Dame, Notre Dame, USA, ltaylor4@nd.edu;
Roley, S. S., University of Notre Dame, Notre Dame, USA, sroley@nd.edu;
Stephen, M. L., University of Notre Dame, Notre Dame, USA, miastephen@gmail.com

EFFECT OF STORMS ON AGRICULTURAL STREAM METABOLISM

In agricultural streams, most nutrient export occurs during high discharge, yet we know little about how storms affect biological processing. We examined the influence of storms on ecosystem function by quantifying daily whole-stream metabolism in an agricultural stream (Indiana, USA). Over one year, there were 12 storms (e.g. 1.5-fold increase in daily discharge) that had variable effects on gross primary production (GPP) and community respiration (CR). During 3 storms occurring in close succession (on 3/22, 4/10, and 4/24), GPP was depressed immediately after each storm, by 41%, 63%, and 70% respectively, likely from repeated benthic scouring and increased turbidity. In contrast, CR decreased by 32% and 14% after the first two storms, but did not change after the third. Variable influence of storms on CR may result from opposing effects of scouring (decreasing CR) and entrainment of allochthonous (soil) organic matter (increasing CR). Recovery of metabolism to pre-storm levels ranged from 3-7 days, and was longer with larger storms. Even in biologically active agricultural systems, there may be low potential for metabolic uptake to mediate nutrient export during high discharge.

Grimes, D. J., The University of Southern Mississippi, Ocean Springs, MS, USA, jay.grimes@usm.edu;
Zimmerman, A. M., Medical College of Wisconsin, Milwaukee, WI, USA, azimmerm@mcw.edu;
Johnson, C. N., The University of Southern Mississippi, Ocean Springs, MS, USA, c.n.johnson@usm.edu;
Flowers, A. R., The University of Southern Mississippi, Ocean Springs, MS, USA, adrienne.r.flowers@usm.edu;
DePaola, A., U.S. Food and Drug Administration, Dauphin Island, AL, USA, angelo.depaola@fda.hhs.gov;
Bowers, J., U.S. Food and Drug Administration, College Park, MD, USA, john.bowers@fda.hhs.gov;
Gould, R. W., Naval Research Laboratory, Stennis Space Center, MS, USA, gould@nrlssc.navy.mil;
Ladner, S., Naval Research Laboratory, Stennis Space Center, MS, USA, ladner@nrlssc.navy.mil

FORECASTING HUMAN HEALTH RISK FROM MARINE VIBRIOS USING SATELLITE DATA

The distribution and abundance of Vibrio spp., marine bacteria that cause human disease, can now be predicted with satellite-based remote sensing (RS). Useful RS data include sea-surface temperature (SST) collected by NOAA's Advanced Very High Resolution Radiometer (AVHRR) and by NASA's Moderate Resolution Imaging Spectrometer (MODIS), turbidity collected by AVHRR, and chlorophyll a detected by Sea-Viewing Wide Field-of-View Sensor (SeaWiFS) and MODIS. When these "nowcasting" RS data, primarily SST, were used to drive a FDA risk assessment model then plotted spatially, maps predicting the incidence and risk associated with V. parahaemolyticus in oysters in the Northern Gulf of Mexico were generated and made available; true incidence was confirmed by genetic detection. This paper focuses on the real-time posting of V. parahaemolyticus risk information on a public web site. Plans are also under way for expansion of this web site to include other pathogens such as V. vulnificus.

Gueguen, C., Trent University, Peterborough, Canada, celinegueguen@trentu.ca;
McLaughlin, F. A., Institute of Ocean Sciences, Sidney, Canada, McLaughlinF@pac.dfo-mpo.gc.ca

CHARACTERIZING DISSOLVED ORGANIC MATTER IN THE ARCTIC OCEAN USING PARALLEL FACTOR ANALYIS OF FLUORESCENCE SPECTRA

Dissolved organic matter (DOM) is known to play a major role in aquatic systems, influencing the speciation, transport and bioavailability of contaminants and light penetration to the underwater environment. Many of these processes are controlled by the nature and composition of DOM. The ability to differentiate and quantify the source of DOM is hence critical to understanding the carbon cycles in the oceans. In this study, DOM samples were collected in summer 2001, 2003 and 2007 in the Canada Basin. Parallel factor analysis (PARAFAC) of fluorescence spectra revealed that halocline DOM fluorescence could be separated into at least 5 individual fluorophores: 3 humic-like and 2-protein-like components. The spatial distribution of these components in the Canada Basin will be discussed in relation with hydrographic parameters.

Guerard, J. J., The Ohio State University, Columbus, USA, guerard.1@osu.edu;
Chin, Y. P., The Ohio State University, Columbus, USA, yo@geology.ohio-state.edu;
Mash, H., US EPA, Cincinatti, USA, Mash.Heath@epamail.epa.gov

PHOTOFATE OF ANTIBIOTICS USED IN AQUACULTURE

Sulfadimethoxine (SDM) and ormetoprim (OMP) comprise Romet 30®, a common antibiotic used in farming channel catfish, and there are concerns regarding their effect on microbial ecosystems. To date the fate of these compounds released into surface waters from aquaculture operations is

relatively unknown. The photochemical transformation of SDM and OMP were studied in the presence of dissolved organic matter (DOM) derived from an aquaculture pond and an adjacent stream. We observed differences in the major pathways of analyte photodegradation depending on DOM source. SDM showed a much greater photosensitization in the presence aquaculture DOM samples relative to the stream DOM. The hydroxyl radical production was only partially responsible for the photodegradation of SDM based upon scavenging studies. Further photoreactions in the absence of oxygen resulted in higher reactivity, which we attribute to excited triplet state DOM. The photofate of ormetoprim was also enhanced by the presence of DOM. Indirect OMP photodegradation is shown to be dependent on hydroxyl radical, and possibly singlet oxygen.

Guyondet, T., Université du Québec à Rimouski, Rimouski, Canada, thomas.guyondet@videotron.ca;
Grant, J., Dalhousie University, Halifax, Canada, jon.grant@dal.ca;
Roy, S., Université du Québec à Rimouski, Rimouski, Canada, suzanne_roy@uqar.qc.ca;
Koutitonsky, V. G., Université du Québec à Rimouski, Rimouski, Canada, vgk@uqar.qc.ca;
Tita, G., Université du Québec à Rimouski, Rimouski, Canada, guglielmo_tita@uqar.qc.ca;
Archambault, P., Université du Québec à Rimouski, Rimouski, Canada, philippe_archambault@uqar.qc.ca;
McKindsey, C. W., MPO - Institut Maurice Lamontagne, Mont-Joli, Canada, mckindseyc@dfo-mpo.gc.ca;
Cranford, P. J., DFO - Bedford Institute of Oceanography, Dartmouth, Canada, cranfordp@mar.dfo-mpo.gc.ca

INTEGRATED MODELLING OF THE INTERACTIONS BETWEEN MUSSEL CULTURE AND THE SURROUNDING ECOSYSTEM IN GRANDE-ENTRÉE LAGOON (MAGDALEN ISLANDS, QUEBEC).

In the context of sustainable management of coastal areas, the carrying capacity studies for bivalve aquaculture can not be addressed from the sole production point-of-view anymore. They truly become multidisciplinary studies involving hydrodynamical, ecological, geochemical and physiological aspects. In order to achieve a more complete assessment of the effects of introducing a large biomass of filter feeders in a coastal system, a coupled physical-biogeochemical numerical model was set-up. Based on field data, the three dimensional model reproduces the ecosystem of Grande-Entrée Lagoon including the mussel farm it shelters. Following calibration, the model is used to investigate the major interactions between cultured mussels and their environment. The model can also highlight the differences in ecosystem functioning with and without the mussel farm. A particular attention is paid to changes in overall productivity and pathways of nutrients and energy as they may constitute useful criteria for management decisions.

Hagerthey, S. E., South Florida Water Management District, West Palm Beach, USA, shagerth@sfwmd.gov;
Black, K. S., Partrac Ltd, Glasgow, United Kingdom, kblack@partrac.com;
Wilson, P., Partrac Ltd, Glasgow, United Kingdom, pwilson@partrac.com;
Athey, S., Partrac Ltd, Glasgow, United Kingdom, sathey@partrac.com

TRACING THE UNTRACEABLE: IN SITU MEASUREMENTS OF THE ERODIBILITY AND TRANSPORT OF NEAR NEUTRALLY BUOYANT POM IN A SUBTROPICAL WETLAND

POM transport can impact landscape patterns, ecosystem metabolism, and water quality, but predicting POM erosion, transport, or fate using standard sediment mechanic approaches is made difficult by the unique hydraulic properties and organic nature of POM. This problem extends to the Everglades hydrologic restoration where scientific uncertainty remains because of the inability to predict ecological responses to increased flow. We approached this problem by adapting two common sediment mechanics approaches used in comparatively high energy environments. Using a benthic annular flume, the in situ critical entrainment velocity ranged between 1.5-2.5 cm/sec. Sedimentation occurred via initially rapid (41 g/m2/min) and then slow (1 g/m2/min) floc settling. POM transport was assessed in varying vegetation densities and flow velocities utilizing a novel fluoromagnetic tracer particle hydraulically matched to Everglades POM. Dense vegetation reduced velocities from 2.65 to 0.02 cm/sec which equated to a 7-fold reduction in mass transport. Vertical deployment of magnets through the water column allowed for particle transport assessment in 3-dimensions. These methods offer a relatively simple, yet statistically robust, means to quantify POM transport/fate in a variety of aquatic ecosystems.

Hale, M. S., University of Portsmouth, Portsmouth, United Kingdom, michelle.hale@port.ac.uk;
Rivkin, R. B., Memorial University of Newfoundland, St. John's, Canada, rrivkin@mun.ca;
Li, W. K., Department of Fisheries and Oceans Canada, Bedford, Canada, LiB@mar.dfo-mpo.gc.ca;
Fileman, E., Plymouth Marine Laboratory, Plymouth, United Kingdom, ese@pml.ac.uk;
Tarran, G. A., Plymouth Marine Laboratory, Plymouth, United Kingdom, gat@pml.ac.uk

MERIDIONAL PATTERNS OF MICROZOOPLANKTON GRAZING PREFERENCES IN CONTRASTING BIOGEOCHEMICAL PROVINCES OF THE TEMPERATE AND SUB-TROPICAL ATLANTIC OCEAN

Microzooplankton play an important role in controlling the abundance and biomass of bacteria, pico- and nanophytoplankton. We quantified microzooplankton bacterivory and herbivory in several distinct biogeochemical provinces in the temperate and sub-tropical Atlantic, including equatorial regions impacted by Saharan dust deposition; the oligotrophic North and South Atlantic Gyral Provinces; and higher latitude, temperate biomes, representing a wide range of temperature and nutrient conditions and food web structures. Grazing losses of heterotrophic bacteria and pico- and nanophytoplankton were determined by a modified dilution assay. The grazing impact on microbial prey was estimated for each prey type by computing the percentage of potential production and standing stock ingested per day. Grazing losses of each group ranged from 0 to 1.2 /d, and grazing preferences differed between and within different biogeochemical provinces. There was a close balance between grazing and growth rates in the sub-tropical Atlantic. Thus, microzooplankton played a crucial role in determining the fate of microbial production and influenced the recycling of carbon within the surface layer.

Hall, E. K., University of Vienna, Vienna, Austria, ed.hall@univie.ac.at;
Stets, E. G., US Geological Survey, Boulder, USA, estets@usgs.gov;
Amado, A. M., URFJ, Rio de Janeiro, Brazil, amado@biologia.urfj.br;
Cotner, J. B., University of Minnesota, Saint Paul, USA, cotne002@umn.edu

RESPIRATION IN TEMPERATE LAKES: ENVIRONMENTAL DRIVERS AND ECOSYSTEM SIZE

We evaluated community respiration (CR) in 58 lakes and bacterial respiration (BR) in 19 lakes in the North Central U.S.A. Respiration was measured one time at one location in the mixed layer of each of 57 lakes, (18 lakes for BR), and on 18 occasions in Lake Superior, for multiple locations and dates. For the entire dataset, approximately 70 percent of the variation in CR could be explained using the two most significant predictors, chlorophyll a and temperature. Similarly, approximately 80 percent of the variation in BR could be explained using the two most significant predictors, temperature and total dissolved phosphorus. For certain environmental predictors Lake Superior represents an endpoint of the trend represented in the 57 smaller lakes while for other predictors it represents an outlier. We compare and discuss the differences in controls on CR and BR and discuss the implications of these differences. We also use the range of aquatic ecosystem size in our dataset to discuss the influence of watershed area and lake area on the relationship between relevant environmental variables and these biogeochemically important metabolic rates.

Hambright, K. D., University of Oklahoma, Norman, USA, dhambright@ou.edu;
Miller, C. J., University of Oklahoma, Norman, USA, Cmiller4462@ou.edu

PLANKTON ECOLOGY IN THE LAST QUARTER CENTURY: HAVE DAPHNIA LED US ASTRAY?

At the time of the last St. John's ASLO meeting, most plankton ecologists had become appreciative of the dramatic effects of planktivorous fish on lake food webs, some began focusing efforts further up the food web on piscivorous fish, and others had begun moving down the food chain,

focusing on microbes and microbial consumers. Many plankton ecologists, however, continued to focus on Daphnia. Even those of us who ventured up or down the food web still invoked Daphnia to explain experimental results. But, has this emphasis on Daphnia been justified? There appears to be a gap in our understanding of food web function and biogeochemical cycling and how Daphnia may be involved in those processes. Theory, modeling, and experimental evidence suggest that many effects attributed to Daphnia are more likely the effects of microbial consumers, although changes in whose populations may be controlled by Daphnia. The major implication of this slightly different view of Daphnia's role in ecosystem functioning is that we may have been slow to fully comprehend the roles of microbial grazers, bacteria, and detrital resources in freshwater lakes.

Hamelin, S., Universite du Quebec a Montreal, Montreal, Canada, melosira@hotmail.com;
Planas, D., Universite du Quebec a Montreal, Montreal, Canada, planas.dolores@uqam.ca;
Amyot, M., Universite de Montreal, Montreal, Canada, m.amyot@umontreal.ca;
Barkay, T., Rutgers University, New Brunswick, USA;
Wang, Y., Rutgers University, Montreal, Canada

METHYLMERCURY PRODUCTION IN THE LITTORAL ZONE OF THE ST. LAWRENCE RIVER: WHO IS RESPONSIBLE?

Wetlands and littoral zone start to be considered as important mercury methylation sites and as sources of mercury to the food webs. Our objective was to verify the importance of epiphytic biofilms growing on aquatic plants in net methylmercury production and also to characterize the active microbes involved in the process. Epiphytic biofilms were sampled in Lake St.Pierre (Qc, Canada) in July and August in order to: 1) determine mercury (THg) accumulation and net methylmercury (MeHg) production; 2) find out which groups of microorganisms contribute to net MeHg production by using specific metabolic inhibitors and sequencing of RNA 16S. Our main findings were: 1) High [THg] and [MeHg] in epiphytes were found, ranging from 30 to 207 ng/gDW and from 0,5 to 22 ng/gDW, respectively. 2) Net MeHg production was high and varied from 1,06 to 7,87 ng/g DWepiphytes/day. 3) Other microorganisms than SRB are the principal Hg methylators in our biofilms.

Hamoutene, D., DFO, St John's, Canada, Hamoutened@dfo-mpo.gc.ca;
Puestow, T., C-CORE, St John's, Canada, tpuestow@mun.ca;
Miller-Banoub, J., DFO, St John's, Canada, judith.banoub@dfo-mpo.gc.ca;
Wareham, V., DFO, St John's, Canada, warehamv@dfo-mpo.gc.ca

MAIN LIPID CLASSES IN SOME SPECIES OF DEEP-SEA CORALS IN THE NEWFOUNDLAND AND LABRADOR REGION (NORTHWEST ATLANTIC OCEAN)

Lipid percentages of 81 deep-sea corals were measured and the presence of 6 major classes, including sterols (STEROLS), free fatty acids (FFA), triacylglycerols (TG), monoalkyldiacyl glycerol (MADAG), wax (WAX), and sterol esters (SE), was assessed. Results show that deep-sea corals have fewer lipids than their shallow water counterparts. Decision-tree analysis revealed a link between coral groups and total lipid percentages, showing that species within a same group had similar lipid amounts. Depth did not seem to impact the total lipid percentages suggesting that deep-sea corals adapt to the differential access to food by changing the proportion of lipid classes while maintaining equivalent lipid levels. Similarly to their shallow water counterparts, deep corals store energy as neutral lipids (wax esters and triacylglycerols), with the difference that a high proportion of a Ã¢â‚Ëœprimitive' compound (MADAG) is present; these compounds being less rich in energy than TG. Depth trends were found for FFA, TG and SE with an increase after 800m suggesting a potential need for storage due to decreased food availability. A subsequent decrease after 1000m is observed for FFA and TG which is a surprising result as increased storage is expected when food sources are sparse.

Hampton, S. E., National Center for Ecological Analysis and Synthesis, Santa Barbara, USA, hampton@nceas.ucsb.edu;
Izmest'eva, L. R., Irkutsk State University, Irkutsk, Russian Federation, ismest@bio.isu.runnet.ru;
Moore, M. V., Wellesley College, Wellesley, USA, mmoore@wellesley.edu;
Katz, S. L., Channel Islands National Marine Sanctuary, Santa Barbara, USA, steve.katz@noaa.gov

LONG-TERM WARMING AND FOOD WEB REORGANIZATION IN THE WORLD'S LARGEST FRESHWATER LAKE - LAKE BAIKAL, SIBERIA

Climate change presents complex and uncertain future scenarios in subarctic Lake Baikal, the world's most ancient, voluminous, and biologically diverse lake. Using 60 yr of biweekly data collected by 3 generations of a single family of Siberian limnologists, we used multivariate autoregressive (MAR) modeling to explore food web interactions, as well as biotic relationships with temperature and climate indices that can proxy for other climatic variables. The MAR results provide interpretation for long-term trends evident in the data. Warming was strongly positively correlated with increases in the cryptophytes, chrysophytes and cyanobacteria but not with diatoms, which have historically dominated algal blooms. Temperature was very strongly correlated with cladoceran increases in recent decades, a change that is particularly important because, unlike copepods, MARs suggested that cladocerans depressed algal taxa without noticeable "fertilization" effects for the algae. Warming has been accompanied by reduction in ice cover and increasing depth of the epilimnion, both further altering the physical environment in which Lake Baikal's endemic cold stenotherms interact.

Hansen , P. J., Marine Biological Laboratory, University of Copenhagen, Helsingør, Denmark, pjhansen@bio.ku.dk

HIGH PH IN COASTAL WATERS: IMPLICATIONS FOR FOOD WEBS STRUCTURE AND PRODUCTION

This paper summarizes the current evidence on the occurrences of high pH in coastal waters and the direct and indirect effects of pH on marine heterotrophic and phototrophic protists. Traditionally, pH has been considered constant around 8 in marine waters due to the high buffer capacity found here. However, recent papers have indicated that pH may increase to above 9 in coastal waters. Such high pH values are found in very shallow waters (<1 m depth) or during algal blooms. While the diurnal changes in pH are huge (>1.5 pH units) in the very shallow waters, pH is far more stable in waters having a pycnocline and diurnal changes rarely exceed 0.2 pH units. Some heterotrophic protists are very sensitive to even slightly elevated pH (pH 8.5), while others are unaffected by pH 10. Phototrophic protists are also mainly affected directly by the high pH itself, while inorganic carbon limitation only plays a minor role at very high pH and low DIC concentrations. Thus, high pH may indeed affect the production and food web structure in coastal waters.

Hanson, A. M., University of Wisconsin-Milwaukee, Milwaukee, USA, hanson2@uwm.edu;
Berges, J. A., University of Wisconsin-Milwaukee, Milwaukee, USA, berges@uwm.edu;
Young, E. B., University of Wisconsin-Milwaukee, Milwaukee, USA, ebyoung@uwm.edu

EXAMINING THE FRESHWATER VIRUS COMMUNITY IN LAKE MICHIGAN AND A EUTROPHIC POND

Viruses are ubiquitous in aquatic ecosystems and important in nutrient cycling through lysis of phytoplankton and bacteria. The role of viral lysis in carbon cycling is well established in marine systems, but less is known for freshwaters. Using epifluorescense and transmission electron microscopy we characterized viruses in surface water from nearshore (<100 m from shore and <10 m deep) and offshore (>2 km from shore and >10 m deep) Lake Michigan, and an urban pond (4047 m^2 and 1.8 m deep). Viral abundance per mL was highest in the pond ($5.31x10^6$) and lower in Lake Michigan ($1.26x10^6$ and $4.68x10^5$ for nearshore and offshore). Bacterial abundances per mL were lower (pond - $7.82x10^5$; nearshore - $4.67x10^4$; offshore - $2.23x10^4$). 35-63% of viruses had icosahedral heads and tails, suggesting that phages dominate. Viral abundance and diversity in these ecosystems suggests that viruses can contribute to phosphorus cycling. Abundant cyanophages and/or bacteriophages may be especially important in phosphorus release from cells. Quantifying the potential for phosphorus release with viral lysis is needed to clarify the significance of viruses to freshwater phosphorus cycles.

Hansson, L. A., Lund University, Lund, Sweden, lars-anders.hansson@limnol.lu.se;
Hylander, S., Lund univeristy, Lund, Sweden

SIZE- STRUCTURED RISK-ASSESSMENT REGULATES DIEL VERTICAL MIGRATION IN DAPHNIA

Diel vertical migration (DVM) among crustacean zooplankton is one of the more fascinating phenomena in oceans and freshwaters. Although this phenomenon has intrigued scientists for more than a century, the knowledge of causes, mechanisms and the adaptive significance of these migrations is surprisingly scarce. Although both predator and UV avoidance would potentially lead to DVM either separately or together, the different threats may invoke different responses. We show here that Daphnia longispina, is able to assess the UV threat at a very fine tuned scale and behaviorally adjust their depth distribution accordingly. However, predation risk induces a size-structured depth separation among Daphnia, such that small individuals, which we show are less vulnerable to predation than larger ones, make a risk-assessment and continue feeding in surface waters during day, offering a competitive release from down-migrating larger animals. The ability to make different assessments based on selfÃ¢â‚¬â„¢awareness of e.g. size is generally associated with more complex animals than invertebrates, although the evolutionary selection pressure and potential fitness gains for such adaptations are considerable.

Harvey, J. W., U.S. Geological Survey, Reston, USA, jwharvey@usgs.gov

MEASURING HYPORHEIC FLOW AND BIOGEOCHEMICAL REACTION RATES AT FINE DEPTH RESOLUTION BENEATH THE SEDIMENT INTERFACE OF FLOWING AQUATIC ECOSYSTEMS

Detailed measurements of mass transfer and biogeochemical reactions near the sediment interface have been made most frequently in the simplified conditions of laboratory flumes. At USGS we are increasingly developing appropriate sampling technologies for field use. An example is the USGS MINIPOINT sampler, which we use to quantify in situ rates of hyporheic flow and biogeochemical reactions rates at relatively fine depth resolution (1.5 cm) beneath the sediment interface. Our approaches are performing well in widely varying hydrologic and sediment conditions ranging in surface water flow velocities (0.03 to 30 cm s^{-1}), grain type (silt, sand, gravel, and organic sediment), median grain size (<0.06 to 2 mm), sediment porosity (0.2 to 0.9), organic content of sediment (0.2 to 80%), hydraulic conductivity of sediment (10^{-5} to 10^{-2} cm s^{-1}), and groundwater specific discharge (undetectable to 10^{-3} cm s^{-1}). Measurements of oxygen reduction, denitrification, and manganese oxidation across these widely varying hydrologic and sediment conditions are suggestive of common patterns in the environmental and biogeochemical factors controlling the depth of flux, turnover time, and significance of reactions in benthic environments to downstream water chemistry.

Hatcher, B. G., Cape Breton University, Sydney, Nova Scotia, Canada, Bruce_Hatcher@cbu.ca;
Yang, B., Dalhousie University, Halifax, Nova Scotia, Canada, Bo.Yang@phys.ocean.dal.ca;
Beresford, R., Cape Breton University, Sydney, Nova Scotia, Canada, Rod_Beresford@cbu.ca;
Sheng, J., Dalhousie University, Halifax, Nova Scotia, Canada, sheng@dal.ca

FORENSIC MODELLING OF MARINE INVASIONS OF AN INLAND SEA USING ECOLOGICAL CONNECTIVITY ANALYSIS

Range expansions of marine species are associated with natural and anthropogenic environmental change, as well as introductions of colonists via human transports. It is important to understand the epidemiology of ecological invasions when deciding whether to attempt costly interventions. We are exploring the use of marine ecological connectivity modelling to support such decisions. Three marine species have appeared in the Bras d'Or estuary in Cape Breton during the past decade. The vectors are unknown, but the crab (Carcinus maenas) is thought to have arrived by larval transport from populations to the southwest, the oyster parasite (Haplosporidium nelsoni) is thought to have been introduced in ship ballast water, and the oyster pathogen (Malpeque disease) is thought to have arrived in transferred oysters. The distribution of these species throughout the 1200km2 estuary is patchy in space-time, with both environmental and recruitment limitations invoked but unproven. We use an advanced 3D numerical model of hydrodynamic connectivity and hydrology overlain on a benthic habitat map to predict the pattern and pace of invasion and post invasion dispersion through a heterogeneous ecosystem of variable water exchange rates to test hypotheses about the mechanisms of arrival and spread of these species through the estuary. The results of this forensic ecological modelling analysis are amenable to validation by population genetic methods.

Haustein, M. D., University of Minnesota, St. Paul, USA, haus0126@umn.edu;
Sterner, R. W., University of Minnesota, St. Paul, USA, stern007@umn.edu

LAKE WATERSHED URBANIZATION: EFFECTS OF IMPERVIOUS SURFACE LAND COVER ON LAKE CHEMISTRY AND PHYTOPLANKTON NUTRIENT LIMITATION

Impervious surfaces within urbanized watersheds fundamentally alter the hydrologic connections between precipitation, groundwater, and surface water. Therefore, the prevalence of this land cover type may be a factor influencing nutrient loading. Lake chemistry and phytoplankton nutrient limitation were assessed during the summer of 2007 in 17 lakes spanning a gradient of watershed imperviousness. Impervious surface land cover was estimated for a buffer distance corresponding to three times the lake radius. Phytoplankton nutrient limitation was assessed using total chlorophyll a from a factorial dilution bioassay design with nitrogen, phosphorus, and silica enrichments in triplicate. Total dissolved nitrogen and dissolved organic carbon displayed a significant negative relationship with watershed imperviousness. In spite of overall reduced levels of some chemical constituents with increased imperviousness, growth rate response to nutrient spikes was greatest at low impervious surface percentage. Phytoplankton growth rates typically responded most strongly to the addition of both nitrogen and phosphorus regardless of watershed imperviousness, indicating co-limitation of nitrogen and phosphorus. These results suggest watershed imperviousness may fundamentally alter the nutrient stoichiometry and algal community response to nutrient enrichment within urbanized lakes.

Havel, J. E., Missouri State University, Springfield, USA, johnhavel@missouristate.edu;
Dickerson, K. D., Missouri State University, Springfield, USA, kdd628@yahoo.com;
Medley, K. A., University of Central Florida, Orlando, USA, kmedley@mail.ucf.edu;
Wolf, J. C., Missouri State University, Springfield, USA, wolf64@missouristate.edu

ZOOPLANKTON COMPOSITION AND ABUNDANCE IN A LARGE RIVER: THE ROLES OF DAMS AND TRIBUTARIES

Zooplankton are common constituents of large rivers, but the sources of their populations are poorly understood. As part of the interdisciplinary Great River Ecosystems project (EPA-EMAP), we explored variation in zooplankton communities in the Missouri River. During 2004-05, collaborators collected fine (20 um) and coarse (63 um) samples from 143 sites, extending over a 2,839 km range (Montana-Missouri). We identified 49 species of cladocerans and 22 species of copepods (macrozooplankton), plus 34 genera of rotifers (microzooplankton). Total zooplankton densities were highly variable among sites (0-2,184 ind./L). Macrozooplankton dominated the inter-reservoir sections of the river and rotifers in the downstream sections. Multivariate analyses (NMDS) revealed strong longitudinal patterns in community structure. Distance from the nearest upstream reservoir explained more of the overall community pattern than any other combination of environmental factors, reflecting an indirect influence of flow and alteration of the river on the zooplankton community. Addition samples in 2006 from tributary and main-channel sites revealed that the flux of individuals is primarily from upstream in the main channel, confirming the role of reservoirs to zooplankton biomass in the Missouri River.

Hayes, P. K., University of Bristol, Bristol, United Kingdom, paul.hayes@bristol.ac.uk

GENOTYPIC AND PHENOTYPIC DIVERSITY IN POPULATIONS OF FILAMENTOUS CYANOBACTERIA

Filamentous cyanobacteria, including members of the genera Planktothrix, Nodularia and Anabaena, are responsible for the formation of some toxic blooms in fresh and brackish waters. Simple observation of samples collected directly from nature, and more detailed physiological and morphological characterisation of clonal isolates, reveal that individuals within these populations differ in their phenotypes. These differences encompass many features including gas vesicle strength, toxicity, cell size and growth rate. Analysis of individual cyanobacterial filaments reveals that natural populations contain many distinct genotypes and that they have an underlying panmictic structure, i.e. there is relatively free exchange of genetic information between lineages. Our aim has been to identify the genes responsible for the observed variation in gas vesicle phenotype and to try and find evidence for selection of particular phenotypic variants driven by the local environment. For example, we would expect that deep mixing would select for strong gas vesicles, but that shallow mixing would encourage dominance of forms with weaker gas vesicles. This talk will summarise the results of our efforts to test these ideas.

Head, E., Dept. of Fisheries, BIO, Dartmouth, Canada, HeadE@mar.dfo-mpo.gc.ca;
Stenvik, E. K., Insitute of Marine Research, Bergen, Norway, erling.stenevik@imr.no;
Melle, W., Insitute of Marine Research, Bergen, Norway, webjoern.melle@imr.no;
Harris, L., Dept. Fishereis and Oceans, BIO, Dartmouth, Canada, HarrisL@mar.dfo-mpo.gc.ca;
Gaard, E., Faroese Fisheries Laboratory, Torshavn, Faroe Islands, eilifg@frs.fo;
Gislason, A., Marine Research Institute, Reykjavik, Iceland, astthor@hafro.is;
Broms, C., Institute of Marine Research, Bergen, Norway, cecilie.broms.aarnes@imr.no;
Propopchuk, I., PINRO, Murmansk, Russian Federation, irene_pr@pinro.ru;
Ellertsen, B., Institute of Marine Research, Bergen, Norway, bjoernar.ellertsen@imr.no;
Gentleman, W., Dalhousie University, Halifax, Canada, wendy.gentleman@dal.ca

A COMPARISON OF EGG PRODUCTION AND EGG MORTALITY FOR CALANUS FINMARCHICUS IN THE LABRADOR AND NORWEGIAN SEAS

Seventy-nine egg production experiments were carried out in the Norwegian Sea basin over an area stretching from 62oN in the south to 73oN in April and May 2003. Fifty-seven egg production experiments were carried out along a section across the Labrador Sea between 55oN and 60oN in May, June or July between 1997 and 2006. In both areas egg production rates were more dependent on food concentration than on ambient temperature and areal egg production rates were higher at stations showing bloom conditions than at stations showing pre-bloom or post-bloom conditions. Maximal egg production rates were higher in the Labrador Sea than in the Norwegian Sea due to the fact that females and their clutch sizes were substantially larger. In the Labrador Sea estimates of areal egg production rates and observations of in situ concentrations of eggs were used to estimate egg mortality, which was found to increase with increasing in situ female abundance and to decrease with increasing phytoplankton concentration.

Heathcote, A. J., Iowa State University, Ames, USA, aheathco@iastate.edu;
Downing, J. A., Iowa State University, Ames, USA, downing@iastate.edu

PALEO-RECONSTRUCTION OF POST-SETTELMENT DEGRADATION OF WATER QAULITY UNDER INTENSIVE AGRICULTURE

Intense agricultural practices have had dramatic effects on natural lakes by drastically increasing rates of nutrient and sediment loading. Concerns involving increasing rates of eutrophication as well as a lack of empirical evidence regarding historical water quality in these systems have generated interest in quantifying ecological changes since European settlement. Diatoms have been used in previous regional studies as paleoindicators of trophic status. We analyzed sediments in four lakes in Northwest Iowa (the most intensively agricultural region in the world) using diatom stratigraphy. Sediment cores from the deepest basin of all four lakes were analyzed for diatom remains and loss on ignition. Three of the cores were dated using ^{210}Pb. Total phosphorous levels were reconstructed by developing a transfer function from an existing regional species assemblage. Preliminary results suggest the arrival of Europeans to the region, and the effects of their subsequent land alteration are reflected in the sediment record by an increasing abundance of diatom species found within eutrophic ecosystems and a sharp rise in percent inorganic matter.

Hecky, B., Department of Biology, DeLuth, USA, rehecky@sciborg.uwaterloo.ca;
Stone, M., University of Waterloo, School of Planning and Department of Biology, Waterloo, ON, Canada, mstone@fes.uwaterloo.ca;
Upsdell, B., Environment Canada, Burlington, ON, Canada

CARBON AND NITROGEN COMPOSITION OF SUSPENDED PARTICULATE MATTER IN THE NEARSHORE ZONE OF LAKE ERIE AND ITS OUTFLOW: IMPLICATIONS FOR THE NEARSHORE SHUNT MODEL

The Nearshore Shunt model describes how dreissenids have reengineered the nutrient cycling in Lake Erie, causing the nearshore benthic community to intercept, retain and recycle greater quantities of nutrients thus changing the composition of particulate matter exported from the nearshore environment. This paper examines the concentrations and isotopic composition of carbon and nitrogen (POC and PN concentrations, POC/PN mass ratio, δ^{13}C and δ^{15}N) associated with suspended particulate matter in the nearshore water, offshore pelagic and discharge (lake outflow) compartments of the nearshore shunt model in lake Erie. The ranges and spatial variability in the POC and PN concentrations, POC/PN mass ratio, δ^{13}C and δ^{15}N OC concentrations in suspended particulate matter at the study sites are discussed as a function of source, water depth, location and particle processing. The data indicate that contributions from catchment sources to nutrients retained by the nearshore shunt are minor compared to contributions from phytoplankton. The data also suggest that dreissenid mussels may be recycling nitrogen back into the water column.

Heerklosss, R., University of Rostock, Rostock, Germany, reinhard.heerkloss@uni-rostock.de;
Beninca, E., Universty of Amsterdam, Amsterdam, Netherlands, <ebeninca@science.uva.nl>;
Huisman, J., Universty of Amsterdam, Amsterdam, Netherlands, jefhuism@science.uva.nl

HOW TO PERFORM CHAOS EXPERIMENTS ON FOOD WEB DYNAMICS?

Theoretical ecologists already argued in the 1970s that populations might fluctuate in an unpredictable manner. However, only few scientists believed in this idea derived form the chaos theory. The common perception was that species fluctuations result from changes in external conditions. This classic perspective has been radically changed by new research of Beninca et al. published in Nature 451, 822 Ã*f*Æ'¢Ã¢Ã¢â‚¬Å¡Ã¢Ã¢â€šÂÂ…â€œ 826 (2008). The core of their work consists of a laboratory experiment in which a plankton community isolated from the Baltic Sea was studied for more than 8 years. The experiment was maintained under constant light and temperature conditions by Reinhard Heerkloss, who detected the development of the different plankton species twice a week. The food web never settled at equilibrium and the species abundances continued to vary wildly. The statistical analysis revealed that the fluctuations were caused by the species themselves; competition and predation generated a dynamic food web in which none of the species succeeded in getting the upper hand. Advanced mathematical techniques proved the indisputable presence of chaos in this food web. The contribution will describe the methodological details of this experiment and discuss some tricks how to keep a complex plankton community in enclosures alive for many years.

Heinze, A. W., Temple University, Philadelphia, USA, aheinze@temple.edu;
Sanders, R. W., Temple University, Philadelphia, USA, robert.sanders@temple.edu

SEASONAL AND VERTICAL DISTRIBUTION OF THE MIXOTROPHIC GENUS *DINOBRYON* IN A MESOTROPHIC LAKE IN NORTHEASTERN PENNSYLVANIA

Mixotrophic organisms utilize both autotrophic and heterotrophic nutritional modes and are increasingly recognized as important contributors to aquatic food webs. *Dinobryon*, a widespread freshwater

genus of mixotrophs had dramatic seasonal and annual variation in Lake Lacawac, a mesotrophic kettle lake in northeastern Pennsylvania. Although light is required for population growth in *Dinobryon*, it does not appear to control vertical distribution patterns observed during this 3-year survey. One year, the maximum annual abundance was observed close to the surface, while the following year the maximum annual abundance occurred at 4 m where light levels were <2% of surface irradiance. The depth of maximum *Dinobryon* abundance overlapped with an oxygen maximum at 4 m, which strongly suggests effective photosynthesis at the relatively low light. Analysis of the distribution data suggests that temperature may be a primary driver of *Dinobryon* spp. distribution in the water column of this lake. Although annual variability in absolute abundance was high, peak *Dinobryon* biomass always occurred within a narrow range of temperature.

Henderiks, J., Stockholm University, Dept. of Geology and Geochemistry, Stockholm, Sweden, jorijntje.henderiks@geo.su.se

COCCOLITHOPHORE SIZE EVOLUTION

Coccolithophores, a group of calcifying unicellular algae, are important oceanic primary producers and supply the bulk of calcium carbonate (in the form of coccoliths) to the seafloor. Hence, they play an important role in the global carbon cycle, representing natural feedbacks in the climate system. A primary interest to investigate coccolithophore size evolution is to determine whether, and how, cell size is affected by climatic and oceanographic change Ã¢â‚â€œ and how major shifts in coccolith and cell size distributions have in turn affected the biogeochemical cycling of carbon over geologic history. Coccolithophore cell size Ã¢â‚â€œ estimated from statistically robust biometry of fossil coccoliths Ã¢â‚â€œ is likely influenced by a variety of selection pressures, with specific factors, such as resource availability and climatic change, determining trends over time. In addition, different selective forcings operate on ecologic to evolutionary time-scales. Therefore, it is crucial to separate regional diversity imprints and ecologic responses at different deep-sea sites from global evolutionary patterns. The potential causes for distinct latitudinal contrasts in coccolithophore size, evident since the late Miocene, will be discussed.

Herborg, L. M., Fisheries and Oceans, Canada, Nanaimo, Canada, herborgL@pac.dfo-mpo.gc.ca;
Therriault, T. W., Fisheries and Oceans, Canada, Nanaimo, Canada;
Foreman, M. G., Fisheries and Oceans, Canada, Sydney, Canada

PAST AND FUTURE DISPERSAL OF THE EUROPEAN GREEN CRAB ALONG BRITISH COLUMBIA'S COAST

The European green crab, Carcinus maenas, is a global invader with documented ecological impacts. Since the species recent arrival in British Columbia, it has reached high densities along the relatively pristine west coast of Vancouver Island. We conducted a combined analysis of dispersal by natural larval drift and human aided transport to identify past and future introduction pathways. While natural dispersal is a likely pathway for the initial introduction to the west coast of Vancouver Island, this pathway makes natural spread into the waters between Vancouver Island and the mainland from current populations less likely. There, human transport vectors associated with shipping and aquaculture activities can pose a greater risk. We also conducted environmental niche modeling based on a variety of introduced and native distributions to identify the range of suitable habitat along CanadaÃƒÆ'Ã¢Ã¢â‚Å¡Ã¢Ã¢â‚Å¾Ã¢Ã¢â‚Å¾¢s West Coast.

Herrman, K. S., University of Nebraska, Lincoln, USA, kherrman2@unl.edu;
Bouchard, V., The Ohio State University, Columbus, USA, bouchard.8@osu.edu

AN ASSESSMENT OF NITROGEN REMOVAL FROM HEADWATER STREAMS IN AN AGRICULTURAL WATERSHED, NORTHEAST OHIO, USA

The objective of this project was to assess in-stream nitrogen removal capacity in a fragmented, agricultural landscape and to compare removal capacities in streams with agricultural/urban and forested riparian land use. We also identified what stream characteristics control nitrogen removal in these systems. We examined paired reaches (one agricultural/urban and one forested reach) along five headwater streams in an agricultural watershed (Upper Sugar Creek Watershed) in Northeast Ohio, USA. Although denitrification rates were high (<0.1 Ã¢â‚â€œ 17.2 mg N m^{-2} hr^{-1}), annual nitrogen removal in our sites was low. Between the ag/urban and forested reaches removal rates were similar in terms of loss rate (ANOVA; $F_{1,59}$=0.236, p=0.629) and uptake velocity (ANOVA; $F_{1,59}$=0.094, p=0.764). Using a redundancy analysis we identified temperature, in-stream nitrate concentration, and relative transient storage as stream characteristics that control nitrogen removal. Further analysis suggests that these headwater streams were controlled by and saturated with nitrate. Overall, we concluded that in this fragmented, agricultural watershed in-stream nitrogen removal was low and that riparian land use had no affect on this process, most likely a result of nitrate saturation.

Hershey, A. E., University of North Carolina Greensboro, Greensboro, USA, aehershe@uncg.edu;
Northington, R. M., University of North Carolina Greensboro, Greensboro, USA, rmnorthi@uncg.edu;
Bostick, M. C., University of North Carolina Greensboro, Greensboro, USA, mcbostic@uncg.edu;
Lofton, D. D., University of North Carolina Chapel Hill, Chapel Hill, USA, ddlofton@unc.edu;
Whalen, S. C., University of North Carolina Chapel Hill, Chapel Hill, USA, steve_whalen@unc.edu

PRODUCTION AND UTILIZATION OF METHANE-DERIVED CARBON IN ARCTIC LAKES: A LABORATORY EXPERIMENT AND FIELD COMPARATIVE STUDIES

CH4 is produced in lake sediments and CH4-derived carbon is a potential carbon source for consumers. However, there has been little study of the DOC sources for CH4 production or of the importance of CH4-derived carbon in consumer diets. In a laboratory experiment using intact sediment cores from a small arctic lake, we evaluated carbon sources for CH4 production, and assessed CH4 utilization by Chironomus. We also and analyzed del 13C of Chironomus from regional lakes. Cores were incubated with ambient DOC, 13C-labeled algal DOC, or 13C-labeled acetate. Algal DOC was preferentially metabolized to CO2 and did not stimulate CH4 production. Acetate stimulated CH4 production and both methyl and carboxyl groups were converted to CH4, demonstrating that both acetoclastic and hydrogenotrophic methanogenesis pathways were important. Chironomus acquired 13C from all labeled sources. Chironomus from regional lakes were 13C-depleted in a manner more consistent with utilization of CH4-derived C than algal C. These studies illustrate that CH4 processes are complex, and are important for supporting production of higher trophic levels in arctic lakes.

Hicks, A. L., Trent University, Peterborough, Canada, andreahicks2@trentu.ca;
Frost, P. C., Trent University, Peterborough, Canada, paulfrost@trentu.ca

WHERE HAVE ALL THE NUTRIENTS GONE? STORAGE AND FLOW OF NUTRIENTS IN THE LITTORAL ZONE OF COTTAGE DEVELOPED LAKES.

Aquatic vegetation is an important component of littoral zones as it provides sediment stabilization, habitat structure, and nutrient storage. Lakeshore cottages alter the biomass and composition of aquatic macrophytes which could potentially alter the quantity and ratios of elements in littoral foodwebs. Our study examined how cottage development influences the storage and flow of nutrients in littoral foodwebs. Within the Kawartha region, Ontario, Canada, we sampled 12 lakes which represent a gradient of cottage development 0 to 23 cottages/km. We assessed the C, N, P pools and their ratios in water, sediment, seston, zooplankton, and macrophytes. Water chemistry showed little variation among lakes and was typical of nutrient poor shield lakes. Seston showed considerable among lake variation, with higher C:N, C:P, and N:P ratios on the highly developed lakes. Macrophyte C:N values also showed variation; interspecific values ranged between 13.24-35.01, intraspecific values ranged an average of 9.89 ± 4.51. Our preliminary results show that the altered macrophyte communities of cottage developed lakes could potentially impact the balance of nutrients in other components of littoral systems.

Hill, K. A., University of St Andrews, St Andrews, United Kingdom, kajh@st-andrews.ac.uk;
Smith, V. J., University of St Andrews, St Andrews, United Kingdom, vjs1@st-andrews.ac.uk;
Brierley, A. S., University of St Andrews, St Andrews, United Kingdom, andrew.brierley@st-andrews.ac.uk

AN INVESTIGATION INTO THE MOLECULAR BASIS OF DIAPAUSE IN THE MARINE COPEPOD *CALANUS FINMARCHICUS*

The marine copepod *Calanus finmarchicus* is a vital component of the pelagic food web in the open North Atlantic and marginal seas. Its life cycle involves a diapause phase, which often occurs at great depth (>500m). The cues for diapause entry and exit remain unknown, as do the associated cellular and molecular mechanisms. However, the lipid-based crustacean hormone methyl farnesoate (MF) has been proposed to act as a possible cellular cue for diapause induction. A potential receptor for MF is the retinoid X receptor (RXR), a nuclear hormone receptor that has been identified in the freshwater Cladoceran *Daphnia magna* (Crustacea). Using material from Loch Etive, a Scottish Sea Loch, and the open North Atlantic, we have isolated RXR mRNA from *C. finmarchicus*. We are now testing for possible association of RXR with diapause induction by measuring expression of the receptor through key life events such as diapause.

Hill, P. S., Dalhousie University, Halifax, Canada, paul.hill@dal.ca;
Milligan, T. G., Fisheries and Oceans Canada, Dartmouth, Canada, milligant@mar.dfo-mpo.gc.ca;
Boss, E., University of Maine, Orono, USA, emmanuel.boss@maine.edu

ENVIRONMENTAL CONTROLS ON SIZE AND MASS FRACTION OF FLOCS IN A COASTAL BOTTOM BOUNDARY LAYER

The transport of organic matter in natural waters depends on the size and suspended mass fraction of flocs, which are agglomerations of organic and inorganic particles. Prevailing theory links floc size and floc fraction primarily to turbulence and particle concentration. Hypothetically, the size and mass fraction of flocs should decrease as turbulence increases, and they should increase as suspended particle concentration increases. To test these hypotheses, we examined floc properties in a coastal bottom boundary layer south of Martha's Vineyard, Massachusetts. For three weeks in September, 2005, we monitored the size distribution of particles ranging in diameter from micrometers to centimeters. At the same time, we measured waves and currents, which allowed us to estimate boundary shear stress, and the optical properties of the suspension, which allowed us to characterize particle concentration and composition. Results show that the maximum values and ranges of floc size and floc fraction decrease with increasing shear stress and particle concentration. These observations are consistent with the hypothesized role of turbulence in limiting floc size and floc packaging, but they are inconsistent with the hypothesized role of particle concentration. Instead, particle composition apparently plays a major role in determining floc size and floc mass fraction, with the presence of organic material encouraging the growth of large and abundant flocs.

Hilpert, M., Johns Hopkins University/Department of Geography and Environmental Engineering, Baltimore, USA, markus_hilpert@jhu.edu;
Liu, E., Johns Hopkins University/Department of Geography and Environmental Engineering, Baltimore, USA, elizabeth.liu@jhu.edu;
Thompson, K. E., Louisiana State University/Department of Chemical Engineering, Baton Rouge, USA, karsten@lsu.edu;
Willson, C. S., Louisiana State University/Department of Civil & Environmental Engineering, Baton Rouge, USA, cwillson@lsu.edu;
Reed, A. H., Naval Research Lab/Seafloor Sciences Branch, Stennis, MS, USA, allen.reed@nrlssc.navy.mil

PORE-SCALE MODELING OF DRAINAGE IN MARINE SANDS

The flow and distribution of water during drainage in nearshore systems has an impact on water table fluctuations, acoustics, and geomechanical properties. Pore-scale geometry and topology, which can be determined from high-resolution X-ray computed tomography (XCT) images, play a major role in the drainage. Results from pore-scale drainage modeling will be presented and compared to mm- and cm-scale experimental drainage data. Good agreement is found between the experimental and simulated drainage curves on both the pore- and REV-scale. Results from a one-dimensional multiphase flow model, based on Richards' equation, are used to show the spatial and temporal changes in water flow and distribution. These results are then related to the pore-level imaging and modeling to highlight impacts on some of the nearshore characteristics listed above.

Hobbs, W. O., Dept. of Earth & Atmospheric Sciences, University of Alberta, Edmonton, Canada, whobbs@ualberta.ca;
Wolfe, A. P., Dept. of Earth & Atmospheric Sciences, University of Alberta, Edmonton, Canada;
Telford, R. J., Bjerknes Centre for Climate Research, Bergen, Norway;
Birks, J. B., Botanical Institute, University of Bergen, Bergen, Norway;
Saros, J. E., School of Biology and Ecology, University of Maine, Orono, USA;
Hazewinkel, R. O., Alberta Environment, Edmonton, Canada;
Perren, B. B., Dept. of Geology, University of Toronto, Toronto, Canada;
Saulnier-Talbot, E., Centre dâ€™études nordiques et Département de géographie, Université Laval, Québec, Canada

QUANTIFYING LIMNOLOGICAL CHANGE IN THE ANTHROPOCENE: A COMPARISON OF HIGH-ALTITUDE AND HIGH-LATITUDE ECOSYSTEMS

Alpine and arctic lakes have been identified as sentinel ecosystems with respect to climate change impacts. Here we present a synthesis of 52 lake-sediment diatom records from North America and west Greenland, detailing the amount of species turnover (β-diversity) over the last ~450 years. In both arctic (n=20) and alpine lakes (n=15) β-diversity during the 20th century was significantly greater than the previous 350 years. Spatially, our analysis shows that species turnover increases with both latitude north and altitude. We consider both physical (lake area, catchment area, and maximum lake depth) and environmental (lake water NO_3^-, modeled atmospheric NO_3^-, winter air temperature, summer air temperature, pH, and conductivity) limnological characteristics as potential drivers of recent increases of diatom β-diversity. No significant linear relationships are apparent between β-diversity and any one limnological parameter, implying that the ecological responses are complex and potentially synchronous. However, regional temperature deviations during the 20th century correspond to the latitudinal trend of diatom β-diversity in arctic lakes, while a southward increase of anthropogenic NO_3^- deposition suggests additional impacts on mid-latitude alpine lakes.

Hoch, M. P., Penn State York, York, USA, mph13@psu.edu;
Knapp, K. A., Penn State York, York, USA, kgk1@psu.edu

CONTRASTS IN SUSPENDED SEDIMENT AND NUTRIENT LOADS BETWEEN TWO PIEDMONT WATERSHEDS WITH AGGRESSIVE EROSION OF LEGACY SEDIMENTS

Codorus Creek Watershed in the eastern piedmont of Pennsylvania, USA, has deeply incised stream channels with rapidly eroding vertical banks of legacy and ancient-wetland sediments. Discharge, suspended sediment (SS), total nitrogen (TN), and total phosphorus (TP) were measured at baseflow and during storm-events and used to calculate loading rates on the East Branch Codorus Creek (EBCC) and South Branch Codorus Creek (SBCC) from March 2003 to August 2006. Precipitation amount was a strong predictor of SS, TN, and TP loading and was used to model annual loads from 2002 to 2006. Storm-events were responsible for <10% TN load, 30%-60% TP load, and >80% SS load. TP during storms was mostly sediment bound, but TN load was mostly dissolved nitrate. Mean annual SS loads were greater on EBCC than SBCC, despite 50% greater discharge at SBCC. SS loading less than stream bank erosion suggests in-stream storage. Differences in land use, topography, and best management practices (including channel restoration) help explain the contrast in mass transport between these adjacent watersheds

Hodgson, J. R., St. Norbert College, De Pere, USA, jim.hodgson@snc.edu;
Rick, A. R., St. Norbert College, De Pere, USA, allison.rick@snc.edu;
Weidel, B., University of Wisconsin-Madison, Madison, USA, weidel@wisc.edu;
Hodgson, C. J., St. Norbert College, De Pere, USA, carol.hodgson@snc.edu

DIET SPECIALIZATION IN LARGEMOUTH BASS

The ubiquitous phantom midge *Chaoborus* has a highly documented susceptibility to predation from obligate planktivores in north temperate lakes. We examined predation on midges by the oft-piscivorous largemouth bass in a small lake in Michigan's Upper Peninsula, USA.

Specifically, we examined distinctive foraging behaviors of pelagic (in the metalimnion and lower) and littoral (epilimnion) foraging bass. We determined forager location in the water column from body core temperatures (T_B). This is particularly noteworthy because bass are diurnal, visual predators of the littoral zone, whereas *Chaoborus* are diel migrators occupying surface waters of pelagic zone at night. We tested the hypothesis that the diet of pelagic bass (T_B of 17-20ÃƒÆ'Ã¢â‚¬Å¡Ãƒâ€šÂ°C) differs from the littoral bass (21-29ÃƒÆ'Ã¢â‚¬Å¡Ãƒâ€šÂ°C) and that there is a foraging preference for *Chaoborus*. We found that pelagic foragers had significantly ($P<0.001$) more *Chaoborus* per gut (248.9) than littoral forages (91.3), that average individual diet consistency (42.6% diet overlap) was greater than diet consistency of random pairings (35.5%) and that >50% of bass stomachs contained more *Chaoborus* than the population mean.

Holiday, D., University Southern Mississippi/Gulf Coast Geospatial Center , Ocean Springs, MS, USA, dan.holiday@usm.edu;
Carter, G., University Southern Mississippi/Gulf Coast Geospatial Center, Ocean Springs, MS, USA, greg.carter@usm.edu;
Gould , R., Naval Research Laboratory, NASA Stennis Space Center, MS, USA, rick.gould@nrlssc.navy.mil;
MacIntyre, H., University South Alabama/Dauphin Island Sealab, Dauphin Island, AL, USA, hugh.macintyre@disl.edu

USING MODIS AQUA AND IN SITU DATA FOR HAB PREDICTION IN THE NORTHERN GULF OF MEXICO: DECISION TREE ANALYSIS AND MODELING OF ECOLOGICAL CONDITIONS

To date, 13 potential HAB species have been detected in coastal waters of Mississippi and Alabama, including representatives of the diatom genera Pseudo-nitzschia and Chaetoceros, and dinoflagellate genera Karenia, Karlodinium, Gonyaulax, and Prorocentrum. This study investigates the potential of satellite remote sensing (MODIS Aqua) to predict environmental conditions leading to the formation of HABs in these turbid coastal waters. Phytoplankton populations and water quality were monitored in situ at 3 to 6 week intervals and 17 locations in Mobile Bay and the Mississippi Sound from July, 2005 through June, 2006. MODIS Aqua imagery corresponding with in situ collections was acquired. Non-parametric multivariate analyses determined relationships between phytoplankton cell counts and in situ or satellite-derived water properties, including surface temperature, salinity, concentrations of chlorophyll-a, total suspended solids, colored dissolved organic material, and nutrient levels. This paper will describe an expert system decision tree analysis approach to prediction of ecological conditions necessary for the formation of HABs. The model assumes unique ranges of chla, total suspended solids, sea surface temperature must be met in order to allow the formation of HABs.

Hollibaugh, J. T., University of Georgia, Athens, USA, aquadoc@uga.edu;
Bano, N., University of Georgia, Athens, USA;
Givens, C., University of Georgia, Athens, USA;
Ransom, B., University of Georgia, Athens, USA

A COMPARISON OF THE INTESINAL MICROFLORA ASSEMBLAGES AMONG SELECTED MARINE FISH SPECIES

Recent data suggest that the intestinal microflora of fish can be dominated by different groups of bacteria, for example Firmicutes or Proteobacteria. In particular, culture-independent analyses have shown that gut microflora assemblages of some fish species are dominated by members of the order Mycoplasmatales of the class Mollicutes. Mycoplasmas are unusual in that they have greatly reduced genomes (and thus presumably reduced metabolic flexibility) and lack cell walls, properties that would seem to make them unlikely candidates to be dominate microorganism in gut microflora. We explored the distribution of intestinal Mycoplasmas among different fish species. We found consistent patterns of assemblage composition, including dominance by Mycoplasmas, among individuals within fish species. These findings contrasted dramatically with large differences seen in the composition of microflora assemblages between fish species of varying degrees of taxonomic and ecological separation. We also detected unexpected phylotypes, including gamma-Proteobacteria closely related to E. coli. These results are significant in that they suggest that gut microflora composition is not simply determined by feeding type.

Holste, L., University Hamburg, Institute for Hydrobiology and Fisheries Research, Hamburg, Germany, linda.holste@uni-hamburg.de;
Neumann, T., Leibniz Center for Baltic Sea Research, Warnemünde, Warnemünde, Germany, thomas.neumann@io-warnemuende.de;
St John, M. A., University Hamburg, Institute for Hydrobiology and Fisheries Research, Hamburg, Germany, michael.st.john@uni-hamburg.de;
Peck, M. A., University Hamburg, Institute for Hydrobiology and Fisheries Research, Hamburg, Germany, myron.peck@uni-hamburg.de

THE EFFECT OF TEMPERATURE AND SALINITY ON REPRODUCTION OF TEMORA LONGICORNIS IN THE BALTIC SEA: A COPEPOD COPING WITH A TOUGH SITUATION

Animals that inhabit Baltic Sea basins are burdened by the presence of strong thermo- and haloclines that create rapid spatial changes in temperature (T) and salinity (S) exceeding 10 ÃƒÆ'Ã†â€™Ãƒâ€ 'ÃƒÆ'¢Ã¢â‚¬Å¡Ãƒâ€¦Ã¡ÃƒÆ'Ã†â€™Ã¢â‚¬Ã¢â€šÂÃ…Ã¡ÃƒÆ'Ã¢â‚¬Å¡Ãƒâ€šÂ°C and 9 psu. These wide ranges in abiotic factors affect the distribution and abundance of Baltic Sea copepods via species-specific, physiological-based impacts on vital rates. In the laboratory, we characterized the influence of T and S on reproductive success of a Baltic population of Temora longicornis including measurements of egg production rate (EP) at 12 different temperatures and the influence of various combinations of acclimation and test salinities on EP and egg hatching success. The interaction between T and S on naupliar survival was also investigated. Our laboratory results were combined with field data on depth- and stage-specific abundance and distribution of T. longicornis to better understand its ecophysiology and life history strategy in the Baltic. We also applied hydrodynamic model estimates of the temporal- and spatial changes in T and S to explore how the distributional limits of this population may expand and contract both intra- and inter-annually.

Horowitz, J. D., University of Washington, Seattle, USA, jdh27@u.washington.edu;
Atieh, B., University of Washington, Seattle, USA, bryan.atieh@gmail.com;
Leque, G. R., University of Washington, Seattle, USA, gleque@geoengineers.com;
Benjamin, M. M., University of Washington, Seattle, USA, markbenj@u.washington.edu;
Brett, M. T., University of Washington, Seattle, USA, mtbrett@u.washington.edu

ARTIFICIAL RAINFALL AS A TOOL FOR CHARACTERIZING NITROGEN STORAGE AND DENITRIFICATION IN COASTAL ONSITE SEPTIC SYSTEM PLUMES

Anthropogenic nitrogen loading can severely perturb the ecological health of aquatic systems, causing or accentuating eutrophication in estuaries leading to hypoxia or anoxia. Nitrogen loading from onsite septic systems (OSSs) to estuaries is potentially substantial in many places. Because OSSs do not typically remove nitrogen within the septic tank, subsurface transformations occurring across oxic-anoxic boundaries and hydrologic transport are the primary mechanisms controlling nitrogen loading from OSSs to surface water systems. Hood Canal, located in the Puget Sound region of Washington, has been severely affected by low dissolved oxygen concentrations due to excess nitrogen loading. Onsite septic systems are the primary wastewater treatment process in this watershed and may be an important source of nitrogen to Hood Canal. This study used artificial rainfall experiments to investigate nitrogen storage and denitrification processes in an onsite septic system plume located in the Hood Canal basin. Irrigation during the dry season mobilized very high concentrations of nitrate stored in the drainfield. In contrast, experiments during the wet season predominantly mobilized ammonium.

Hosoi, M., The University of Shiga Prefecture, Hikone, Japan, m_hosoi@ses.usp.ac.jp;
Sarai, N., The University of Shiga Prefecture, Hikone, Japan;
Hosoi-Tanabe, S., Kobe University, Kobe, Japan;
Ichii, R., The University of Shiga Prefecture, Hikone, Japan;
Mori, T., Nihon University, Fujisawa, Japan, tellme07@brs.nihon-u.ac.jp;
Ban, S., The University of Shiga Prefecture, Hikone, Japan, ban@ses.usp.ac.jp

CLONING AND TRANSCRIPTIONAL EXPRESSION ANALYSIS OF CUTICLE PROTEINS IN *DAPHNIA MAGNA*

We identified sequences coding cuticle proteins (CP) from water flea *Daphnia magna*. Four cDNAs encode CPs (DpM-CP1-4) containing RR-1 consensus, which generally exists in ÃƒÆ'¢Ã¢Ã¢â‚¬Å¡Ã¡Ãƒâ€¦"soft ÃƒÆ'¢Ã¢Ã¢â‚¬Å¡Ã¡Ã¯¿½ cuticle protein. Another CP (DpM-CP5) is RR-2 consensus bearing protein, associated with hard cuticle. Using a real-time PCR method, we then analyzed time courses of mRNA expression of DpM-CP1-4 during 6th instar. As a result, the amount of mRNA changed by two orders of magnitude, and the high level expression was observed in the latter half of the instar duration. These results were consistent with the previous histological observations indicating that the secretion of the new cuticle begins when about 60% of the instar duration has elapsed. We will also show the localization of DpM-CPs mRNA analyzed by in situ hybridization histochemistry in the presentation.

Huelin, H. R., Memorial University of Newfoundland, St. Johnâ€™s, Canada, sheldonhuelin@gmail.com;
Ziegler, S., Memorial University of Newfoundland, St. Johnâ€™s, Canada

EXAMINING THE ROLE OF DISSOLVED ORGANIC MATTER SOURCE IN THE FORMATION OF CHLORINE DISINFECTION BYPRODUCTS (CDBPS)

The chlorination of drinking water produces hundreds of potentially carcinogenic chlorine disinfection byproducts (CDBPs) formed when chlorine reacts with dissolved organic matter (DOM). Factors controlling the yields of CDBPs, however, remain poorly understood. Levels of CDBPs in 20% of drinking water supplies in Newfoundland and Labrador have exceeded national guidelines. Based on an extensive water quality and GIS land cover data set, trihalomethane (THM) concentrations were found to be positively correlated to the ratio of water body to watershed area and to the percent landcover of only one vegetation community type. These analyses suggest variation in allochthonous and autochthonous sources of DOM may influence the yield of CDBPs. To isolate DOM and watershed characteristics from variation in the chlorination procedure, water samples collected from the sites spanning the relationships described were chlorinated using a standardized procedure. To differentiate the role of autochthonous and allochthonous sources, experiments will be performed using a combination of leachates from dominant watershed plants and 13C-enriched autochthonous DOM. Results from this study will provide insight into the role DOM source plays in the generation of CDBPs.

Hughes, J. E., Wellesley College, Wellesley, MA, USA, jhughes@wellesley.edu;
Moore, M., Wellesley College, Wellesley, MA, USA, mmoore@wellesley.edu;
Timofeyev, M., Irkutsk State University, Irkutsk, Russian Federation;
Protopopova, M., Irkutsk State University, Irkutsk, Russian Federation;
Lucey, K., Wellesley College, Wellesley, MA, USA;
Zamora, M., Wellesley College, Wellesley, MA, USA;
Yip, A., Wellesley College, Wellesley, MA, USA

SPECIES RICHNESS AND ABUNDANCE OF BENTHIC MACRO-SCAVENGERS ALONG A DEPTH GRADIENT IN L. BAIKAL, SIBERIA

Recruitment of benthic scavengers to food-falls in the ocean has been used to estimate species richness of this faunal group and how it changes with depth. Hypotheses predict that species richness may either increase with depth resulting from less predation on generalist consumers at deeper depths or it may decrease with depth due to increased food scarcity. Using baited traps, we tested these hypotheses in the southern basin of L. Baikal at three depths: 20 m (littoral zone), 60 m (sub-littoral zone), and 120 m (supra-abyssal zone). Number of species, abundance, size of scavengers, and rate of bait consumption were determined. Although fewer species were recovered from traps in deeper waters, supporting the second hypothesis, only gastropod species (n = 5) were recovered from the shallowest depth and amphipod species (n = 3) from the deeper depths. The change in species composition with depth may be due to habit and feeding preferences, or possibly competition between snails and gammarids. Recruitment to traps was rapid and high; within 2 d, average total scavenger abundance ranged from 100-257 individuals per trap.

Humphrey, D. B., University of British Columbia, Vancouver, Canada, dhumphrey@eos.ubc.ca;
DiBacco, C., Fisheries and Oceans Canada, Dartmouth, Canada, cdibacco@gmail.com;
Levings, C. D., Fisheries and Oceans Canada, Vancouver, Canada, LevingsC@pac.dfo-mpo.gc.ca

CHARACTERIZING BALLAST WATER AS A TRANSPORT VECTOR FOR NON-INDIGENOUS ZOOPLANKTON

This study characterizes zooplankton composition in ballast water sampled from cargo ships upon arrival to various Vancouver Harbour ports between September 2006 - October 2007. Three classes of vessels sampled included (i) intra-coastal vessels carrying mid-ocean exchanged ballast water (ICE), (ii) intra-coastal vessels carrying un-exchanged ballast water (ICU), and (iii) trans-oceanic vessels carrying mid-ocean exchanged water (TOE). Preliminary analysis identified 137 taxa in densities as high as 63,562 ind. m^{-3}. Out of 39 non-indigenous zooplankton (NIZ) taxa identified in this study, 14, 19, and 20 were observed in ICU, ICE and TOE vessels, respectively. ICU vessels averaged 1723 ind. m^{-3} (i.e. 91% of NIZ) compared to 55 and 72 ind. m^{-3} for ICE and TOE vessels, respectively. The occurrence of cyclopoid copepods (*Pseudodiaptomus forbesi* and *P. marinus*) in ICU vessels are of particular concern due to recent invasions in Pacific Northwest estuaries, including the Columbia River. These observations suggest that ballast water continues to serve as a potential vector for aquatic invasions and the exemption of some intra-coastal vessels from ballast water exchange procedures may pose the greatest invasion threat.

Ibarra, D. A., Dalhousie University - Department of Oceanography, Halifax, Canada, dibarra@dal.ca;
Hasegawa, D., Dalhousie University - Department of Oceanography, Halifax, Canada, daisuke@dal.ca;
Fennel, K., Dalhousie University - Department of Oceanography, Halifax, Canada, katja.fennel@dal.ca;
Cullen, J. J., Dalhousie University - Department of Oceanography, Halifax, Canada, john.cullen@dal.ca

WATER-COLUMN IMPACTS OF BIVALVE AQUACULTURE: BIO-OPTICAL ASSESSMENT AND 3-D MODELING IN A MUSSEL FARM IN SHIP HARBOUR, NOVA SCOTIA

Advances in bio-optical oceanography and 3-D modeling, and the proliferation of optical instruments, present the opportunity to examine the influence of bivalve aquaculture on pelagic biogeochemical dynamics. We designed a study to examine bio-optical variability in a mussel farm in Ship Harbour (Nova Scotia, Canada). Transects were conducted at each tidal cycle over 4 days and nights using an arsenal of optical tools. At each station, we measured proxies of suspended particles and phytoplankton using 3 types of chlorophyll fluorometers, hyperspectral spectrophotometers, transmissometers and diffuse attenuation meters, and a multispectral/multi-angle scattering meter. Preliminary results from a 3-D coupled bio-physical model showed the lowest concentration of phytoplankton near the mussel leases, which was consistent with all measured proxies with the notable and surprising exception of chlorophyll fluorescence, which was highest near the mussels. Here we recommend a subset of optical measurements as a practical and affordable monitoring solution. However, we emphasise the need for continuous records of at least two independent estimates of phytoplankton, to understand the impact of bivalve aquaculture on pelagic ecosystems.

Ichii, R., The University of Shiga Prefecture, Hikone, Japan, i ryoko ultrasmile623@yahoo.co.jp;
Hosoi, M., The University of Shiga Prefecture, Hikone, Japan;
Hosoi-Tanabe, S., Kobe University, Kobe, Japan;
Sarai, N., The University of Shiga Prefecture, Hikone, ;
Mori, T., Nihon University, Fujisawa, Japan;
Ban, S., The University of Shiga Prefecture, Hikone, Japan, ban@ses.usp.ac.jp

VITELLOGENIN TRANSCRIPTIONAL EXPRESSION IN Ï¼ŒDAPHNIA MAGNAÏ¼Ž IS MOLT CYCLE RELATS

We examined vitellogenin (VTG) mRNA expression in 3rd instar and at 12h interval through 4th and 5th instar in ÃƒÆ'¯Ãƒâ€šÃ‚Ã¯Ã‚Ã¢â‚¬Ã¢â€žÂ¢Daphnia magnaÃƒÆ'¯Ãƒâ€šÃ‚Ã¯Ã‚Ã¢â‚¬Ã¢â€žÂ¢ with a realtime RT-PCR. VTG mRNA expression level was extremely low in 3rd instar, while high in 4th and 5th instar. In 4th and 5th instar, VTG mRNA expressed periodically and the maximum expression was observed at 75% of the instar elapsed (12 h before next molt). According to histological study, it has been shown that vitellogenesis for first clutch of eggs in ÃƒÆ'¯Ãƒâ€šÃ‚Ã¯Ã‚Ã¢â‚¬Ã¢â€žÂ¢D.

magnaÃƒÆ'Ã¯Ãƒâ€šÃ‚Ãƒâ€¦Ã‚Â¾ occurs in 5th instar. However, our results suggested that vitellogenesis at a molecular physiological level started during 4th instar, when the accumulation of yolk has not occurred yet. We are now trying to detect the localization of VTG mRNA with an in situ hybridization method.

Ilikchyan, I. N., Bowling Green State University, Bowling Green, USA, iirina@bgnet.bgsu.edu;
McKay, R. M., Bowling Green State University, Bowling Green, USA, rmmckay@bgnet.bgsu.edu;
Zehr, J. P., University of California, Santa Cruz, USA;
Dyhrman, S. T., Woods Hole Oceanographic Institutio, Woods Hole, , sdyhrman@whoi.edu;
Bullerjahn, G. S., Bowling Green State University, Bowling Green, USA, bullerj@bgnet.bgsu.edu

DETECTION AND EXPRESSION OF THE PHOSPHONATE TRANSPORTER GENE *PHND* IN MARINE AND FRESHWATER PICOCYANOBACTERIA

We describe a PCR-based assay designed to detect expression of the phosphonate assimilation gene *phnD* from picocyanobacteria.° *phnD* encodes the phosphonate binding protein of the ABC-type phosphonate transporter, present in many of the picocyanobacteria genome sequences. Detection of *phnD*°expression can indicate a capacity of picoplankton to utilize phosphonates, a recalcitrant form of phosphorus that can represent 20% of the high molecular weight dissolved organic phosphorus pool in marine systems. Primer sets were designed to specifically amplify *phnD* sequences from marine and freshwater *Synechococcus* spp., *Prochlorococcus* spp. and environmental samples from the ocean and Laurentian Great Lakes. RT-PCR from cultured *Synechococcus* spp. demonstrated induction of *phnD* expression in P-deficient media. Similarly, RT-PCR of environmental RNA samples from the Sargasso Sea, Pacific Ocean, and Lake Erie detected *phnD* expression from the endemic picocyanobacterial population.

Innes, D. J., , St. John's, Canada, dinnes@mun.ca

ADVECTIVE DISPERSAL BRINGS SEXUAL AND ASEXUAL *DAPHNIA PULEX* INTO CONTACT

The temporary pond landscape of southern Ontario consists of facultative sexual and obligately asexual populations of *Daphnia pulex*. Dominance of asexual populations may be due to the invasion of asexual genotypes into and subsequent elimination of sexual populations. However, successful invasion will depend on the probability of asexual diapausing eggs dispersing into sexual populations. Limitations on dispersal may protect sexual populations from invasion. For one sexual population sampled in five successive years, invading asexual genotypes represented 16, 33, 3, 0 and 2 % of the total population. A total of 12 asexual genotypes were detected with three accounting for 90 % of asexual genotypes. The sexual population is exposed to periodic flooding from an adjacent stream. Five ponds 1.7, 6.7, 7.6, 12.3 and 16.6 km up stream contained 8.4, 3.5, 64.9, 45.1 and 99.0 % asexual genotypes, respectively and were dominated by three asexual genotypes, two of which were detected in 4 of the 5 upstream ponds and the downstream sexual population. The sexual population may be resisting invasion but advective dispersal ensures repeated opportunities for invasion by asexual genotypes.

Irwin, A. J., Mount Allison University, Sackville, Canada, airwin@mta.ca;
Mei, Z. P., Mount Allison University, Sackville, Canada;
Finkel, Z. V., Mount Allison University, Sackville, Canada

HOW RESOURCE AVAILABILITY AFFECTS SIZE-STRUCTURE OF PHYTOPLANKTON COMMUNITIES

The physiology and ecology of phytoplankton are strongly affected by their cell size, in particular, both the supply of and demand for resources. Using a modelling approach we show that the size-scaling of cellular nutrient requirements, light acquisition, and growth can cause the often observed power-law relationships between cell size and abundance, and the relative increase in abundance of larger phytoplankton cells under eutrophic conditions. When we include both phylogenetic and size differences in resource acquisition the model can also replicate field observations such as the absence of small, slow-growing Prochlorococcus spp. and the relative dominance of large diatom species in nutrient-rich, upwelling regions of the ocean.

Iversen, M. H., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, morten.iversen@awi.de;
Ploug, H., Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, helle.ploug@awi.de;
Poulsen, L. K., Danish Institute for Fisheries Research, Charlottenlund, Denmark, lkp@bio.ku.dk;
Koski, M., Danish Institute for Fisheries Research, Charlottenlund, Denmark, mak@difres.dk;
Buitenhuis, E. T., University of East Anglia, Norwich, United Kingdom, E.Buitenhuis@uea.ac.uk

COPEPOD FECAL PELLET DEGRADATION: THE USUAL SUSPECTS OR OTHER CRITTERS ON THE LOOSE?

Studies of fecal pellet fluxes and retention have revealed that most pellets are degraded within the surface waters. However, the key degraders are poorly known. The retention of carbon and nutrients is not matched by bacterial respiration and the major degradation process is believed to be coprophagy (pellet ingestion) by copepods, though field evidence is lacking. We observed copepods (Danish coastal waters) rejecting pellets immediately after capture, in some cases with pellet fragmentation as outcome. Pellet ingestion was rare and only of small pellet fragments unintentionally along with alternative food. Therefore, coprorhexy (pellet fragmentation) seems the main impact by copepods, and they are not the key degraders. From size fractionation of a plankton community (ÃƒÈœresund, Denmark), we identified large heterotrophic dinoflagellates as major pellet degraders in the upper ocean. In deeper waters bacterial degradation dominates, only limited by pellet residence time, which is hypothesized to be dependent on ballast minerals. Bacterial degradation (laboratory) was independent of ballast material whereas sinking velocity increased with denser diet, leading to <10-fold higher pellet carbon flux with coccolithophorid and diatom diets than with flagellate diet.

Izaguirre, I., Dept. Ecología, Genética y Evol., Fac Ciencias Exactas y Nat., Universidad Buenos Aires, CONICET, Buenos Aires, Argentina, iri@ege.fcen.uba.ar;
Unrein, F., Inst. Invest. Biotecnológicas-Inst. Tecnológico Chascomùs - CONICET, Chascomùs, Argentina, funrein@intech.gov.ar;
Massana, R., Departament de Biología Marina i Oceanografia, Institut de Ciències del Mar-CMIMA, CSIC. , Barcelona, Spain, ramonm@icm.csic.es;
Balagué, V., Departament de Biología Marina i Oceanografia, Institut de Ciències del Mar-CMIMA, CSIC., Barcelona, Spain, vbalague@icm.csic.es;
Gasol, J. M., Departament de Biología Marina i Oceanografia, Institut de Ciències del Mar-CMIMA, CSIC., Barcelona, Spain, pepgasol@icm.csic.es

MICROBIAL DIVERSITY OF ANTARCTIC LAKES: A POLYPHASIC APPROACH FROM MICROSCOPY TO MOLECULAR BIOLOGY

The microbial diversity of lakes from Hope Bay (Antarctic Peninsula) has been studied since 15 years. First studies involved traditional determinations of living specimens by microcopy. Nevertheless, the biodiversity of small flagellates (3 ÃƒÆ'¢Ã¢Ã¢â‚¬Å¡Ã¢Ã¢â€šÂÃ…â€œ 20 µm) and pico-eukaryotes, main microbial components in the plankton of these lakes, remained uncertain without molecular analyses. A molecular fingerprinting analysis (DGGE) revealed that most of the lakes shared several bands, and the band pattern of each lake was relatively constant between two consecutive years. Most sequenced bands belong to Chrysophyceae. 18S rRNA clone libraries from two type-lakes of this region retrieved the sequences of the main nanoplanktonic species: at least 12 Chrysophyceae (including one *Ochromonas* species), 9 Chlorophyceae (including 6 *Chlamydomonas* species), and one Prasinophyceae (Order Mamiellales). Most of these sequences showed high similarities with sequences found in other cold regions (Antarctica, Arctic, high mountain lakes). The diversity of Chrysophyceae and Chlorophyceae found in these clone libraries was higher than that observed by other methods used before. The combined use of epifluorescence microscopy, flow cytometry and CARD-FISH allowed the quantification and differentiation of picoplankton populations.

Jacobs, L. E., The Ohio State University, Columbus, OH 43210, USA, jacobs.585@osu.edu;
Chin, Y. P., The Ohio State University, Columbus, OH 43210, USA, yo@geology.ohio-state.edu;
Fimmen, R. L., The Ohio State University, Columbus, OH 43210, USA;
Mash , H. E., U.S. Environmental Protection Agency, Cincinnati, OH 45268, USA;
Weavers, L. K., The Ohio State University, Columbus, OH 43210, USA

THE PHOTOLYSIS OF IBUPROFEN MEDIATED BY DISSOLVED ORGANIC MATTER

The photolysis of the nonsteroidal anti-inflammatory drug ibuprofen was studied in water and solutions of fulvic acid isolated from Pony Lake, Antarctica; Suwannee River, GA, USA; and Old Woman Creek, OH, USA. At 10 μM ibuprofen degrades by direct photolysis, but the presence of fulvic acids (6 mgC/L) significantly increases reaction rates. This reaction proceeded even more quickly in solutions at lower and more environmentally relevant ibuprofen concentrations (0.1 μM). Quenching studies suggest that the hydroxyl radical is responsible for some of the degradation because isopropanol was able to reduce the reaction rate by 50%. Liquid chromatography with quadrapole time of flight mass spectrometry and ^{1}H NMR spectroscopy reveal the formation of multiple hydrophobic photo-products, with the dominant byproduct identified as 4-(1-ethanol)-β,β-dimethylstyrene with an -OH attached to the benzene ring as well as isobutylacetophenone. Compared to direct photolysis and the other fulvic acids, the presence of Pony Lake fulvic acid significantly increases the production of the major byproduct. Thus, the photofate of ibuprofen in sunlit waters is affected by its concentration and the composition of dissolved organic matter.

Jacobs, M. J., Great Lakes Institute for Environmental Research, Windsor, Canada, jacobs5@uwindsor.ca;
MacIsaac, H. J., Great Lakes Institute for Environmental Research, Windsor, Canada, hughm@uwindsor.ca

PREDICTING THE SPREAD OF *CABOMBA CAROLINIANA* IN ONTARIO

Humans play a major role in the global spread of nonindigenous species (NIS). Predicting NIS spread requires an understanding of where propagules are being transported, whether these propagules can survive in novel habitats, and whether they can integrate successfully within the resident community. *Cabomba caroliniana* is a submersed aquatic plant, native to South America that is now widespread globally. It passively spreads by fragmentation and has a wide climatic range, invading fresh waters from tropical (latitude 12°) to cold temperate regions (latitude 45°). I present models that consider the first two stages of invasion, introduction and environmental tolerance, to forecast *C. caroliniana* spread in Ontario. I use a combination of hydrologic, gravity, and environmental niche models to measure propagule pressure and environmental suitability. This project produces a refined model that predicts both where *C. caroliniana* will disperse and where it may be expected to survive in Ontario.

Jamieson, R. E., Earth Sciences Dept., Memorial University of Newfoundland, St. John's, Newfoundland, Canada, robyn.jamieson@nf.sympatico.ca;
Sherwood, O. A., Biology Dept., Memorial University of Newfoundland, St. John's, Newfoundland, Canada, osherwood@gmail.com;
Edinger, E. N., Geography Dept., Memorial University of Newfoundland, St. John's, Newfoundland, Canada, eedinger@cs.mun.ca;
Wareham, V. E., Northwest Atlantic Fisheries Centre, Fisheries and Oceans Canada, St. John's, Newfoundland, Canada, wareham@dfo-mpo.gc.ca

CARBON AND NITROGEN STABLE ISOTOPIC COMPOSITION OF DEEP-SEA CORALS FROM OFFSHORE NEWFOUNDLAND AND LABRADOR

Stable isotopic analysis of deep-sea coral tissues can provide information on their ecology and on productivity and nutrient dynamics in the deep ocean. To assess inter-species differences in trophic ecology, we analyzed the C and N isotopic compositions of eleven species of deep-sea coral collected along the Newfoundland and Labrador continental slope. Specimens were examined from three regions (Hudson Strait, Labrador Slope and the Southern Grand Banks) with a range of depths (50 and 1400 m) for each site. Significant inter-species variation in C and N isotopic composition likely reflects substrate control of food availability and quality. Large gorgonian corals such as *Primnoa resedaeformis* and *Paragorgia arborea*, from high current habitats, had the lowest δ^{15}N and δ^{13}C values, ingesting a greater proportion of "fresh" sinking POM. More fragile gorgonians, the antipatharian *Bathypathes arctica* and soft corals occupy higher trophic levels, with a greater proportion of resuspended POM. The highest δ^{15}N values were observed for *Flabellum*, indicating a carnivorous diet. Isotopic composition did not vary with depth, and showed only a slight (<1 ‰) north to south increase in δ^{13}C values.

Jezberova, J., Institute for Limnology, Austrian Academy of Sciences, Mondsee, Austria, Jitka.Jezberova@oeaw.ac.at;
Jezbera, J., Institute for Limnology, Austrian Academy of Sciences, Mondsee, Austria, Jan.Jezbera@oeaw.ac.at;
Hahn, M. W., Institute for Limnology, Austrian Academy of Sciences, Mondsee, Austria, Martin.Hahn@oeaw.ac.at

MICRODIVERSITY OF CLOSELY RELATED *POLYNUCLEOBACTER* GENOTYPES AND THEIR CO-OCURRENCE AND DYNAMICS IN SELECTED FRESHWATER HABITATS IN CENTRAL EUROPE

Seasonal dynamics in community structure of bacterioplankton belonging to the *Polynucleobacte* cluster (*Betaproteobacteria*) was investigated in selected dystrophic ponds (high humic content, low conductivity and low pH) in Austria (Europe) for several years. Here the most abundant strains are affiliated to *Polynucleobacte* C subcluster (PnecC) (up to 10^{6} cells/mL). Fluorescence in situ hybridization (FISH) with PnecC specific probe, real-time PCR and Reverse line-blot hybridisation were used for deeper phylogenetic and screening analyses. The entire PnecC subcluster contributed up to 59% to the total abundance of bacteria. Application of cultivation-acclimatisation method and construction of clone library (16S rRNA gene+ITS region) discovered six closely related (<0,1% difference on 16S rRNA gene) genotypes. Divergence of different genotypes was among others detectable by using supplement genetic markers, such as rplL-rpoB spacer and glnA gene. Seasonal dynamics of the PnecC genotypes was recorded and could be observed every year. Our research shows low intraspecific diversity with a relatively stable composition within the phylogeneticaly shallow PnecC subcluster of *Polynucleobacte* bacteria and probably suggests strong affiliation of this subcluster to this type of freshwater habitat.

JIAO, N. Z., Xiamen University, Xiamen, China, jiao@xmu.edu.cn

PHOTOTROPHY VS HETEROTROPHY IN AEROBIC ANOXYGENIC PHOTOTROPHIC BACTERIA (AAPB) - OBSERVATIONS AND IMPLICATIONS FROM THE GLOBAL OCEANS AND IN SITU EXPERIMENTS

Aerobic anoxygenic phototrophic bacteria (AAPB) are a group of heterotrophic bacteria that can utilize light for supplemental energy. Field survey in the global oceans showed that AAPB are more abundant in eutrophic than oligotrophic waters, which is controversial to the speculation that AAPB should be more competitive over other bacteria when dissolved organic carbon (DOC) are sparse. Statistic analysis showed that AAPB are closely associated with chlorophyll, which is further demonstrated by in situ incubation experiments with and without presence of phytoplankton. Contrasting to the fast growth of AAPB in the field with phytoplankton carbon supplies, growth rates of AAPB cultures in the lab are much slower, which is in consistence with the selective use of carbon sources in AAPB as seen through Biolog bioassay (95 carbon species provided) and membrane potential detected by flow cytometry. Although the precise mechanism that AAPB possess in the degradation of organic matter is still unclear, AAPB would serve as an effective pump that takes up phytoplankton DOC rapidly and leaves more relatively refractory DOC (RDOC) in the water. Such a process, together with other processes forming RDOC leads to a concept of "Non-sinking biological pump". We also estimate the contribution of AAPB through utilization of light energy to carbon flow in the surface ocean based on the field observations and experimental conversion factors, and propose a new model of carbon cycling in the ocean

Johnson, C. L., Fisheries and Oceans Canada, Dartmouth, NS, Canada, JohnsonC@mar.dfo-mpo.gc.ca;
Leising, A. W., National Oceanic and Atmospheric Adminstration, Pacific Grove, CA, USA, Andrew.Leising@noaa.gov;
Runge, J. A., University of Maine and Gulf of Maine Research Institute, Portland, ME, USA, jrunge@gmri.org;
Tarrant, A. M., Woods Hole Oceanographic Institution, Woods Hole, MA, USA, atarrant@whoi.edu;
Baumgartner, M. F., Woods Hole Oceanographic Institution, Woods Hole, MA, USA, mbaumgartner@whoi.edu;
Head, E. J., Fisheries and Oceans Canada, Dartmouth, NS, Canada, HeadE@mar.dfo-mpo.gc.ca;
Pepin, P., Fisheries and Oceans Canada, St. John's, NL, Canada, Pierre. Pepin@dfo-mpo.gc.ca;
Plourde, S., Fisheries and Oceans Canada, Mont Joli, QC, Canada, PlourdeS@dfo-mpo.gc.ca

THE LIPID ACCUMULATION HYPOTHESIS FOR DORMANCY CONTROL IN OCEANIC COPEPODS

Demographic time-series of *Calanus finmarchicus* abundance from four stations in the northwest Atlantic Ocean were analyzed to estimate the timing of entry into and emergence from dormancy and to evaluate hypothesized environmental cues for dormancy. No single environmental cue (photoperiod, temperature, or chlorophyll concentration) explained entry or emergence dates across all stations. Among hypotheses to explain dormancy in *Calanus*, only the lipid accumulation window hypothesis for onset of dormancy and a lipid-modulated endogenous timer controlling dormancy duration could not be eliminated. According to these hypotheses, individuals can only enter dormancy if their food and temperature history allows them to accumulate sufficient lipid to endure overwintering, molt, and undergo early gonad maturation. Individual-based modeling of *C. finmarchicus* population growth, including lipid-based dormancy control, and recent research on differential gene expression in active and dormant *C. finmarchicus* both support a key role for storage lipid accumulation during preparation for dormancy. While lipid accumulation probably does not control dormancy, it may be either a downstream result of a shift in metabolic pathways or a precondition for endocrine control of dormancy.

Jones, I. D., Centre for Ecology and Hydrology, Lancaster, United Kingdom, ianj@ceh.ac.uk;
Persson, I., Uppsala University, Uppsala, Sweden, irinapersson@hotmail.com

THE EFFECT OF CHANGING THE EXTINCTION COEFFICIENT ON THE THERMAL PROPERTIES OF A LAKE: A MODEL STUDY

The extinction coefficient within a lake is a measure of the depth at which solar radiation is absorbed within the water. It is affected, in particular, by the colour of the water and the abundance of phytoplankton within the lake. Here, a modelling approach, using the 1-dimensional equation solver, PROBE, is adopted to examine the effects of a changing extinction coefficient on the thermal structure of a moderately sized Swedish lake, Lake Erken. Results show that, despite the initial warming of surface water associated with an increase in extinction coefficient, subsequently the surface water of a more coloured lake becomes cooler than that of a less coloured lake because of entrainment of cold hypolimnetic water. In addition, heat flux, Schmidt stability, length of stratification and hypolimnetic temperatures are all shown to be greatly affected by the value of the extinction coefficient. Multi-year model runs show that qualitative results are the same each year, while quantitatively the results are subject to up to a fourfold inter-annual variation.

Jumars, P. A., University of Maine, Orono, Maine, USA, jumars@maine.edu

SERVICE AS A MEMBER BENEFIT: CHOOSING SCIENTIFIC SOCIETIES ACCORDINGLY

Service is generally viewed as a sacrifice on the part of the server. Two functions have endured in scientific societies from the outset: meeting of people with common interests and publishing of peer-reviewed research results. Even these core society functions have ample room for service that empowers the server as well as the society. As I can attest, nothing hones editorial skills like suddenly being Editor-in-Chief of a major journal and nothing hones leadership skills like running an ASLO Board Meeting. Societies now offer a much wider array of standing and ad hoc committee service than was available even a decade ago. From the individual perspective, these activities allow tremendous opportunities to amplify a single person's efforts and to engage with like-minded colleagues toward worthy goals. One way to choose where among the panoply of scientific societies to put one's efforts is to match the fit of your own aspirations with service opportunities in that organization. Both precision of fit and scale of the enterprise matter.

Kaczmarska, I., Mount Allison University, Sackville, Canada, iehrman@mta.ca;
Klein, G., Mount Allison University, Sackville, Canada, gklein@mta.ca;
Ehrman, J. M., Mount Allison University, Sackville, Canada, jehrman@mta.ca;
MacIntosh, K., Mount Allison University, Sackville, Canada, kmmcnts@mta.ca;
Martin, J. L., SABS, Fisheries and Oceans Canada, St. Andrews, Canada, MartinJL@mar.dfo-mpo.gc.ca

DIATOM SURVIVORSHIP IN SHIP BALLAST WATER - INITIAL INSIGHT

The rapid increase of large container shipping since the 1970's facilitated rapid inter-connection between ports worldwide. This provided marine biota with an unprecedented anthropogenic means of worldwide dispersal via ballast water. Despite visible cases of non-indigenous aquatic macro-organisms invading new regions and habitats, ship ballast transport of microalgae has received little scientific attention although diatoms one of the most species rich and abundant ballast water micro-biota. We present an initial assessment of diversity and abundance of viable diatom propagules arriving in ship ballasts at Canadian ports. We found approximately 120 diatom species and selected dinoflagellates. Both marine and freshwater species were found to be viable in ballast tanks. The total cell density varied over three orders of magnitude, from 13-34,000 cells/L in the East and 32-87,000 cells/L in West coast exchanged tanks. Species composition and individual species densities varied widely between ships, but were sometimes dominated by one species. Several species are unreported from Canada. Cell densities of some species increased during the trans-oceanic transport, suggesting that the ballast tank environment is not stressful for all diatoms.

Kainz, M., Inter-university research centre WasserCluster Lunz, Lunz am See, Austria, martin.kainz@donau-uni.ac.at;
Fisk, A., University of Windsor, Windsor, Canada, afisk@uwindsor.ca

LINKING CONCEPTS - LIPIDS AND XENOBIOTICS DYNAMICS IN AQUATIC FOOD WEBS

For aquatic ecologists and ecotoxicologists it is important to understand the concepts that link and differentiate the dynamics of essential and xenobiotic compounds in aquatic food webs. Lipids are recognized to be amongst the most important nutritional factors that affect the fitness of aquatic organisms, supplying energy and essential compounds for general metabolic functioning, somatic growth, reproduction, and enhanced immunocompetency. Xenobiotics, such as mercury, can be accumulated by consumers and have no physiological value but can, in cases were concentrations are sufficiently high, be toxic. Stressors, including temperature and invasive species, can have profound effects on lipid and xenobiotic dynamics, which could ultimately influence fitness. To date, most ecological and ecotoxicological studies have investigated the dynamics of lipids or xenobiotics in aquatic food webs separately. Recognizing that most lipids and xenobiotics are trophically transferred, but at rates that can vary widely with potentially very different effects and relevance, we discuss the factors that influence the fate of essential and xenobiotic compounds in aquatic food webs across different ecosystems.

Kamarainen, A. M., University of Wisconsin - Madison, Madison, USA, kamarainen@wisc.edu;
Van de Bogert, M. C., University of Wisconsin - Madison, Madison, USA, mcvandeb@wisc.edu;
Penczykowski, R. M., University of Wisconsin - Madison, Madison, USA, rmpenczykows@gmail.com;
Carpenter, S. R., University of Wisconsin - Madison, Madison, USA, srcarpen@wisc.edu

PLANKTONIC METABOLISM AND PHOSPHORUS DEMAND IN A EUTROPHIC FRESHWATER ECOSYSTEM

Phosphorus (P) limits the productivity of many freshwater ecosystems, and many studies show a positive relationship between total P and whole lake net ecosystem production. Other work, however, suggests that nitrogen or light may limit phytoplankton population growth at smaller spatial extents or time frames. In order to better understand episodic changes in phytoplankton populations, like algal blooms, it is necessary to examine changes in phytoplankton community dynamics at a finer temporal resolution. We did so using high-resolution estimates of gross primary productivity (GPP), based on real-time dissolved oxygen measurements. GPP estimates were combined with frequent estimates of plankton stoichiometry to assess the temporal variability in phosphorus demand. Empirical observations were used in a process model to explore relationships between planktonic P demand, P stocks within the lake, and phytoplankton biomass. Fluctuations in P demand exceed fluctuations of P input in this eutrophic system, suggesting a crucial role for recycling.

Kamenir, Y. G., Bar-Ilan Univ., Ramat-Gan, Israel, kamenir@mail.biu.ac.il

STABILITY OF LAKE KINNERET PHYTOPLANKTON AS EVIDENCED BY A MATRIX OF SEVERAL SIMULTANEOUSLY APPLIED TYPES OF SIZE SPECTRA

Stability analysis of the aquatic community is among the most important and complicated fields in modern ecology. Application of statistical approaches and modern automated tools has introduced new operational methods for the comparative analyses of aquatic assemblage structures. While much work has been done on two types of biomass size spectra (BSS and NBS), the traditional taxonomic size spectrum (TTSS, a discontinuous size-frequency distribution of taxonomic units) helps connect the ataxonomic and taxonomic studies. The frequency-weighted taxonomic size spectrum (FTSS) helps alternate the species importance estimated by organism abundance and biomass criteria. The composite size spectrum (CSS) integrates several types of structures as lines of a matrix where columns describe size classes. Thus, CSS compares several types of assemblage size structures. Three of them (NBS, TTSS, and FTSS) evidenced consistent long-term patterns for Lake Kinneret phytoplankton. Highlighting different size classes, each of these spectra enhances the complementary multi-sided vision. A matrix, composed of several types of size spectra applied simultaneously, provides a more comprehensive description of community structural changes than a single index or spectrum.

Karatayev, A. Y., Buffalo State College, Great Lakes Center, Buffalo, USA, karataay@buffalostate.edu;
Burlakova, L. E., Buffalo State College, Great Lakes Center, Buffalo, USA, burlakle@buffalostate.edu;
Padilla, D. K., Stony Brook University, Department of Ecology and Evolution, Stony Brook, USA, padilla@life.bio.sunysb.edu;
Mastitsky, S. E., Belarusian State University, General Ecology Department, Minsk, Belarus, sergmast@tut.by;
Olenin, S., Coastal Research and Planning Institute, Klaipeda University, Klaipeda, Lithuania, sergej@corpi.ku.lt

AQUATIC INVADERS ARE NOT A RANDOM SELECTION OF SPECIES

To succeed in a new environment, a species must pass through a series of filters, including biogeographic, physiological, and biotic. Although many species have the potential to be introduced, only a few pass all filters and establish populations in a new environment, suggesting that invaders may not be a random selection of species. We assembled information on 119 freshwater macroinvertebrate invaders and compared them to native species in North America and Europe. We found that invaders are generally more tolerant to pollution, characterized by a higher percentage of suspension feeders and are over represented by molluscs and crustaceans relative to native biota. The current spread of invaders could be facilitated by a reduction in water quality, which may reduce the local biodiversity due to the extirpation of native species that require high water quality. The dominance of suspension feeders among invaders will increase benthic-pelagic coupling, and thus can have dramatic impacts on entire ecosystems they invade. Because these processes are similar in the New and Old World, we suggest that the observed patterns are likely to hold globally.

Kattner , G., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, gerhard.kattner@awi.de;
Hagen, W., Marine Zoology, University of Bremen, Bremen, Germany, whagen@uni-bremen.de;
Graeve, M., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, martin.graeve@awi.de

PHOSPHOLIPIDS OF MARINE ZOOPLANKTON: HIGH POLYUNSATURATION IN POLAR AND TROPICAL SPECIES

In marine animals, especially in zooplankton species, the omega-3 fatty acids, eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (DHA, 22:6n-3) predominate in phospholipids. Together with the saturate 16:0 they comprise up to 80% of total phospholipid fatty acids. High proportions of these polyunsaturated fatty acids were found not only in zooplankton living at high latitudes but also in tropical species. The major phospholipid class is phosphatidylcholine (PC) followed by phosphatidylethanolamine (PE). PC is composed of equal amounts of EPA and DHA (both ca. 35%), whereas in PE half of the fatty acids are composed of DHA with smaller contributions of EPA (ca. 10%) resulting in a very specific phospholipid pattern. The hypothesis that high amounts of polyunsaturated fatty acids in phospholipids may be necessary in regulating membrane fluidity at cold temperature is not yet substantiated. The high proportions of EPA and DHA in tropical zooplankton phospholipids further challenge the reasoning with regard to membrane fluidity. There are still many open questions, which need to be studied in context with membrane structures and functions of marine organisms.

Keats, K. F., Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, NL, Canada, kkeats@mun.ca;
Hale, M. S., School of Earth and Environmental Sciences, University of Portsmouth, Hants, United Kingdom, michelle.hale@port.ac.uk;
Rivkin, R. B., Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, NL, Canada, rrivkin@mun.ca

EFFECTS OF TEMPERATURE AND NUTRIENT AMENDMENTS ON BACTERIAL GROWTH AND COMMUNITY STRUCTURE IN BIOGEOCHEMICAL PROVINCES OF THE ATLANTIC OCEAN

Bacteria are ubiquitous and abundant in the World Ocean, often dominate the planktonic biomass, and have a central role in the cycling of organic carbon and inorganic nutrients. Moreover, the abundance and activity of distinct phylogenetic groups and their roles in elemental cycling and transformation vary spatially and temporally. Bacterial growth and physiological characteristics are controlled, in part, by seasonal changes in water temperature and the availability of nutrients; however, the degree to which these population-level changes reflect differences in the growth capacities of distinct bacterial phylotypes and their contribution to the cycling and transformation of nutrients is uncertain. As part of the Atlantic Meridional Transect programme, we examined the potential temperature and nutrient regulation of bacterial growth in biogeochemical provinces of the Atlantic Ocean by measuring the responses of bacteria, i.e. changes in abundance, growth rates, and community structure, to shifts in temperature and organic (C, N) and inorganic (N, P) enrichment. Understanding the factors that regulate the growth of distinct bacterial phylotypes is crucial in determining the linkage between bacterial community structure and larger-scale ecological and biogeochemical processes.

Kelly, J. R., Dalhousie University, Halifax, Canada, jennifer.kelly@dal.ca;
Scheibling, R. E., Dalhousie University, Halifax, Canada, rescheib@dal.ca

CAN FATTY ACID PROFILES BE USED TO INFER DIET IN MARINE HERBIVORES?

Vertebrate predators generally deposit dietary fatty acids (FA) in their tissues with relatively little modification; tissue FA can therefore be used to characterize the diet of these animals. In contrast, some invertebrate herbivores modify dietary FA such that diet cannot be directly determined from tissue FA. The green sea urchin (*Strongylocentrotus droebachiensis*) is the dominant herbivore in the rocky subtidal ecosystem in Nova Scotia. We examined FA profiles of 1) wild-collected urchins from kelp beds and coralline algae-dominated barrens, 2) urchins fed four single-algal diets in the laboratory, and 3) the algal species that comprised each diet. We compared these profiles to determine the extent to which FA profiles

of urchins resemble those of their diet, and to infer dietary differences between wild-collected and laboratory-reared urchins. We suggest that, in cases where FA profiles of herbivores do not resemble their diets, the profiles of herbivores consuming known diets may provide a useful proxy for tracing primary production through to higher trophic levels.

Kent, A. D., University of Illinois at Urbana-Champaign, Urbana, USA, akent@uiuc.edu;
Peralta, A. L., University of Illinois at Urbana-Champaign, Urbana, USA, alperalt@uiuc.edu;
Flanagan, D. N., University of Illinois at Urbana-Champaign, Urbana, USA, dflanaga@uiuc.edu;
Matthews, J. W., Illinois Natural History Survey, Urbana, USA, jmatthew@uiuc.edu

WETLAND ASSESSMENT FROM A SOIL MICROBIAL ECOLOGY PERSPECTIVE

Changing patterns of land use over the last 200 years have resulted in the dramatic loss of wetlands in the US. The resulting nutrient pollution and degradation of coastal ecosystems may potentially be mitigated through restoration of wetland ecosystems. While current wetland classification focuses on plant and soil attributes, understanding the ecological drivers shaping the composition and activity of the microbial communities responsible for denitrification may enhance restoration of wetlands and their water quality functions. Denitrification, microbial community composition and microbial functional diversity were evaluated in natural and constructed wetlands throughout Illinois, along with a suite of plant and soil variables. Microbial community structure and denitrification activity differed significantly among natural and constructed wetlands. Constructed wetland sites that meet the criteria for jurisdictional wetlands (for vegetation, soil type, and hydrology) are not performing the water quality functions expected of natural wetlands. Results also indicate that the legacy of prior land use may influence the activity and composition of wetland microbial communities. Current criteria for wetland classification do not necessarily reflect the successful restoration of denitrification and other microbially-mediated processes.

Kerfoot, W. C., Michigan Technological University, Houghton, USA, wkerfoot@mtu.edu;
Green, S. A., Michigan Technological University, Houghton, USA, sgreen@mtu.edu;
Budd, J. W., Michigan Technological University, Houghton, USA, jrbudd@mtu.edu;
Schwab, D. J., National Oceanic and Atmosperic Administration, Great Lakes Environmental Research Laboratory, Ann Arbor, USA, David.Schwab@noaa.gov;
Vanderploeg, H. A., National Oceanic and Atmosperic Administration, Great Lakes Environmental Research Laboratory, Ann Arbor, USA, Henry.Vanderploeg@noaa.gov

GLOBAL CLIMATE CHANGE AND BIOTIC-MEDIATED PRODUCTIVITY DISPLACEMENT IN THE GREAT LAKES

Global climate change in the Great Lakes has reduced winter ice cover (80%), increased coastal temperatures and evaporation. There is also evidence for greater frequency and intensity of winter storms. With diminished coastal ice, winter storms encourage stronger currents that aid advection of nutrient-enriched river discharges (earlier thaw, limited ice blockage) and resuspended nearshore sediments into deeper waters during March to April. Lateral transport of nutrients enhances productivity in deeper waters prior to the traditional spring bloom in May. This "deep displacement" (Kerfoot et al. 2008) is most pronounced in the southern shallow and warmer basins (southern Lake Michigan, southern Lake Huron, Lake Erie), where introduced mussels (*Dreissena* sp.) also are depleting productivity along coastal margins during the spring bloom ("shunt effect", Hecky et al. 2004). Quagga mussel veligers graze on the winter blooms and are dispersed by the strong winter currents. The net effect appears to be an impending shift of productivity patterns in time (late-winter vs spring) and space (deep water vs coastal).

King, A. M., Dalhousie University, Halifax, Canada, amkng@mta.ca;
Qiu, Z., Dalhousie University, Halifax, Canada, qiuz@niaid.nih.gov;
MacRae, T. H., Dalhousie University, Halifax, Canada, tmacrae@dal.ca

GENE REGULATION DURING DIAPAUSE INITIATION AND MAINTENANCE IN THE CRUSTACEAN *ARTEMIA FRANCISCANA*

Diapause-destined *Artemia* embryos undergo a developmental program that yields encysted gastrulae (cysts) characterized by morphological adaptations, profound reduction in metabolic activity and exceptional stress tolerance. To better understand mechanistic aspects of diapause induction and maintenance mRNAs up-regulated in encysting embryos two days post-fertilization were selected by subtractive hybridization. Sequence analysis identified fifty-five up-regulated mRNAs including transcripts for p8, a helix-loop-helix, stress-responsive transcription co-factor and three small heat shock proteins (sHSPs), namely p26, ArHsp21 and ArHsp22. p8 potentially modulates gene expression during early embryo development, whereas the sHSPs, well known for their ability to prevent irreversible protein denaturation caused by environmental and physiological insult, may contribute to stress resistance. RNAi methodology is being employed to examine diapause-related roles of these and other proteins such as artemin, a ferritin homologue with chaperone activity. Mass spectrometry, in concert with two-dimensional gel electrophoresis, is also in use to investigate the embryo proteome, ultimately enhancing appreciation of the diapause developmental program in *Artemia*, a model experimental organism which is also used extensively as live food for larvae of commercially important species.

King, D. W., Colby College, Waterville, USA, dwking@colby.edu;
Powers, L. C., Colby College, Waterville, USA;
Ong, T., Colby College, Waterville, USA

REACTIVITY OF SUPEROXIDE IN NATURAL WATERS

Superoxide is a radical anion produced in surface waters by the photooxidation of dissolved organic matter. Because of its intermediate redox potential, superoxide participates in the oxidation of dissolved organic materials and the redox cycling of dissolved metal ions like iron and copper. Steady state superoxide concentrations in natural waters are in the picomolar to nanomolar range requiring sensitive chemiluminescence methods for detection. Two chemiluminescent reagents have been investigated, 2-Methyl-6-(4-methoxyphenyl)imidazo[1,2-a]pyrazin-3(7H)-one (MCLA) and 1,10-phenanthroline in a cetyldimethylethylammonium bromide micelle. Using these systems we have studied the reactivity of superoxide in natural waters. A surprising outcome of these studies is the reaction of superoxide with dissolved carbon dioxide to form the peroxycarbonate radical and subsequent dimers. Because carbon dioxide is ubiquitous in natural waters, the formation of the peroxycarbonate radical may significantly modify the reactivity of superoxide.

Kinney, E. L., Boston University Marine Program / Ecosystems Center, Marine Biological Laboratory, Woods Hole, USA, ekinney@bu.edu;
Valiela, I., Ecosystems Center, Marine Biological Laboratory, Woods Hole, USA, ivaliela@mbl.edu

NITROGEN LOADING AND SOURCES TO GREAT SOUTH BAY

Great South Bay on Long Island, New York has been the site of much research and monitoring. However, considerable time has elapsed since these earlier studies, and inexorably, human populations have increased, land covers have become more urbanized, and other land use changes have taken place, so it seemed timely to assess the current nutrient loading to Great South Bay. Moreover, there has been much discussion as to the relative importance of the various sources of land-derived materials that affect the waters of Great South Bay. To respond to such concerns, we have modeled the nitrogen loading to Great South Bay and identified the relative contribution of atmospheric, wastewater and fertilizer nitrogen to apply these results to possible management options for Suffolk County, NY. Wastewater from septic systems is the greatest source of nitrogen to Great South Bay (65%), with atmospheric deposition contributing 25% and fertilizer from lawns, golf courses and agriculture contributing 9%. Atmospheric deposition to impervious surfaces is of particular concern to stakeholders. For example, the South Shore Estuary Reserve Council was concerned that "urban runoff is the major problem in most cases of water quality degradation." In response to this concern, we have found that a conservative "worst-case scenario" estimate of direct runoff results in a 6% increase in total nitrogen load to Great South Bay.

Kling, G. W., University of Michigan, Ann Arbor, USA, gwk@umich.edu;
Keller, K. A., University of Michigan, Ann Arbor, USA, kateak@umich.edu;
Kipphut, G. W., Murray State University, Murray, USA, george.kipphut@murraystate.edu;
Bettez, N. D., Cornell University, Cornell, USA, ndb23@cornell.edu ;
Giblin, A. E., Marine Biological Lab, Woods Hole, USA, agiblin@mbl.edu

CLIMATE CHANGE: WHAT'S COMING DOWN THE PIKE FOR LAKES MAY BE FROM LAND

Despite clear evidence of warming, many measurements throughout the Arctic show a surprising lack of permafrost melting in soils. At the same time, we measured a doubling of alkalinity in Toolik Lake since 1975, and these changes are unrelated to lake processes and appear instead to be caused by increased weathering of mineral soils in the catchment. This is puzzling given that the depth of summer thaw has not increased over time to expose more mineral soil. Using geochemical methods we show that strontium isotopes (87Sr/86Sr) in soils decrease with depth, and we document a trend of decreasing 87Sr/86Sr in stream water entering Toolik Lake. The implication is that water flowpaths in the basin have progressively deepened and are now in contact with previously frozen soils of different chemistry. Because thaw depths on land have not changed during that time period, it is likely that the unfrozen thaw bulb underneath streams and lakes has actually expanded, and the deeper thaw there contributes most to the altered chemistry received by lakes. This 'unseen thaw' may be affecting other arctic aquatic systems as well.

Knickle, D. C., Fisheries Conservation Group/Fisheries and Marine Institute/Memorial University, St. John's, Canada, dcknickle@yahoo.com;
Rose, G. A., Fisheries Conservation Group/Fisheries and Marine Institute/Memorial University, St. John's, Canada, grose@mi.mun.ca

EFFECT OF SPAWNING PATTERNS ON DISPERSAL AND RETENTION OF EGGS AND LARVAE IN COASTAL ATLANTIC COD (GADUS MORHUA)

Egg and larval surveys were conducted simultaneously with hydroacoustic estimates of Atlantic cod (Gadus morhua) spawning behaviour, distribution and biomass during the spring and summer of 2006 and 2007, in Smith Sound, Trinity Bay, a known over wintering and spawning area. Spring egg distribution was consistent with acoustic observations of spawning cod, and indicated a high degree of dispersal of stage I eggs out of the Sound. Later in summer, stage I egg to larval densities were highest within the innermost portion of the Sound, suggesting significant retention and local development. We hypothesize that spawning cod in Smith Sound are a source of stock recruitment in two ways: through export (advection) of eggs and larvae away from the spawning site in spring and local retention and development later in the summer. We also hypothesize that these events represent different life history strategies (resident and migratory ecotypes) at play in this species.

Koch, U. E., Limnological Institute, University of Konstanz, Konstanz, Germany, Ully_Koch@gmx.de;
Von Elert, E., University of KÃln, Zoological Institute, Koeln, Germany, evelert@uni-koeln.de;
Straile, D., Limnological Institute, University of Konstanz, Konstanz, Germany, Dietmar.Straile@uni-konstanz.de

THE ROLE OF FOOD QUALITY OF THE RESTING EGG PRODUCTION OF TWO DAPHNIA CLONES

The role of food quality on growth and reproduction of the key herbivore Daphnia is well studied. However, Daphnia is a cyclic parthenogen animal and reproduces both asexually and sexually. The sexual part of the reproductive cycle is combined with resting egg production, another important fitness parameter. It is unknown how food quality affects sexual reproduction and resting egg production. In this study we examined the role of food quality on sexual reproduction and resting egg production of two Daphnia clones belonging to two species, D. pulex and D. galeata. Both Daphnia species were fed with two algae species known to differ in their biochemical composition. Under crowding conditions, both Daphnia reproduced parthenogenetically when fed the algal species Cryptomonas, but started producing resting eggs when fed with the green algal species Scenedesmus. Supplementation experiments suggested that the induction of resting egg production in Daphnia was due to a dietary deficiency in the green alga.

Kodama, M., National Research Institute of Fisheries Science, Fisheries Research Agency, Japan, Yokohama, Japan, mkodama@affrc.go.jp;
Kimoto, K., Seikai National Research Institute of Fisheries Science, Fisheries Research Agency, Japan, Nagasaki, Japan, kimoto@fra.affrc.go.jp

CHARACTERISTICS OF SUSPENDED PARTICULATE ORGANIC MATTER AND ITS IMPLICATIONS FOR THE OXYGEN DEPLETION OF BOTTOM WATER IN THE ARIAKE BAY, JAPAN

During the summer of 2007, spatio-temporal distribution and elemental composition of suspended particulate organic matter (SPOM) and dissolved oxygen concentration (DO) of bottom water were investigated in the turbid macro tidal estuary, Ariake Bay, Japan. Oxygen consumption rate of SPOM in the bottom water and sediment were also measured and those effects on the depletion of bottom DO were investigated. During the neap tides, bottom DO decreased, especially at the shallow station, and recovered to higher level during spring tides. For the decrease of bottom DO during neap tides, contribution of oxygen consumption by SPOM was dominant rather than that of sediment. While oxygen consumption rate of SPOM was principally explained by the particulate organic carbon (POC) concentration, oxygen consumption rate per carbon content (mgO_2/mgC/day) shows significant positive correlation with carbon stable isotope $\delta^{13}C$. Furthermore, considering the distribution and composition of SPOM in the Ariake Bay, it is suggested that the POC in the bottom water originated from the marine phytoplankton plays important role for the formation of hypoxia in the inner Ariake Bay.

Koester, J. A., University of Washington, School of Oceanography, Seattle, USA, koesterj@u.washington.edu;
Swalwell, J., University of Washington, School of Oceanography, Seattle, USA, jarred@u.washington.edu;
van den Engh, G., University of Washington, School of Oceanography, Seattle, USA, gvdengh@u.washington.edu;
Armbrust, E. V., University of Washington, School of Oceanography, Seattle, USA, armbrust@ocean.washington.edu

RELATIONSHIPS BETWEEN DNA CONTENT, CELL SIZE AND GROWTH RATE IN POPULATIONS OF THE PLANKTONIC DIATOM DITYLUM BRIGHTWELLII

Ditylum brightwellii from Puget Sound, WA maintains population structure despite living in a well-mixed environment. In other organisms, changes in genome size can drive population divergence and eventually speciation. DNA content, therefore, was compared for recent isolates from two Puget Sound populations (A and B) that have different ITS1 sequences. A flow-cytometer was modified for large cells and used to determine relative DNA content. Population B isolates were larger, grew more slowly, and contained approximately 1.5 times more DNA per cell than isolates from Population A. We also examined D. brightwellii isolates collected from Akaroa Harbor, New Zealand. Isolates from New Zealand and Population A shared identical ITS1 sequences and were similar in size. However, the growth rates of New Zealand isolates were within the range of the slowly-growing isolates of Population B, despite having different ITS1 sequences, suggesting that cell size is not an absolute predictor of growth rate. It appears that macroevolutionary processes mediate ecological differentiation for closely related diatom populations living in sympatry, whereas microevolution is more prevalent in populations differentiating in geographically distant regions.

Kohler, C. C., Southern Illinois University, Carbondale, USA, ckohler@siu.edu;
Trushenski, J. T., Southern Illinois University, Carbondale, USA;
Lewis, H. A., Southern Illinois University, Carbondale, USA;
Meyer, S. M., Southern Illinois University, Carbondale, USA;
Lane, R. L., Southern Illinois University, Carbondale, USA

POLYUNSATURATED FATTY ACIDS MAY BE SELECTIVELY RETAINED BY SOME FISHES AND SATURATES SELECTIVELY CATABOLIZED: EVIDENCE FROM NUTRITIONAL STUDIES WITH MORONIDS

Fish nutritionists are striving to minimize use of marine-derived feedstuffs in aquaculture with minimum loss of long-chain (>20 carbon atoms) polyunsaturated fatty acids (PUFA) in the fillets. Alternative lipids in growout feeds include various grain products containing 18-carbon, medium-chain (MC) PUFA, which subsequently predominate in the fillets. Implementation of 'finishing' feeds can have a restorative effect on fillet FA composition, however, the duration of the finishing period can

be extensive, and profile restoration is frequently incomplete. We suggest this occurs due to selective FA metabolism in some fishes and provide evidence in hybrid striped bass (HSB, female white bass Morone chrysops X male striped bass M. saxatilis) that saturates may be preferential catabolic substrates while MC-PUFA and LC-PUFA are selectively deposited. Accordingly, MC-PUFA competes with bioactive LC-PUFA for deposition in fillet tissue, impeding restoration of the FA profile. We found striped bass apparently have less ability to selectively catabolize LC- and MC-PUFA. Our preliminary evidence suggests white bass FA metabolism is similar to the hybrid, indicating selective FA metabolism in the hybrid is maternally influenced. Given most carnivorous fishes (including Moronids) have limited ability to synthesize sufficient amounts of LC-PUFA de novo, selective FA metabolism in white bass may be an adaptation to cope with the relative scarcity of LC-PUFA in freshwater environs.

Korhola, A., University of Helsinki, Helsinki, Finland, atte.korhola@helsinki.fi;
ForsstrÃm, L., University of Helsinki, Helsinki, Finland, laura.forsstrom@helsinki.fi;
Nyman, M., University of Helsinki, Helsinki, Finland, marjut.nyman@helsinki.fi;
Rautio, M., University of Jyväskylä, Jyväskylä, Finland, milla.rautio@bytl.jyu.fi;
Sorvari, S., University of Helsinki, Helsinki, Finland, sanna.sorvari@helsinki.fi;
WeckstrÃm, J., University of Helsinki, Helsinki, Finland, jan.weckstrom@helsinki.fi

15 YEARS OF POLAR LAKE RESEARCH IN FINNISH LAPLAND: A SYNTHESIS

Little was known about the limnology and palaeolimnology of polar lakes in Finnish Lapland before we launched intensive research on their physical, chemical and biological characteristics and limnological development about 15 years ago. Our extensive studies have shown, inter alia, that (1) many small lakes have undergone drastic changes in their thermal features and water volumes during lake development; (2) in contrast to often quite distinct changes in physical limnology, changes in chemical conditions have been relatively moderate and smooth during lake ontogenies; (3) the impacts of acid rain and other pollutants on the lakes have been minor during their recent histories; (4) major ecological reorganisations have taken place in the lakes due to recent global warming; (5) spring time is the most dynamic season in the limnology of the lakes; and (6) the lake's thermal features are extremely sensitive to even minor changes in weather conditions. Our future work will concentrate on understanding more comprehensively the responses of various types of lakes to climate change as well as using novel palaeolimnological techniques to decipher information about changes in lake ecosystem structure.

Korkonen, S., University of Helsinki, Helsinki, Finland, sanna.korkonen@helsinki.fi;
Korhola, A., University of Helsinki, Helsinki, Finland, atte.korhola@helsinki.fi;
Sorvari, S., University of Helsinki, Helsinki, Finland, sanna.sorvari@helsinki.fi;
Weckström, J., University of Helsinki, Helsinki, Finland, jan.weckstrom@helsinki.fi

A QUEST TO FIND A CYCLOTELLA INCREASE DURING THE HOLOCENE THERMAL MAXIMUM IN SUBARCTIC LAKE SAANAJÄRVI

Previous surface sediment studies in subarctic Lake Saanajärvi (located in NW Finnish Lapland) show a distinct change in diatom assemblages from benthic to planktonic species within the last 100 years. The increase of small planktonic *Cyclotella comensi*s and *Cyclotella glomerata* in the lake is considered to be associated with the recent Arctic warming. To find out if similar changes occurred in the diatom species composition during an earlier warm period i.e. the Holocene Thermal Maximum (HTM ca. 8000-6000 years ago), a diatom analysis from a Holocene sediment core was carried out. The small *Cyclotella* species were present in very low numbers or absent during the HTM. If their occurrence cannot be explained by temperature alone what causes their abundance in the lake now? Modern day peak in numbers might be caused by the co-effect of both rising temperatures and increasing nutrient availability, changes in the stratification pattern and mixing, or differences in competition compared to early Holocene.

Kostka, J. E., Florida State University, Tallahassee, USA, jkostka@ocean.fsu.edu;
Gihring, T. M., Florida State University, Tallahassee, USA, gihring@ocean.fsu.edu;
Lavik, G., Max Planck Institute for Marine Microbiology, Bremen, Germany, glavik@mpi-bremen.de;
Kuypers, M., Max Planck Institute for Marine Microbiology, Bremen, Germany, mkuypers@mpi-bremen.de

THE RATES AND PATHWAYS OF NITROGEN REMOVAL FROM ARCTIC FJORDS

Despite the potential significance of polar regions to the global N cycle and their susceptibility to global climate change, few rate measurements of nitrogen removal are available from shallow estuaries of the Arctic region. Nitrogen removal rates and the temperature regulation of microbial communities that mediate N removal were investigated in permanently cold sediments (1-3 oC) from Arctic fjords of the Svalbard archipelago using a combination of the isotope pairing technique (IPT) and membrane inlet mass spectrometry (MIMS). Direct rate measurements by MIMS indicate nitrogen loss rates that rival those measured in comparable temperate environments. In intact core incubations which employed IPT, anammox comprised the majority of nitrogen removal in sediments exhibiting low overall organic matter turnover, while denitrification predominated in sediments in which organic matter turnover is high. Anammox activity showed an optimum temperature of 9 oC indicating a psychrophilic response, while denitrification activity showed a mesophilic response with an optimum of 26 oC at one of the Svalbard sites. To our knowledge, we provide the first direct rate measurements of N removal from polar marine sediments using the N2/Ar approach. In addition, we confirm the significance of anammox in Arctic sediments through rate measurements in intact core incubations.

Kotzur, S., University of Oldenburg, Oldenburg, Germany, kotzur@icbm.de;
Dürselen, C. D., AquaEcology, Oldenburg, Germany, duerselen@aquaecology.de;
Raabe, T., AquaEcology, Oldenburg, Germany, raabe@aquaecology.de;
Brockman, U., University of Hamburg, Hamburg, Germany, brockmann@uni-hamburg.de;
Kohlmeier, C., University of Oldenburg, Oldenburg, Germany, kohlmeier@icbm.de;
EbenhÃh, W., University of Oldenburg, Oldenburg, Germany, ebenhoeh@icbm.de

PRIMARY PRODUCTION IN A MESOCOSM - A MODELLING STUDY

The European Regional Seas Ecosystem Model (ERSEM) has been used to study the diurnal and the seasonal dynamics of phytoplankton in coastal mesocosms on different nutrient supply conditions. In addition to the original formulation of the primary production module in ERSEM, we present a revised model that focuses on (i) a dynamic description of the carbon to chlorophyll ratio depending on the light climate and nutrient availability, (ii) the co-limitation of the nutrient uptake rate by other nutrients and (iii) the carbon storage capacity of diatoms and thus varying carbon to silicate ratios. The model enhancements are shown to be essential for an accurate reproduction of the observed dynamics in the mesocosm experiments. Disregarding these processes may lead to an incorrect estimation of nutrient consumption by phytoplankton and primary production. Furthermore the consideration of the large variability of the carbon to chlorophyll ratio on smaller timescales like bloom events as well as on seasonal time scales is fundamental for a correct interpretation of chlorophyll based comparisons between model results and field data.

Kowalke, G. L., Oregon State University, Corvallis, USA, gkowalke@coas.oregonstate.edu;
Batchelder, H. P., Oregon State University, Corvallis, USA, hbatchelder@coas.oregonstate.edu

POTENTIAL TRANSPORT OF THE COPEPOD, *CALANUS FINMARCHICUS*, IN THE LABRADOR SEA AND SCOTIAN SHELF REGIONS DURING DIAPAUSE.

Calanus finmarchicus is common throughout the North Atlantic with peak abundances in the Labrador, Norwegian, and Barents Seas. During the late summer, *C. finmarchicus* sinks to depths greater than 300m, and enters diapause for up to six months. Continental shelves, such as

the Scotian Shelf and the Gulf of Maine, are too shallow and must be seasonally repopulated by individuals from adjacent basins through ascent and onshore transport. The southward Labrador Current may transport diapausing *C. finmarchicus* from the Labrador Sea to these shelf regions. Using an individual-based model (IBM) coupled to ROMS simulations we evaluate the potential transport of diapausing *C. finmarchicus* from the Labrador Sea to the Scotian and Slope regions. We examine high-NAO(1980-1993) and low-NAO (1962-1971) periods. Particles were seeded at depths of 300m to 1000m in the Labrador Sea, and were tracked throughout diapause. Diapause duration was determined in two ways: (1) copepodites emerge from diapause at predetermined dates; (2) emergence from diapause was based upon temperature-dependent depletion of lipid stores by copepodites.

López Correa, M., University of Erlangen / Institute of Paleontology, Erlangen, Germany, lopez@pal.uni-erlangen.de;
Montagna, P., ICRAM / Central Institute of Marine Research, Rome, Italy;
Rüggeberg, A., IFM-GEOMAR, Kiel, Germany;
McCulloch, M., RSES-ANU / Australian National University, Canberra, Australia;
Taviani, M., CNR-ISMAR, Bologna, Italy;
Freiwald, A., University of Erlangen / Institute of Paleontology, Erlangen, Germany

TRACE ELEMENTS AND STABLE ISOTOPES IN RECENT NORTH ATLANTIC LOPHELIA PERTUSA ALONG A LATITUDINAL GRADIENT AND FROM FOSSIL MEDITERRANEAN SITES

Along a latitudinal transect Recent cold-water corals (*Lophelia pertusa*) from the North Atlantic and the Mediterranean were sampled for trace element (LA-ICP-MS) and stable isotope composition (Micromill). Bathyal sites from boreal (72°N) to tropical (7°S) latitudes span a wide range of environmental settings: from eutrophic to oligotrophic, temperatures of 5.5 to 14°C and different seasonality. Boreal corals exhibit annual theca-banding. Trace element levels are often microstructure-linked (B, Mg, Ba, U, P and Li/Ca), but Sr/Ca less so. Stable isotopes show strong vital effects, with strict $\delta^{18}O/\delta^{13}C$-correlation and regression lines form three clusters (Norwegian Sea, Mid-Atlantic and Mediterranean with deep-outflow), reflecting watermasses. Lines-technique temperature-reconstructions are difficult, due to varying metabolic carbon. Mg/Ca and U/Ca ratios are also highly correlated ($Y=X^{-1}$) and equal for all sites, reflecting dominant geochemical/biological control independent of temperature. Mg/Ca and U/Ca exhibit respectively negative and positive linear correlation with $\delta^{18}O$. Their regression intercept is always at 2.18 ± 0.05 mmol/mol and the corresponding $\delta^{18}O$-value coincides with the expected aragonite equilibrium, calculated from ambient seawater-temperature and oxygen isotope composition. This relationship yields good paleotemperatures for Glacial to Holocene Mediterranean corals.

Laforsch, C., Ludwig-Maximilians University Munich, Munich, Germany, laforsch@bio.lmu.de;
Petrusek, A., Charles University in Prague, Prague, Czech Republic;
Tollrian, R., Ruhr-University Bochum, Bochum, Germany;
Schwenk, K., Johann Wolfgang Goethe-University, Frankfurt, Germany

Â€ŒCROWN OF THORNSÂ€ PROTECTS DAPHNIA AGAINST AN ANCIENT PREDATOR: AN EXCEPTIONAL INDUCIBLE DEFENSE DISCOVERED BY DNA BARCODING

Here we present an example how DNA barcoding in combination with morphological and ecological data unraveled a striking predator-prey interaction of aquatic organisms. The ÃƒÆ'¢Ã¢â‚¬Å¡Ã¡Ãƒâ€¦"crown of thornsÃƒÆ'¢Ã¢â‚¬Å¡Ã¡Ã¯¿½ a conspicuous morphological feature among members of the Daphnia atkinsoni group, has been considered to represent a species specific trait. However, our study shows that this feature is phenotypically plastic and induced by chemical cues released by Triops cancriformis, the tadpole shrimp (Notostraca). The trait acts as effective defense and is found in several Daphnia lineages coexisting with notostracans and enhances efficiently the survival, suggesting that the ÃƒÆ'¢Ã¢â‚¬Å¡Ã¡Ãƒâ€¦"crown of thornsÃƒÆ'¢Ã¢â‚¬Å¡Ã¡Ã¯¿½ evolved specifically in coexistence with this ancient predator species. Our study emphasizes moreover, that a DNA barcoding approach might open the avenue for the identification of ecological and evolutionary relevant causalities.

Lancaster, J., University of Edinburgh, Edinburgh, United Kingdom, J.Lancaster@ed.ac.uk;
Downes, B. J., University of Melbourne, Melbourne, Australia, barbarad@unimelb.edu.au;
Arnold, A., University of Edinburgh, Edinburgh, United Kingdom, a.arnold@ed.ac.uk

LIFE BEFORE ADVECTION: RECRUITMENT LIMITATION OF A QUINTESSENTIAL STREAM DRIFTER AT LOCAL AND REGIONAL SCALES

Long-distance dispersal by advection is thought important for species frequently found in the drift, but measuring how far individuals travel is difficult. We used novel methods to shed light on whether drift is important for baetid mayfly nymphs. *Baetis* is generally considered to be the quintessential drifter, and drift is often assumed to be important in its population dynamics. If true, we predicted that there should be no correlations between the numbers of adjacent life-history stages at local scales, as dispersing nymphs should blur patterns caused by local variation. Nevertheless, an ambitious field survey of *Baetis rhodani* showed that egg mass density was positively associated with the availability of oviposition spots at both local and regional scales (30 m vs 1 km stream lengths). Neonate and egg mass densities were also positively associated, consistent with the hypothesis that neonates do not drift far, an outcome supported by estimates of size-specific drift rates. We question whether long-distance drift is frequent for baetids, and suggest that recruitment limitation and small-scale environmental variation might play bigger roles than previously appreciated.

Landrum, J. P., Georgia Institute of Technology, Atlanta, USA, jason.landrum@gatech.edu;
Altabet, M. A., University of Massachusetts, Dartmouth, North Dartmouth, USA, maltabet@umassd.edu;
Montoya, J. P., Georgia Institute of Technology, Atlanta, USA, joseph.montoya@biology.gatech.edu

INPUTS OF NEW NITROGEN TO THE PLANKTONIC FOOD WEB ALONG A ZONAL TRANSECT IN THE NORTH ATLANTIC OCEAN

New N inputs via biological N_2 fixation play a critical role in supporting oceanic primary production and influencing global biogeochemical cycles. Numerous studies have documented significant N_2 fixation rates in the North Atlantic, but little is known of the pathways and fluxes of new N through the planktonic food web. Stable isotopes can effectively discriminate between the main sources of N for these organisms and reveal the major pathways of nitrogen flow. We measured the $\delta^{15}N$ of NO_3^-, bulk particles, and size-fractionated zooplankton communities along a zonal transect in the North Atlantic at 32°N (75.0°W to 21.3°W) to determine the extent to which N_2 fixation supports biological production. We found that N_2 fixation is a key component in supporting primary production throughout the subtropical North Atlantic Ocean, while zooplankton $\delta^{15}N$ patterns suggest either broad geographical differences in diazotroph contribution to secondary production, or differential utilization of diazotrophic N by zooplankton in different regions. Our isotopic measurements also imply that zooplankton vertical migration may play a key role in the movement of N produced by diazotrophs into deeper waters.

Larsen, L. G., U.S.G.S., Reston, VA, USA, Laurel.Griggs@colorado.edu;
Harvey, J. W., U.S.G.S., Reston, VA, USA, jwharvey@usgs.gov;
Noe, G. B., U.S.G.S., Reston, VA, USA, gnoe@usgs.gov;
Crimaldi, J. P., University of Colorado, Boulder, CO, USA, crimaldi@colorado.edu

ENTRAINMENT, SETTLING, AND AGGREGATION OF ORGANIC WETLAND FLOC AND IMPLICATIONS FOR LANDSCAPE DEVELOPMENT

Entrainment, settling, and aggregation of floc significantly impact mass fluxes in aquatic environments. However, organic floc dynamics remain poorly understood, particularly in wetlands, where these processes can affect landscape evolution. We quantified transport properties of floc from an Everglades patterned peatland through flume and settling column experiments. Like marine and wastewater aggregates, the wetland floc had low bulk densities and settling velocities. Unlike most floc, Everglades floc was entrained at a very low bed shear stress (2.0×10^{-2} Pa) and experienced insignificant disaggregation over the expected velocity range.

Despite the low entrainment threshold and often highly organic nature of wetland floc, wetland suspended particle dynamics are expected to be dominated more by the balance between settling and entrainment than by aggregation and disaggregation, due to typically slow flow velocities. During relatively high-flow conditions in the historic Everglades, floc was likely entrained within sloughs and settled in ridges of emergent sawgrass, effecting a net redistribution that reinforced the topographic relief of the patterned landscape. However, present-day shear stresses rarely exceed the entrainment threshold, which has implications for Everglades restoration.

Larson, C. A., University of Texas at Arlington, Arlington, USA, clarson@uta.edu;
Passy, S. I., University of Texas at Arlington, Arlington, USA, sophia.passy@uta.edu

STRUCTURAL AND SUCCESSIONAL CHARACTERISTICS OF ARTIFICIAL STREAM PERIPHYTON COMMUNITIES RESPOND TO CURRENT REGIME

Periphytic biofilms provide excellent study systems for examining how communities are assembled in space and time. In streams and rivers, periphytic biofilm communities are highly responsive to modifications in water flow resulting in substantial shifts in species abundance and richness. We investigated how current velocity influences the 3D community structure of stream biofilms throughout succession with an experiment in recirculating artificial streams. We subjected periphytic communities accumulating on ceramic tiles to different water velocity regimes (10 and 30 cm Ã¢â‚Â¢ sec^{-1}) and examined them with confocal and light microscopy. Bioflilms growing in faster currents had simpler 3D organization and lower genera richness than biofilms from slow currents. Algal genera richness was correlated with biofilm structural properties. Low richness was associated with low structural complexity, both at the level of individual algal patches as well as the entire biofilm mosaic. By the end of the experiment (35 days), periphytic communities in high velocity streams were dominated by diatoms, while more diverse periphytic communities developed in low velocity streams.

Lasternas, S., CSIC, Esporles, Spain, sebastien.lasternas@uib.es;
Agustí, S., CSIC, Esporles, Spain, sagusti@uib.es;
Duarte, C. M., CSIC, Esporles, Spain, carlosduarte@ifisc.uib.es;
Regaudie-de Gioux, A., CSIC, Esporles, Spain, aurore.regaudie@uib.es

ICE MELTING IMPACTS ON PELAGIC ARCTIC PRODUCTION: RECENT EVIDENCE FROM FIELD OBSERVATIONS

Intense warming of the Arctic is leading to rapid loss of summer ice cover. As part of the International Polar Year, the Spanish ATOS cruise aimed at evaluating the consequences of Arctic ice melting for pelagic communities. The ATOS cruise took place in the summer of 2007, when record Arctic ice melting was observed. The impacts of ice melting on primary production, evaluated using both C14 incorporation and O2 production, was examined across a range of conditions, from waters receiving ice melting to open waters away from the ice front. Phytoplankton biomass and primary production declined sharply as salinity decreased, indicating a reduction in primary production and phytoplankton biomass with ice melting. These results suggest a suppression of primary production with Arctic ice melting, in contrast with the enhancement of bloom development associated with ice melting in Antarctic waters.

Laurent, A., Dalhousie University, Halifax, Canada, arnaud.laurent@dal.ca;
Vézina, A. F., Bedford Institute of Oceanography, Dartmouth, Canada, VezinaA@mar.dfo-mpo.gc.ca;
Cullen, J. J., Dalhousie University, Halifax, Canada, John.Cullen@dal.ca

SUMMER WIND EVENTS AND PLANKTONIC COMMUNITY STRUCTURE IN LUNENBURG BAY, CANADA

The prevailing summer southwesterly winds along the Atlantic coast of Nova Scotia result in the development of upwelling events on the inner shelf. These pulsing events can lead to enhanced exchanges and nutrients availability in bays and estuaries, resulting in a significant source of biological and physical variability. The objectives of this study are to evaluate the influence of upwelling events on the inshore-offshore coupling and its effects on plankton communities in nearshore pelagic systems. Seasonal variability in plankton biomass and community structure are studied in Lunenburg Bay in relation to meteorological events. A six-year dataset (2002-2007) from an in situ coastal observatory (www.cmep.ca) was analyzed to relate seasonal physical variability with changes in phytoplankton biomass measured from the apparent optical properties of the water. In addition, a weekly sampling experiment (June-August 2006) was conducted along an inshore-offshore transect. CTD profiles, plankton composition (cell counts), nutrients and chlorophyll concentrations are used to demonstrate contrasting conditions at inshore and offshore sites which can be related to the occurrence of upwelling events and their effects on inshore-offshore coupling.

Lavoie, I., Université du Québec à Trois-Rivières, Trois-Rivières, Canada, ilavoie@trentu.ca;
Campeau, S., Universite du Quebec à Trois-Rivières, Trois-Rivières, Canada, stephane.campeau@uqtr.ca

FISHING FOR DIATOMS: FISH GUT ANALYSIS REVEALS PAST DIATOM ASSEMBLAGES

A better understanding of reference conditions is needed to identify target communities representing the level of ecological integrity to reach for stream restoration. However, defining the reference state of some highly perturbed sites is challenging since their non-altered state is rarely encountered. Sediment cores are commonly used in paleolimnology to estimate past environmental conditions, but are not appropriate for paleolimnological study of lotic systems where sediments are periodically washed downstream. Studies have shown that diatom assemblages extracted from fish guts are comparable to diatom samples collected from rock scrapes. Fish collected from streams in Ontario and Québec (Canada) from the early 19th century to the present were used to sample diatoms from gut content. Paleo-diatom communities from the gut content analysis were compared with modern communities to evaluate the ecological status of several sites and their deviation from the reference status over time. This study provides information on how lotic ecosystems in Ontario and Québec have fluctuated following anthropogenic activities, and how diatom communities have responded to increasing water pollution.

Lavoie, R. A., University of Ottawa, Ottawa, Canada, raphaelavoie@hotmail.com;
Hill, L., University of Ottawa, Ottawa, Canada, lhill032@uottawa.ca;
Yumvihoze, E., University of Ottawa, Ottawa, Canada, eyumvi@uottawa.ca;
Rail, J. F., Canadian Wildlife Service, Québec, Canada, jean-francois.rail@ec.gc.ca;
Lean, D. R., University of Ottawa, Ottawa, Canada, dlean@uottawa.ca

INSIGHTS ON THE DISTRIBUTION OF MERCURY IN A GULF OF ST. LAWRENCE FOOD WEB FROM STABLE NITROGEN AND CARBON ISOTOPE ANALYSIS

The objective of this study was to determine the variables that are driving total mercury (THg) and methyl-mercury (MeHg) concentrations in a Gulf of St. Lawrence food web from zooplankton to seabirds. Stable isotope analysis was used to provide information on the trophic level and the source of the organic matter. We found that the trophic level was the main contributor of elevated THg concentrations and that the source of the organic matter was a minor contributor. The relationship with trophic level was even stronger for MeHg whereas no correlation was found with the source of the organic matter. We found that there was no trophic enrichment of the inorganic mercury suggesting that MeHg was the exclusive biomagnifying species. Inorganic Hg was correlated with the source of the organic matter which implies that MeHg is not linked to benthos. This study suggests that elevated THg concentrations are more likely to be associated with predators that feed in the benthos whereas variations of MeHg are almost exclusively explained by trophic level.

Le Clainche, Y., Québec-Océan, Université Laval, Quebec, Canada, yvonnick.leclainche@giroq.ulaval.ca;
Vézina, A. F., Bedford Institute of Oceanography, Dartmouth, Canada, vezinaa@dfo-mpo.gc.ca;
Levasseur, M., Québec-Océan, Université Laval, Quebec, Canada, Maurice. Levasseur@bio.ulaval.ca;
Allen, I., Plymouth Marine Laboratory, Plymouth, United Kingdom, jia@pml.ac.uk;
Archer, S., Plymouth Marine Laboratory, Plymouth, United Kingdom, stda@pml.ac.uk;
Cropp, R., Centre for Environmental Systems Research, Griffith University, Nathan, Australia, R.Cropp@griffith.edu.au;
Deal, C., International Arctic Research Center, University of Alaska, Fairbanks, USA, deal@iarc.uaf.edu;
Jin, M., International Arctic Research Center, University of Alaska, Fairbanks, USA, mjin@iarc.uaf.edu;
Vallina, S., School of Environmental Science, University of East Anglia, Norwich, United Kingdom, sergio.vallina@uea.ac.uk

A 1D OCEAN ECOSYSTEM-DMS MODELS COMPARISON (SOLAS CODIM)

As part of the first CODiM (Comparison of Oceanic Dimethylsulfide Models) workshop, we report on the comparison of five 1D ecosystem-DMS models of different levels of complexity. The models were tested at three oceanic stations in the subtropical north Atlantic (BATS), the western Mediterranean (DYFAMED) and the subarctic northeast Pacific (OSP). Their simulations were compared to local time series of Chl-a, particulate DMSP and DMS. Models that were applied at all the stations showed varying performance in simulating Chl-a, pointing to portability issues. Each model showed a distinct signature in ecological dynamics that persisted across stations and had a strong impact on the simulated DMS cycling response. More specifically, some models revealed the need to incorporate direct impact of environmental forcing (e.g. irradiance) on DMS cycling, so as to reproduce the decoupling between the summer DMS maxima and the earlier winter-spring phytoplankton bloom. Even though the mechanisms involved are not yet well understood, the capacity to dissociate the DMS(P) dynamics from the dynamics of the parent ecosystem model is clearly a crucial issue in ecosystem-DMS modelling.

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

DEGRADATION OF LAKE ECOSYSTEMS BY ANTHROPOGENIC NITROGEN: A NEW PARADIGM FOR FUTURE LAKE EUTROPHICATION

This model proposes that a combination of population growth, agricultural intensification, N fertilization, and shifts in societal preference for N-rich foodstuffs will create conditions in which future water quality and cyanobacterial abundance are regulated by flux of reduced N, particularly urea. Traditionally, farming practices slowly raise soil P content because P is easily imported to catchments and because N:P ratios of manure are lower than many crop requirements. As a result, old agricultural soils may be saturated with P and will remain so for centuries, leading to conditions in which P influx no longer regulates lake production. Unfortunately, 15-fold increases in N fertilization since 1970, combined with shifts from NH3 to urea, may now favour energy-efficient, but toxic, cyanobacteria. Further, because toxin production increases with growth rate and N supply, and because cyanobacteria may prefer urea over other N sources, future degradation of water quality may be linked to diffuse N influx. Given that ~1 billion people presently lack clean water, there is significant need to develop a predictive understanding of the unique effects of N in P-rich lakes.

LeBlanc Renaud, S., University of Ottawa, Ottawa, Canada, slebl027@uottawa.ca;
Pick, F., University of Ottawa, Ottawa, Canada, frances.pick@uottawa.ca;
Saleem, A., University of Ottawa, Ottawa, Canada;
Aranda-Rodriguez, R., Health Canada- Chemistry Research Division, Ottawa, Canada

THE EFFECT OF LIGHT INTENSITY ON GROWTH AND THE PRODUCTION OF DIFFERENT MICROCYSTIN CONGENERS IN THE CYANOBACTERIUM MICROCYSTIS.

Light quality and intensity have been shown to affect the growth of cyanobacteria along with the production of cyanotoxins including microcystins. However, few studies have determined whether light affects the production of specific microcystin congeners. The goal of this study was 1) to determine the effect of light intensity on total microcystin production and the production of different microcystin congeners in Microcystis aeruginosa and 2) to determine if light intensity affects the growth rate of toxic and non-toxic strains differently. Six strains of M. aeruginosa were grown in batch cultures at 25Ãƒ Æ'Ã†â€™Ãƒâ€ 'Ãƒ Æ'Ã¢Ã¢â‚¬Å¡Ãƒâ€¦Ã¡Ãƒ Æ'Ã†â€™Ã¢Ã¢â€š ÂÃ…Ã¡Ãƒ Æ'Ã¢â‚¬Å¡Ãƒâ€šÂ°C under continuous illumination at three levels of light intensity. Growth rate, cell density (by flow cytometry), and production of microcystin congeners variants (by HPLC-MS) were measured for each culture. No significant differences in growth rate were observed between toxin and non-toxin producing strains. Among the microcystin producing strains there were significant differences in the number and identity of congeners produced and in the total amount of microcystin produced under different light intensities. This indicates that each strain may represent a distinct chemotype in terms of microcystin production.

Leech, D. M., Institute of Marine Sciences, University of North Carolina at Chapel Hill, Morehead City, USA, dmleech@email.unc.edu;
Piehler , M. F., Institute of Marine Sciences, University of North Carolina at Chapel Hill, Morehead City, USA, mpiehler@email.unc.edu;
Waters, M. N., University of South Florida, St. Petersburg, USA, mwaters@stpt.usf.edu

CURIOUS BEHAVIORS AMONG ZOOPLANKTON INHABITING SHALLOW, COASTAL LAKES IN NORTH CAROLINA, USA

The lakes of the Albemarle-Pamlico Peninsula display exemplary effects of environmental heterogeneity on zooplankton. We studied three lakes that lie in close proximity (maximum distance 34 km) with similar land use and climate but differ in their morphology, productivity, and transparency. Lake Mattamuskeet (161.87 km^2) is divided into two basins by a highway with one basin dominated by macrophytes and the other by phytoplankton. Lake Phelps (67.18 km^2) is clear and oligotrophic, and Pungo Lake (11.33 km^2) is dystrophic. Planktivorous fish are present in all lakes but least abundant in Pungo. These environmental differences are correlated with differences in zooplankton community structure and diel vertical migration (DVM). Lake Mattamuskeet is dominated by small-bodied copepods and rotifers, which are more abundant and exhibit reverse DVM in the phytoplankton-dominated basin. Lake Phelps is dominated by rotifers, which also show reverse DVM. Pungo Lake contains large-bodied copepods and cladocerans exhibiting typical DVM movements despite low light levels and fish abundance. Between-lake differences in light transparency and predation pressures suggest the observed migration patterns are the result of different cues in each lake.

Legendre, L., Villefranche Oceanography Laboratory, Villefranche-sur-Mer, France, legendre@obs-vlfr.fr;
Rivkin, R. B., Memorial University of Newfoundland, St. John's, Canada, rrivkin@mun.ca

EFFECTS OF ZOOPLANKTON FAECAL PELLET PRODUCTION ON THE EXPORT OF ORGANIC MATTER AND ON ITS REMINERALIZATION WITHIN THE EUPHOTIC ZONE

The dissolved and particulate organic matter that is exported (E) from the euphotic zone is correlated with water temperature in the World Oceans, where it ranges from >60% of primary production at 0-10°C to 10-20% at 25°C. The organic matter that is not exported is respired in the euphotic zone. Export mechanisms vary, and include mixing of water, sinking of particles, and vertical migrations of organisms. The sinking particles include phytodetritus, remains of organisms, organic aggregates, and faecal pellets. The ratio of zooplankton faecal pellet export to faecal pellet production (i.e. EF:PF) varies widely, from negligible to about 60%. Although the factors that control EF:PF are poorly known, it has been proposed that EF:PF is related to the pelagic food-web type (e.g. grazing dominated by large copepods vs. smaller zooplankton). In the present study, we use a combined food-web and biogeochemical model to explore the effects of temperature and pelagic food-web type (i.e. herbivorous, multivorous, and microbial; food-web type determines EF:EP) on the contribution of EF to E, and the partitioning of euphotic-zone respiration between microbes and metazoans.

Legendre, L., CNRS, Villefranche sur Mer, France, legendre@obs-vlfr.fr;
Rivkin, R., Memorial University of Newfoundland, St. John's, Canada, rrivkin@mun.ca

HOW DO THE VERY SMALL-SIZED AQUATIC MICROBES INFLUENCE THE VERY LARGE-SCALE BIOGEOCHEMICAL CYCLES?

Marine and freshwater microbes dominate the production and cycling of organic matter in aquatic systems, where they mediate the biogeochemical cycling of biologically relevant chemical elements and climatically active gases (e.g. CO2, NOx, DMS). This has led to increasingly large numbers of budget, process and modelling studies. Reviewing this topic could fill several books. This tutorial will not attempt to review the literature on the roles of microbes in aquatic biogeochemical cycles, but will instead focus on some general mechanisms that allow the very small-sized microbes to influence the very large-scale biogeochemical cycles. Our presentation will explore the contrasting ideas that pelagic microbes are key components of biogeochemical cycles because of intrinsic characteristics (e.g. high metabolic rates) coupled with large standing stocks, or alternatively, because of their unique positions in aquatic food webs, where they are the main producers, consumers and remineralizers of organic matter. The combined action of bottom-up (i.e. environmental) and top-down (i.e. food-web) processes focuses inorganic and organic compounds toward microbes, which transform and redirect them toward the inorganic environment and the remainder of aquatic food webs.

Lehman, J. C., University of California, Santa Cruz, Santa Cruz, USA, jlehman@ucsc.edu;
McCarthy, M. D., University of California, Santa Cruz, Santa Cruz, USA, mccarthy@pmc.ucsc.edu

COUPLED 13C AND 15N PATTERNS OF INDIVIDUAL AMINO ACIDS IN PROKARYOTIC VS. EUKARYOTIC PHYTOPLANKTON PRODUCTION

Traditional d13C and d15N bulk isotopic measurements have been used to evaluate source and transformation of marine organic matter (OM). Compound specific amino acid (AA) 13C and 15N measurements are a relatively new tool, which may be able to elucidate source, metabolic transformation, and extent of microbial degradation affecting marine OM. Here we present coupled d13C -AA and d15N-AA metabolic patterns in prokaryotic vs. eukaryotic phytoplankton biomass and excreted DOM. We also measured the AA-isotopic signatures of whole cells, cell walls and cytosol fractions, to examine whether particular cellular components have diagnostic signatures. We compare these patterns to the AA stable isotopic patterns of ultrafiltered-POM (UPOM) from central North Pacific and coastal California waters. We propose that changes in bulk parameters, as well as AA isotopic patterns, can be used as a proxy for the degree of degradation and trophic transfer the OM has undergone, and that comparison of specific metabolic patterns can track changes in source organisms between the coastal and oceanic ecosystems.

Lehtinen, S., Finnish Environment Institute (SYKE), Helsinki, Finland, sirpa.lehtinen@ymparisto.fi;
Hällfors, G., Finnish Institute of Marine Research (FIMR), Helsinki, Finland;
Hällfors, S., Finnish Institute of Marine Research (FIMR), Helsinki, Finland, seija.hallfors@fimr.fi;
Kangro, K., Tartu University, Tartu, Estonia, kersti.kangro@ut.ee;
Kuuppo, P., Finnish Environment Institute (SYKE), Helsinki, Finland, pirjo.kuuppo@ymparisto.fi;
Lignell, R., Finnish Institute of Marine Research (FIMR), Helsinki, Finland, risto.lignell@fimr.fi;
Olli, K., Tartu University, Tartu, Estonia, kalle.olli@ut.ee;
Seppälä, J., Finnish Institute of Marine Research (FIMR), Helsinki, Finland, jukka.seppala@fimr.fi;
Tamminen, T., Finnish Environment Institute (SYKE), Helsinki, Finland, timo.tamminen@ymparisto.fi

PHYTOPLANKTON SUCCESSION IN LARGE-SCALE MESOCOSM EXPERIMENTS WITH VARIABLE NUTRIENT TREATMENTS

The data set includes six large-scale mesocosm experiments that have been carried out during the years 1988-2003 in south-west coast of Finland, northern Baltic Sea. The experiments have lasted for 14-21 days in June-August. Used mesocosms have been 9-15 m deep with volume of 30-50 m^3. The mesocosms have been manipulated with distinct nutrient additions (nitrogen, phosphorus and carbon in varying amounts and ratios) to study the pelagial community responses within different food-webs. The single experiments have been studied also earlier, but pooled analyses including all the experiments have not been done. The phytoplankton community structure and the responses of key phytoplankton species within the various nutrient manipulations of the data set will be analyzed, and the results will be presented in the 2008 Aslo Summer Meeting. The current study is related to the EU project Thresholds, which is focused on recognizing thresholds of environmental sustainability.

Leichsenring, J., University of New Brunswick, Fredericton, Canada, jonas.leichsenring@unb.ca;
Lawrence, J. E., University of New Brunswick, Fredericton, Canada, jlawrenc@unb.ca

THE EFFECT OF MID-OCEAN EXCHANGE ON THE ABUNDANCE OF VIRUS-LIKE PARTICLES IN BALLAST WATER

Ballast water is a potential source of invasive species, including viruses that target a variety of hosts. Annually $3x10^{22}$ viruses are transferred around the globe via ship ballast. We examined the effectiveness of mid-ocean ballast exchange (MOE) on reducing virus abundance during two voyages from Asia to Canada during 2007. Ballast was sampled daily from four tanks per voyage and total virus-like particle (VLP) abundance enumerated using epifluorescence microscopy. Two of the four tanks faced sequential MOE. During the first voyage, MOE significantly impacted VLP abundance ($F_{1,22}$=15.24 P<0.001), decreasing from a mean of $22.8x10^6$ ml^{-1} (SD=$9.89x10^6$) before to $8.74x10^6$ ml^{-1} ($4.25x10^6$) after exchange, while control tanks remained around $25.1x10^6$ ml^{-1} ($17.1x10^6$). Data from the second voyage did not show an impact of MOE ($F_{1,53}$=0.315 P=0.577). VLP abundance in all tanks remained around $9.88x10^6$ ml^{-1} ($4.66x10^6$). This study indicates a great variation in the efficacy of MOE at reducing total VLP abundance. Additional studies are needed to determine the impact of MOE on specific viruses.

Lento, J., University of Ottawa, Ottawa, Canada, jlento@gmail.com;
Morin, A., University of Ottawa, Ottawa, Canada, amorin@uottawa.ca

TEMPORAL VARIATION IN SIZE DISTRIBUTIONS OF LOTIC FISH AND CRAYFISH

Size distributions of stream macroinvertebrate communities are typically similar among sites and seasons. When large organisms such as fish and crayfish are added to these size distributions, there is evidence of a negative linear trend with a slope that implies higher biomass in the large size classes. However, there has been little research on the temporal patterns of size spectra in large stream organisms, and the slopes of the combined size spectra may change temporally because of somatic growth and population flux. To examine how size distributions of large organisms vary temporally, we sampled fish and crayfish in six streams 3-4 times throughout one summer. The data were plotted in combined size distributions with macroinvertebrate data, and the regression residuals were compared among size classes and sampling dates in order to evaluate temporal variability. There were no significant differences among sampling dates, whereas all sites had significantly different residual values among size classes. These results suggest that the temporal differences in the size spectra of fish and crayfish are small relative to the variation within the size classes.

Levasseur , M. E., Université Laval, Québec, Canada, maurice.levasseur@bio.ulaval.ca

DUST AND OCEAN DMS PRODUCTION: RECONCILING GEOLOGICAL RECORDS WITH RECENT OBSERVATIONS

Ocean emissions of dimethylsulfide (DMS) contribute to global climate regulation via the formation of aerosols that scatter solar radiation and increase cloud albedo. DMS emissions thus alter the radiative balance of the Earth and exert a cooling effect on climate. A recent re-analysis of the geological records of atmospheric concentrations of methane sulfonic acid (MSA, a proxy for DMS) south of the Antarctic Polar Front suggests that DMS oceanic emissions remained constant over the last 740 ky despite large changes in dust (iron) deposition and climate (Wolf et al. 2006). This new interpretation of the ice core signal suggests that the glacial-interglacial variations in iron deposition had no significant impact on biological DMS

production in the Southern Ocean. This goes against the results from large scale iron fertilisation experiments which have consistently shown an increase in DMS following iron fertilisation in the Southern Ocean. This paper explores how these observations at different time scales can be reconciled based on our current understanding of the ocean DMS microbial cycle. The concept of a highly buffered ocean DMS production system is presented.

Levin, L. A., Scripps Institution of Oceanography, La Jolla, USA, llevin@ucsd.edu;
Rasmussen, L., Scripps Institution of Oceanography, La Jolla, , raz@ucsd.edu

CONNECTIVITY CONUNDRUMS: THE BENEFITS AND CHALLENGES OF INTEGRATING CONNECTIVITY APPROACHES

Larval connectivity, the exchange of larvae among populations , has emerged as a fundamental concept within the arenas of marine metapopulation ecology, biotic resource management, biodiversity conservation, invasive species control, and habitat restoration. Key approaches to resolving connectivity include use of numerical simulations of ocean circulation, geochemical tags, and genetic markers. Integration of these methods to provide a larger understanding of connectivity dynamics remains a challenge. I will compare different connectivity approaches with respect to the time and space scales, and different specific life stages considered. Integration of multiple approaches will require a common connectivity currency and methods for quantification and comparison. Using examples from elemental fingerprinting and ROMS-based mussel connectivity research, I will illustrate how multivariate methods and diversity indices can be adapted to quantify and compare local patterns of larval connectivity, dispersal kernels, degree of self seeding, spatial correlations and temporal stability. Results for mytilid mussels suggest that the outplant-fingerprinting-modeling approach offers insight into key determinants of species-specific connectivity patterns, and their time-space variability, with potential benefits for conservation and management.

LI , H., TEXAS A&M UNIVERSITY / DEPARTMENT OF WILDLIFE & FISHERIES SCIENCES, COLLEGE STATION, TX, USA, original@tamu.edu;
DAVIS , S., TEXAS A&M UNIVERSITY / DEPARTMENT OF WILDLIFE & FISHERIES SCIENCES, COLLEGE STATION, TX, USA, sedavis@tamu.edu;
ROELKE , D., TEXAS A&M UNIVERSITY / DEPARTMENT OF WILDLIFE & FISHERIES SCIENCES, COLLEGE STATION, TX, USA, droelke@tamu.edu;
LIU , K., TEXAS A&M UNIVERSITY / DEPARTMENT OF WILDLIFE & FISHERIES SCIENCES, COLLEGE STATION, TX, USA, kungjen@tamu.edu;
QUIGG , A., Texas A&M University at Galveston / Department of Marine Biology, GALVESTON, TX, USA, quigga@tamus.edu

IMAPCTS OF PULSE FRESHWATER INFLOW ON FUCTION AND STRUCTURE OF TWO TEXAS ESTUARIES

Freshwater inflow and nutrient loading to an estuary contribute greatly to estuarine water quality and ecosystem health, and in some estuaries, poor health, reduced productivity, and even losses of coastal wetlands have been linked to modifications in freshwater input. Given the rapid population growth in Texas and the state's plans for water diversion along the coast, an understanding of the importance of natural variation in freshwater inflow events to estuaries is needed. Monthly observations have been conducted from 2005 to 2006 in Trinity-San Jacinto estuary (i.e. Galveston Bay) and Guadalupe estuary (i.e. San Antonio Bay), including mapping on water quality with high spatial resolution, nutrients and water column productivities at fixed stations along estuarine gradients. Higher annual inflows along with frequent pulse inflows occurred in 2005 than in 2006. The occurrence of pulse inflows resulted in the structure change in both estuaries where Galveston Bay presented lower availability of soluble reactive phosphorus and higher light attenuation, and San Antonio Bay showed higher availability of nitrate plus nitrite after pulse inflows apart from salinity change. Net autotrophic conditions were also observed at both estuaries during this study period.

Li, W. K., Bedford Institute of Oceanography, Dartmouth, Canada, LiB@mar.dfo-mpo.gc.ca

DETECTING MULTIYEAR CHANGE IN A PHYTOPLANKTON COMMUNITY FROM DESEASONALIZED ANOMALIES IN RECURRENT ANNUAL CYCLES

The long term response of phytoplankton to environmental change is recognised as a multiyear trend embedded in a strong repeating annual cycle. Seasonal forcing and response return approximately to their initial states at the beginning of each annual cycle, thus any long term signal is discerned as departures from the annual average state. In Bedford Basin (Canada), seasonal vertical stratification of the water column is determined primarily by temperature, but multiyear change in the annual deseasonalised average stratification is induced by salinity which is linked to precipitation and river discharge. Stratification anomalies explain significant amounts of variability in the anomalies of nutrients and total phytoplankton biomass including that contributed by diatoms, but not the biomass of nanophytoplankton and picophytoplankton. Instead, the responses of the small phytoplankton groups seem more complex, apparently related to temperature and incident solar radiation but not mediated through vertical mixing. The adjustment of phytoplankton to environmental change over time appears consistent with patterns established from comparative analysis of widely-spaced ecosystems.

Lie, A., The Chinese University of Hong Kong, Hong Kong, Hong Kong POC, AlleAYLie@gmail.com;
Wong, C. K., The Chinese University of Hong Kong, Hong Kong, Hong Kong POC, chongkimwong@cuhk.edu.hk

MICROZOOPLANKTON GRAZING ON PHYTOPLANKTON IN TWO BAYS WITH DIFFERENT NUTRIENT LEVELS

Tolo Harbour (TH) and Mirs Bay (MB) are semi-enclosed bays in the subtropical coastal waters of Hong Kong. TH has higher nutrient levels. Microzooplankton grazing on phytoplankton in the two bays was studied bimonthly from March 2007 to January 2008 using dilution experiments combined with HPLC pigment analysis and phytoplankton size fractionation (< 200 um, < 20 um and < 5 um). Mean total chlorophyll a concentration during the study period was 10.52 ugL-1 for TH and 0.82 ugL-1 for MB, with < 5 um phytoplankton being the major contributor. Both microzooplankton grazing rates (0.58-2.26 d-1 for TH and 0.61-1.49 d-1 for MB) and phytoplankton growth rates (-0.17 - 2.44 d-1 for TH and 0.11 - 2.87 d-1 for MB) were similar between the two bays and among all size fractions. Microzooplankton grazing impact on phytoplankton was slightly higher in TH than in MB where grazing rates were lower than growth rates during most of the study period. Grazing rates on alloxanthin in TH were always higher than the growth rates, suggesting that there was a preference for cryptophytes.

Lillis, A., Memorial University, St. John's, Canada, alillis@mun.ca;
Snelgrove, P. V., Memorial University, St. John's, Canada, psnelgro@mun.ca

INTERACTING EFFECTS OF HYDRODYNAMICS AND BEHAVIOUR ON THE SETTLEMENT OF POSTLARVAL AMERICAN LOBSTER

Following planktonic larval development, lobster postlarvae seek out appropriate settling grounds in which to develop through a shelter-restricted juvenile phase. Lobster postlarvae have been shown to display strong directional swimming ability, distinct bottom-searching behaviours, and clear responses to physical and chemical cues. However, nearly all experiments performed on larval and postlarval lobster have been done in still water, and little is known on the effect of hydrodynamics on the settlement process. Flume experiments were conducted to investigate the effect of flow on postlarval swimming behaviour and settlement. In a moderate flow, postlarvae performed significantly fewer dives and exhibited fewer searching behaviours than postlarvae in still water. In 1-hour settlement trials, postlarvae were significantly more likely to settle in flow than in still water. In flow, postlarvae were observed to settle immediately if they came into contact with substrate whereas postlarvae in still water tended to search longer. These results suggest that lobster settlement could be affected by spatial and temporal differences in flow and that the influence of hydrodynamics needs to be considered when developing models for settlement.

Lizotte, M., Université Laval, Québec, Canada, martine.lizotte@giroq.ulaval.ca;
Levasseur, M., Université Laval, Québec, Canada, maurice.levasseur@bio.ulaval.ca;
Merzouk, A., University of British Columbia, Vancouver, Canada, amerzouk@eos.ubc.ca;
Scarratt, M., Institut Maurice-Lamontagne, Fisheries and Oceans Canada, Mont-Joli, Canada, ScarrattM@dfo-mpo.gc.ca;
Michaud, S., Institut Maurice-Lamontagne, Fisheries and Oceans Canada, Mont-Joli, Canada, MichaudS@dfo-mpo.gc.ca;
Gosselin, M., Institut des Sciences de la Mer, Université du Québec à Rimouski, Rimouski, Canada, michel_gosselin@uqar.qc.ca;
Pommier, J., Université du Québec à Trois-Rivières, Trois-Rivières, Canada, julien.pommier@uqtr.ca

SEASONAL AND SPATIAL PATTERNS OF MICROBIAL DMSP CYCLING IN THE NORTHWEST ATLANTIC OCEAN

Microbial dimethylsulfoniopropionate (DMSP) cycling measurements were conducted at 8 stations in the NW Atlantic ranging in latitude from 36.8 °;N to 59.6 °;N during three Canadian SOLAS campaigns in the months of May, July and October 2003. Pools of DMSP and dimethylsulfide (DMS), as well as abundances of phytoplankton and bacterioplankton were determined in the surface mixed layer (SML). Seawater was amended with 35S-DMSP and the products of bacterial DMSP catabolism were measured during 3-h incubations. The proportion of DMSP cleaved into DMS (i.e. the bacterial yield of DMS) was lowest during fall (7 ± 1 %) and highest during spring (14 ± 4 %). Notwithstanding the season, North Atlantic drift (NADR) waters were generally the most productive in terms of abundance of sulfur compounds, phytoplankton, bacterioplankton, as well as bacterial consumption of DMSP and DMS yields, while Subtropical and Arctic waters were the least productive. Our results support previous observations of an apparent "hotspot" for biogenic sulfur cycling in NADR waters which suggests that this region may be of significant importance to the regional and global DMS flux.

Llabrés Comamala, M., CSIC, Esporles, Spain, moira.llabres@uib.es;
Agusti, S., CSIC, Esporles, Spain, sagusti@uib.es;
Duarte, C. M., CSIC, Esporles, Spain, carlosduarte@ifisc.uib.es

IMPACTS OF UV IRRADIANCE ON GROWTH, CELL DEATH, AND THE STANDING STOCK OF ANTARCTIC PHYTOPLANKTON

The degradation of the stratospheric ozone layer has resulted in the persistent development in spring of the ozone hole over Antarctica. The consequent increased ultraviolet radiation (UVR) reaching the Antarctic Ocean is stressing primary producers. We performed a series of experiments with Antarctic natural communities exposed to underwater natural levels of solar radiation in order to quantify the effect of ambient levels of ultraviolet radiation (UVR) on phytoplankton growth, cell death and their balance. Phytoplankton growth rates were inhibited by UVR, increasing up to 5 times in treatments where UVR was excluded. Antarctic phytoplankton communities also experienced important cell death with percentages of death cells decreasing when UVR was filtered out. The decreasing growth and the increasing cell death influenced the net balance of the phytoplankton stock that appeared to be strongly controlled by UV, with phytoplankton biomasses inhibited by up to 80-90% during the period when the higher UVR levels were received.

Lo, W. T., National Sun Yat-sen University, Kaohsiung, Taiwan ROC, lowen@mail.nsysu.edu.tw;
Yu, S. F., National Sun Yat-sen University, Kaohsiung, Taiwan ROC, m935020001@alumni.nsysu.edu.tw;
Su, W. C., Fisheries Research Institute, Keelung, Taiwan ROC, weicheng@mail.tfrin.gov.tw;
Liu, D. C., Fisheries Research Institute, Keelung, Taiwan ROC, dcliu@mail.tfrin.gov.tw

EFFECTS OF TROPICAL CYCLONES ON HYDROGRAPHY AND SIPHONOPHORES IN THE TAIWANESE WATERS, WESTERN NORTH PACIFIC

This study evaluates the effects of tropical cyclones (typhoons) on hydrography and distribution of siphonophores in the waters around Taiwan in 2005 and 2006. There were 3 typhoons during summer cruises in 2006 but no typhoon during summer cruise of 2005. Higher Chlorophyll a concentration and lower siphonophore abundance were found in 2006 than in 2005, but no significant differences in temperature and salinity between years. Cluster analysis of hydrography distinguished two main water masses in summer cruise of each year: Kuroshio Current (KC)+South China Sea Waters (SCSW) and East China Sea Shelf Waters (ECSSW). KC+SCSW showed higher species richness and lower abundance and were dominated by widespread oceanic species, while ECSSW had higher abundance and lower species richness and was dominated by widespread neritic species. Temperature and salinity showed positive associations with species richness but were negatively correlated with abundance of siphonophores. Our results implied that KC+SCSW usually enhance species richness, ECSSW brings higher biomass, while typhoons might lower abundance but enhance species richness of siphonophores, and reduces the differences in siphonophore assemblages and hydrography between water masses in this study area.

Locke, A., Fisheries and Oceans Canada, Moncton, NB, Canada, lockea@dfo-mpo.gc.ca;
Hanson, J. M., Fisheries and Oceans Canada, Moncton, NB, Canada, hansonm@dfo-mpo.gc.ca;
Bernier, R. Y., Fisheries and Oceans Canada, Moncton, NB, Canada, bernierr@dfo-mpo.gc.ca

CONTRASTING THE SECONDARY SPREAD OF COLONIAL VERSUS SOLITARY TUNICATES IN THE SOUTHERN GULF OF ST. LAWRENCE, CANADA

Following the discovery of non-indigenous clubbed tunicate, Styela clava, in an estuary of eastern Prince Edward Island in December 1997, management measures to reduce dispersal to other sites were considered. For the first two years, no management was deemed necessary, but by 2000 the species had become a fouling pest, and management of bivalve transfers and harvests was initiated. There were few models for methods to manage tunicates at that time, but by trial and error a quarantine system was adopted which has proven largely successful. When the vase tunicate, Ciona intestinalis, subsequently colonized, minor adaptations of the method limited its dispersal. The arrival of two colonial tunicates, the golden star tunicate, Botryllus schlosseri, and the violet tunicate, Botrylloides violaceus, has proven problematic. Because these colonial species can reproduce by fragmentation, and disperse by natural means such as rafting, containment has been ineffective. An unexpected observation has been their ability to hitchhike on species such as American lobster, Homarus americanus, which is transported live worldwide.

Luce, M., Laval University, Québec, Canada, myriam.luce.1@ulaval.ca;
Levasseur, M., Laval University, Québec, Canada, Maurice.Levasseur@bio.ulaval.ca;
Scarratt, M., Fisheries and Oceans Canada, Mont-Joli, Canada, scarrattm@dfo-mpo.gc.ca;
Michaud, S., Fisheries and Oceans Canada, Mont-Joli, Canada, michauds@dfo-mpo.gc.ca;
Lovejoy, C., Laval University, Québec, Canada, connie.lovejoy@bio.ulaval.ca;
Royer, S. J., Laval University, Québec, Canada, sarah-jeanne.royer.1@ulaval.ca

MICROBIAL PRODUCTION OF DIMETHYLSULFIDE IN THE ARCTIC

One of the most striking impacts of global warming in the Arctic is the reduction of the annual ice cover, which will affect the dynamics of climate active trace gases like dimethylsulfide (DMS). This paper presents new information on the microbial metabolism of DMS and its algal precursor dimethylsulfoniopropionate (DMSP) in Arctic waters, using radioactively marked ^{35}S-DMSP. The measurements were conducted across the Canadian Archipelago, from Baffin Bay to the Beaufort Sea, during the fall of 2007 as part of the Canadian International Polar Year program. DMSP and DMS concentrations in surface waters tended to decrease westward and as the season progressed. The physiological capacity of the bacteria to use DMSP (DMSP loss rate constant) and the bacterial DMS production efficiency (DMS yield) exhibited a similar westward decrease. DMS concentrations were correlated with the DMS yield (R^2=0.35, $p<0.05$), which in turn followed total DMSP concentrations (R^2=0.40, $p<0.05$). These results suggest that, throughout the Canadian Arctic at this time of year, DMS production is limited by the DMS microbial yield, which in turn depends on the abundance of the DMSP producers.

Lum, T., University of British Columbia, Vancouver, Canada, tlum@eos.ubc.ca;
DiBacco, C., Fisheries and Oceans Canada, Dartmouth, Canada, DiBaccoC@mar.dfo-mpo.gc.ca;
Jamieson, G., Fisheries and Oceans Canada, Nanaimo, Canada, JamiesonG@pac.dfo-mpo.gc.ca;
Therriault, T., Fisheries and Oceans Canada, Nanaimo, Canada, TherriaultT@pac.dfo-mpo.gc.ca

ECOLOGICAL INTERACTIONS BETWEEN TWO INVASIVE CLAMS IN THE STRAIT OF GEORGIA, BRITISH COLUMBIA

It is necessary to understand the ecology of biological invasions in order to control the spread of invasive species and to predict and prevent future introductions. To date, most research has focused on interactions between native and non-native species. This study investigates interactions between two invasive, commercially harvested clam species. Manila (*Venerupis philippinarum*) and varnish (*Nuttalia obscurata*) clams represent the most abundant clam species in the Strait of Georgia (SoG), British Columbia yet they never co-occur at equally high densities. Transplant experiments were initiated in June 2007 in Baynes Sound (SoG) to examine ecological and environmental parameters that may explain the relative distribution and abundance of these species. The effects of intertidal height, relative abundance of the other clam species (i.e., competition), absence of predation pressure and a suite of environmental parameters were measured to test their effect on clam growth and natural mortality rates. Information gathered here will help with the management of future invasions and broaden our knowledge on invasive species ecology.

Lyon, D. R., University of Arkansas, Fayetteville, USA, DavidRichardLyon@gmail.com;
Kopecky, A. L., University of Arkansas, Fayetteville, USA;
Jaffe, R., Florida International University, Miami, USA, jaffer@fiu.edu;
Yamashita, Y., Florida International University, Miami, USA, yamashiy@fiu.edu ;
Ziegler, S. E., Memorial University of Newfoundland, St. John's, Canada, sziegler@esd.mun.ca

THE EFFECTS OF SOLAR RADIATION ON DOM CYCLING AND NITRIFICATION IN A HIGHLY EUTROPHIC OZARK HEADWATER STREAM

The effects of solar radiation on DOM and nitrogen cycling were investigated at Columbia Hollow, a highly eutrophic headwater stream in the Arkansas Ozarks receiving WWTP effluent within a watershed supporting poultry production in a mixed forest/pasture karst landscape. After 8-hour insolation of sterilized stream water, absorbance and total fluorescence of DOM decreased but relative fluorescence increased for protein-like components as determined by EEM-PARAFAC. Simultaneous losses of DOC and nitrite during insolation suggest DOM photo-oxidation by nitrite photolysis. After addition of biofilm-colonized tiles and 1-day dark incubations, nitrification accounted for 70% of oxygen uptake and proceeded at the rate of 5.1 μM nitrate+nitrite-N h^{-1} with up to 40% of nitrate+nitrite derived from DON. Following incubation, insolated water had increased nitrite formation and DOC & DON mineralization and exhibited lower fluorescence of protein-like components. Glucose additions during incubations were respired at rates similar to DOM and reduced nitrite formation and DON mineralization. These findings suggest that solar radiation exposure enhanced the microbial conversion of DON to nitrate by coupled mineralization-nitrification, potentially impacting downstream nitrogen export in Columbia Hollow.

Lyons, D. A., Dalhousie University, Halifax, Canada, dalyons@dal.ca;
Scheibling, R. E., Dalhousie University, Halifax, Canada, rescheib@dal.ca

RATES AND PATTERNS OF SPREAD OF INVASIVE MARINE ALGAE AT A REGIONAL SCALE

Tracking range expansions of invasive species at different spatial scales can provide insights into the invasion process that can be used to predict spread. We used literature reports and herbarium records to map temporal changes in distributions of invasive algal species in different geographic regions around the world (e.g., NW Pacific, NE Atlantic, New Zealand). In most cases, periods of gradual local spread were punctuated by saltatory expansions of 10s to 100s of km. Species ranges (as linear along-coast distances) tended to increase linearly with time. Rates of range expansion differed between species within regions, and between regions for some species (e.g., *Codium fragile*, in the Mediterranean, mean ± SE: 121 ± 6 km/y; in the NW Atlantic: 55 ± 3 km/y) but not others (e.g., *Undaria pinnatifida*, all regions: 80 ± 6 km/yr). These patterns reflect the influence of algal traits, human activities, and ecosystem characteristics on the spread of invasive algae. The remarkably rapid range expansions of most species suggest invasion rates are primarily driven by human-mediated introductions, or occasional long-distance dispersal events.

Ma, J., University of Maryland, College Park, USA, majiahaiiccas@gmail.com;
Zhu, Q., University of Mayland, College Park, USA, qingz@umd.edu;
Del Vecchio, R., University of Maryland, College Park, USA, rossdv@umd.edu;
Blough, N. V., University of Maryland, College Park, USA, neilb@umd.edu

OPTICAL PROPERTIES OF MODEL QUINONES AND THEIR CORRESPONDING HYDROQUINONES: IMPLICATIONS FOR THE OPTICAL PROPERTIES OF HUMIC SUBSTANCES

Absorption and fluorescence spectroscopy were employed to examine the optical properties of an extensive series of substituted p-benzoquinones, o-benzoquinones, napthoquinones and anthraquinones, as well as their corresponding hydroquinones generated by NaBH4 reduction. Absorption spectra, molar absorptivities and when possible, fluorescence quantum yields and fluorescence lifetimes were acquired. The results show that the quinones either do not fluorescence or fluorescence extremely weakly; thus quinones alone cannot account for the long-wavelength emission observed in humic substances and chromophoric dissolved organic matters (CDOM). Further, with only one exception, the hydroquinones emitted in the ultraviolet and exhibited very low or negligible fluorescence (except for hydroquinone and CH3-substituted p-hydroquinones). The results of these optical measurements indicate that quinones and hydroquinones by themselves do not contribute largely to the absorption and emission properties of humic substances and CDOM. However, borohydride reduction of humic substances leads to a loss of long-wavelength absorption and enhanced blue-shifted emission, consistent with the involvement of redox active groups such as quinones in the optical properties of these materials. These results can be explained by a charge transfer model (Rossana Del. Vecchio, Neil V. Blough, Environ. Sci. Technol. 2004, 38, 3885-3891).

Maberly, S. C., Centre for Ecology & Hydrology, Lancaster, United Kingdom, scm@ceh.ac.uk

PH IN FRESHWATERS

pH is a pervasive property of aquatic systems. In freshwaters it can vary greatly among sites from around pH 1 to 2 in waters in volcanic regions to around 10 to 11 in productive lakes experiencing extreme carbon depletion and/or with a high alkalinity. pH can also vary greatly within a water-body at different depths and over short distances around rapidly photosynthesising material. Finally, pH can vary extremely rapidly with time, by over 2 units in 24 hours, and typically exhibits a diel cycle. pH is influenced by, and in turn influences, the availability of material resources, particularly carbon dioxide and bicarbonate. The possible ecological consequences of varying pH for the ecological distribution of freshwater macrophytes and phytoplankton will be discussed based on physiological and behavioural measurements in the laboratory. The effect that pH has, indirectly, on biogeochemical cycling of inorganic carbon will be described.

Macalady, D. L., Colorado School of Mines, Golden, CO, USA, dmacalad@mines.edu

NEW LIGHT ON A DARK SUBJECT: REDOX CHEMISTRY OF NATURAL ORGANIC MATTER

Investigations of the redox chemistry of aquatic natural organic matter (NOM) have generally pointed to quinone-like functionalities as the primary redox-active moieties. More recently, NOM has been shown to possess limited capacity to reduce ferric iron despite long-time exposure to light and molecular oxygen. Recent investigations have been conducted using excitation emission matrix fluorescence spectra (EEMS) and the parallel factor statistical analysis (PARAFAC) package developed in the research group of Dianne McKnight at INSTAAR at the University of

Colorado. These spectra have been analyzed for a variety of NOM samples, including surface waters, a ground water and aqueous extracts of senescent plant materials. In all samples, 60-75 % of the fluorescence is calculated to be from quinone-like moieties. More surprisingly, of the quinones indicated, between 46 and 69% were reduced (i.e. either semiquinones or hydroquinones) moieties. Subsequent work to test the validity of these findings through independent methods will be described. Spectral and/or acid/base changes upon selective oxidation and reductions, either chemical or photochemical, have been used to indicate changes in the quinone/hydroquinone levels in this suite of samples.

MacDonald, L. A., Northwestern University, Evanston, USA, l-macdonald@northwestern.edu;
Hestin, M., Northwestern University, Evanston, USA, mathieu.hestin@gmail.com;
Gaillard, J. F., Northwestern University, Evanston, USA, jf-gaillard@northwestern.edu;
Packman, A. I., Northwestern University, Evanston, USA, a-packman@northwestern.edu;
Alsina, M. A., Pontificia Universidad Católica de Chile, Santiago, Chile, malsina@ing.puc.cl;
Florenzano, A., Pontificia Universidad Católica de Chile, Santiago, Chile, alejandroflorenzano@gmail.com;
Vega, A., Pontificia Universidad Católica de Chile, Santiago, Chile, alejandrasvega@gmail.com;
Pastén, P. A., Pontificia Universidad Católica de Chile, Santiago, Chile, ppasten@ing.puc.cl;
Pizarro, G. E., Pontificia Universidad Católica de Chile, Santiago, Chile, gpizarro@ing.puc.cl

DISTRIBUTIONS OF ARSENIC AND OTHER GEOTHERMALLY DERIVED ELEMENTS IN THE RIO LOA SYSTEM, NORTHERN CHILE

Many watersheds are contaminated by arsenic (As) derived from natural weathering of earth-surface minerals. One of the most severe cases of As contamination in the world occurs in the Atacama desert, Chile. We focus on the Loa river system, which is the only significant surface water body in the Atacama. Arsenic enters the Rio Loa watershed primarily from El Tatio geothermal system, located in the high Alitplano near the Bolivian border at ~4,200 masl. This high-concentration geothermal input ([As] = 650 μM) produces substantial dissolved and particulate-phase As throughout the entire river system. Despite the scientific and practical significance of As in the Rio Loa, little information is available on the processes that control As dynamics in this system. Here we describe the geochemical patterns apparent in the Rio Loa in an attempt to understand the dynamics of As migration through the system. We will summarize the sparse results available in the literature and then present new results comparing the distributions of As to those of other geochemical constituents of geothermal origin.

MacIsaac, H. J., Great Lakes Institute, University of Windsor, Windsor, Canada, hughm@uwindsor.ca;
Muirhead, J., University of Alberta, Edmonton, Canada, muirhe1@uwindsor.ca

EFFECTS OF LIFE HISTORY AND PROPAGULE PRESSURE ON SPREAD OF AQUATIC INVASIVE SPECIES

We utilize two groups of species with contrasting life histories - the molluscs Dreissena polymorpha and Dreissena rostriformis bugensis and the waterfleas Bythotrephes longimanus and Cercopagis pengoi - to explore patterns of spread to inland lakes. The former group lack diapausing stages but possess biphasic life cycles, whereas the latter produce resting eggs but have monophasic life cycles. Two of the species (D. polymorpha, B. longimanus) have spread rapidly to inland lakes, whereas the others have not. Both of the former species had much higher propagule pressure than the latter species, consistent with patterns of spread. Lower propagule pressure for Cercopagis and Dreissena rostriformis were associated with low relative production of resting eggs, and low abundance in littoral areas and higher mortality, respectively. Our study shows that opportunities for spread are influenced by species abundance and by the differential intersection of life histories with dispersal mechanisms.

MacKay, M. D., Environment Canada, Toronto, Canada, murray.mackay@ec.gc.ca

SMALL LAKES AND THE BOREAL CLIMATE SYSTEM

The importance of very large lakes, such as the Laurentian Great Lakes, on local weather and climate is well known. Less clear is the impact of the innumerable smaller lakes that, for example, characterize the Canadian boreal shield region. The boreal forest is a globally significant ecosystem whose carbon balance is sensitive to the local climate. In most simulations of present day climate and numerical weather prediction models horizontal resolution is such that the vast majority of boreal lakes would be subgrid-scale, and parameterization schemes are clearly needed in order to represent their impact. The Canadian Land Surface Scheme (CLASS) Small Lake Module has been developed for just such purpose. In this talk the model is presented and evaluated against extensive data collected at the Experimental Lakes Area in Northern Ontario. The impact of dissolved organic carbon on transparency and the suppression of mixed layer turbulence is examined in a simulation of reference lake 239. An upcoming watershed manipulation experiment in which the contributing area (and thus DOC) is suddenly reduced (representing a climate regime shift) will also be discussed.

MacKay, S. E., University of Toronto Scarborough, Toronto, Canada, sarah.mackay@utoronto.ca;
Williams, D. D., University of Toronto Scarborough, Toronto, Canada, williamsdd@utsc.utoronto.ca;
Mwansa, B. J., Barbados Water Authority, Eagle Hall, Barbados, john.mwansa@bwa.bb

THE POTENTIAL OF INVERTEBRATES LIVING IN DEEP FRESHWATER WELLS AS BIOINDICATORS OF AQUIFER WATER QUALITY IN BARBADOS

The freshwaters of Barbados consist of 19 primary watersheds and a thin freshwater aquifer made accessible by a network of man-made wells. The dependence of the island on the groundwater for potability and irrigation has lead to the increasing risk of salt-water intrusion and surface contamination. We conducted the first comparative study of Barbados surface and subsurface macroinvertebrate communities, focusing on the use of bioassessment and potential connections between habitats. Here we present preliminary results of the first part of the study that quantifies and describes the subsurface macroinvertebrate community. Macroinvertebrate samples and physicochemical parameters were obtained from 10 public supply wells during the dry season of 2007. These wells ranged in depth from 34-69m and were located throughout the central and Northwestern parts of the island. The dominant taxa across all wells were Acari, in particular one type of Oribatida, several types of Gastropoda, and Diptera, whereas Oligochaeta and Polychaeta were the more rare taxa. The invertebrate variance appears to be best explained by conductivity, temperature and well depth.

MacLeod, D. M., Memorial University Of Newfoundland, St. John's, Canada, dmacleod@mun.ca;
Lang, A. S., Memorial University Of Newfoundland, St. John's, Canada, aslang@mun.ca

PREVALENCE AND DIVERSITY OF GENE TRANSFER AGENT SEQUENCES IN NATURAL MICROBIAL COMMUNITIES.

Rhodobacter capsulatus is a purple non-sulfur bacterium in the alphaproteobacteria class. It produces an unusual genetic exchange vector known as a gene transfer agent (RcGTA). RcGTA resembles a bacteriophage and transfers random ~4.5-Kb pieces of DNA between R. capsulatus cells. It has been found that many other species of bacteria that fall within the same sub-group of alphaproteobacteria as R. capsulatus, the Rhodobacterales, contain complete clusters of the genes that direct synthesis of GTA particles. Many species within the Rhodobacterales, which includes the Roseobacter group, are mixotrophic. We are using a culture-independent approach to evaluate the presence and diversity of potentially GTA-producing bacteria in marine microbial communities. Our approach is to use primers for PCR that are designed to specifically amplify GTA gene sequences from microbial communities, and we are currently focusing on microbial communities in Logy Bay, Newfoundland. The amplified regions are being characterized by sequencing to identify

the GTA sequences present. Our initial results show a substantial diversity of GTA genes are present in Newfoundland waters, with many sequences highly divergent from known cultured organisms.

MacPhee, S. A., Queen's University, Kingston, Canada, 6sam@queensu.ca;
Arnott, S. E., Queen's University, Kingston, Canada, arnotts@biology.queensu.ca

THE EFFECTS OF LAKE THERMAL HABITAT STRUCTURE AND SPATIALLY-DEPENDENT PREDATION ON FRESHWATER ZOOPLANKTON COMMUNITIES

The potential effects of climate change on spatially-dependent species interactions are poorly understood. We used enclosures to test the effects of changes in lake thermal habitat on predator avoidance, abundance, and biomass in a freshwater zooplankton community. We performed a 3 X 4 factorial experiment with three levels of thermal habitat: "cool"-stratified, "warm" and "hot" Ã¢â‚¬â€œisothermal, and four predator treatments: no predators, surface-orienting predators (Notonectidae: Buenoa macrotibialis), vertically-migrating predators (Chaoborus punctipennis), and both predators combined. Surprisingly, thermal habitat and predators had no effect on mean abundance- or biomass-weighted zooplankton depth distribution. We did not detect a predator effect on mean zooplankton abundance or biomass, although preliminary results indicate a significant thermal effect ($p < 0.001$) and a weak interaction between thermal habitat and predation ($p = 0.06$). In general, mean abundance and biomass were greatest in the cool habitat, suggesting that direct temperature stress is important in structuring the zooplankton community. This research advances the understanding of climate effects on complex trophic interactions by examining the relative importance of direct thermal and indirect, biologically-mediated temperature effects on zooplankton community structure.

Maerz, J., Institute for Chemistry and Biology of the Marine Environment (ICBM), Oldenburg, Germany, maerz@icbm.de;
Feudel, U., Institute for Chemistry and Biology of the Marine Environment (ICBM), Oldenburg, Germany, u.feudel@icbm.de;
Lunau, M., Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven, Germany, mirko.lunau@awi.de

DO MICROBES MEDIATE FLOCCULATION PROCESSES OF SUSPENDED PARTICULATE MATTER?

Properties of suspended particulate matter (SPM) like size, shape, density and structure determine the settling velocity of SPM and hence its transport. In turn, these properties change with time as they are subject to several transformation processes that are mainly of hydrodynamical nature. By contrast, in the present laboratory study we investigated the microbial impact on SPM size dynamics under different hydrodynamical conditions in three parallel, newly developed rolling tanks. Filtered (10µm) and ultra-filtered (0.2µm) sea water, loaded with air-dried, sonicated natural SPM (90mg/L), was used for treatments in presence and abscence of bacteria, respectively. Photos of formed aggregates were taken continuously and analyzed automatically to determine the particle size distribution and its evolution. Results indicate that microbes alter particle number and size evolution on a short timescale, dependent on hydrodynamical conditions. Therefore, it is likely that they influence particle properties like collision efficiency, density and structure. This interplay between hydrodynamics, microbes and SPM dynamics, potentially having implications for SPM transport and biogeochemical cycles, should be further addressed in experimental and model studies.

Makhutova, O. N., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences , Krasnoyarsk, Russian Federation, makhutova@ibp.krasn.ru;
Dubovskaya, O. P., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences , Krasnoyarsk, Russian Federation, dubovskaya@ibp.krasn.ru;
Sushchik, N. N., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences , Krasnoyarsk, Russian Federation, labehe@ibp.ru;
Gladyshev, M. I., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences , Krasnoyarsk, Russian Federation, glad@ibp.ru;
Kalachova, G. S., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences , Krasnoyarsk, Russian Federation, kalach@ibp.ru

GROWTH RATE OF DAPHNIA FEEDING ON SESTON FROM AN EUTROPHIC SIBERIAN RESERVOIR: THE ROLE OF SESTONIC ESSENTIAL FATTY ACID AND ELEMENTAL CONTENT

Dependence of specific integral population growth rate with random size and age structure on elemental and essential fatty acid composition of natural seston was studied in a laboratory flow-through system using a multiple regression. Under a comparatively high content of particulate phosphorus the best single predictor of the growth of Daphnia appeared to be content of eicosapentaenoic acid (EPA, 20:5n-3). Regression equation with two independent variables, EPA and particulate nitrogen, gave a significantly better fit for the population growth as the dependent variable, than the equation with EPA as the single independent variable. The essential n-3 fatty acid and nitrogen appeared to be complementary indicators of the food quality. Under particulate EPA concentrations in seston below ~ 13 ug/L, statistically significant influence of EPA on the growth occurred (regression ANOVAR F-test value was 7.91), while above the concentration there were no relation between EPA and the specific growth rate. Thus, we consider this concentration of EPA in seston (115 um) to be the limiting concentration of EPA for the growth of Daphnia (longispina group).

Maki, K., Kyoto University, Otsu, Shiga, Japan, k-maki@ecology.kyoto-u.ac.jp;
Kim, C., Kangwon National University, Chuncheon, Kangwon-dl, Republic Of Korea, ecorest@gmail.com;
Yoshimizu, C., Japan Science and Technology Agency, , Japan, chikage@ecology.kyoto-u.ac.jp;
Tayasu, I., Kyoto University, Otsu, Shiga, Japan, tayasu@ecology.kyoto-u.ac.jp;
Nagata, T., Kyoto University, Otsu, Shiga, Japan, nagata@ori.u-tokyo.ac.jp

STABLE ISOTOPIC EVIDENCE FOR AUTOCHTHONOUS ORIGIN OF SEMI-LABILE DISSOLVED ORGANIC CARBON IN A LARGE MONOMICTIC LAKE (LAKE BIWA, JAPAN)

Previous work has demonstrated that semi-labile dissolved organic carbon (SL-DOC) accounts for a significant fraction (8%) of carbon mineralization in the hypolimnion of Lake Biwa. However, little is known about the source of SL-DOC. Here we collected data over two years on vertical and seasonal variations of carbon stable isotope ratio ($\delta^{13}C$) of DOC in the lake water. During the stratification period, concentrations and $\delta^{13}C$ values of DOC were higher in the epilimnion (103.1 ± 4.7 µM, -25.4 ± 0.3‰, n = 40) than in the hypolimnion (81.6 ± 2.0 µM, -26.0 ± 0.1‰, n = 40), whereas these values varied little over the depth during the winter overturn period (88.1 ± 2.9 µM, -25.7 ± 0.1‰, n = 84). A two-component mixing model was used to derive the average $\delta^{13}C$ value (-23.0 ± 1.2‰) of SL-DOC, suggesting that SL-DOC was largely autochthonous in origin. The above data support the hypothesis that SL-DOC that originates from primary production in the epilimnion during productive seasons contributes to hypolimnetic oxygen consumption during the subsequent year.

Maltais-Landry, G., Universite de Montreal, Montreal, Canada, gabriel.maltais-landry@umontreal.ca;
Maranger, R. J., Universite de Montreal, Montreal, Canada, r.maranger@umontreal.ca;
Brisson, J., Institut de recherche en biologie vegetale, Montreal, Canada, jacques.brisson@umontreal.ca

NITROGEN TRANSFORMATIONS AND RETENTION IN CONSTRUCTED WETLANDS

Higher nitrogen (N) delivery to aquatic ecosystems due to human activities highlights the need for the creation of buffer zones to maintain water quality. Constructed wetlands (CWs) have been successfully used to reduce N loads particularly with respect to human and animal wastes, but their role in terms of N transformations remains poorly understood. We studied the seasonal effects of different macrophyte species and artificial aeration on N transformations in 14 CW mesocosms. Removal of total N was higher in planted and aerated units, but organic N removal remained high in all treatments. This mineralization resulted in the production of different N species, depending on treatment: ammonium export in non-aerated and unplanted units, and release of oxidized N in aerated and planted mesocosms. The plant treatments studied had different N removal rates (generally: Typha angustifolia > Phragmites australis = Phalaris arundinacea > unplanted). Plant N uptake was variable but accounted for less than 25% of removal. N processing was more similar in summer and autumn than in winter, and could be predicted with redox potential, temperature and hydrology.

Maranger, R., Université de Montréal, Montreal, Canada, r.maranger@umontreal.ca;
Harrison, J., Washington State University, Vancouver WA, USA, harrisoj@vancouver.wsu.edu;
Baulch, H., Trent University, Perborough ON, Canada, helenbaulch@yahoo.ca

A GLOBAL ASSESSMENT OF THE ROLE OF LAKES AND RESERVOIRS IN NITROGEN RETENTION USING AN EMPIRICAL APPROACH

Lakes and reservoirs are hotspots in the landscape for nitrogen (N) retention. Using the NiRReLa (Nitrogen Retention in Reservoirs and Lakes) model, approximately 23 TgN yr-1 is estimated to be removed by lentic systems globally. In this study we compare the role of lakes and reservoirs in N retention. Using a wide range of literature data, we found a good correspondence between hydrologic load and % N retention, with no significant differences in the %N removed in lakes versus reservoirs. We also found no significant differences in the relationships among latitudes. A greater % of nitrate was removed from lakes and reservoirs as compared to total nitrogen. Interestingly, eutrophic and hypereutrophic systems consistently removed 12% more N on average for the same hydraulic load as compared to oligotrophic and mesotrophic systems. This is related to higher N uptake rate velocities (vf) of richer systems and may have important repercussions in future modeling. We discuss current initiatives to use dams in small streams to facilitate N removal via denitrification, and potential long-term negative impacts these restoration projects may have.

Markager, S., National Environmental Research Institute, Aarhus University, Roskilde, Denmark, markager@dmu.dk;
Stedmon, C. A., National Environmental Research Institute, Aarhus University, Roskilde, Denmark, cst@dmu.dk;
Søndergaard, M., University of Copenhagen, Hillerød, Denmark, MSondergaard@bi.ku.dk

SEASONAL DYNAMICS AND CONSERVATIVE MIXING OF DISSOLVED ORGANIC MATTER (DOM) IN THE TEMPERATE EUTROPHIC ESTUARY HORSENS FJORD

This study presents the results of a year long measurement program investigating the characteristics of dissolved organic matter (DOM) in the Danish estuary Horsens Fjord. The behaviour of different DOM parameters, i.e. DOC, DON, DOP, light absorption and eight fluorescence components, were analysed relative to conservative mixing. Many of the parameters did not behave conservatively. For DON, DOP and absorption, more than 65% of the freshwater concentration was removed initially at salinities below 12. At higher salinities two general patterns where identified. Concentrations of DON, DOP and four humic fluorescent fractions were not, or only weakly, related to salinity, indicating that concentrations were mainly governed by processes within the estuary other than mixing. Other parameters such as DOC, two terrestrial humic components and DON during winter behaved conservatively. These results are consistent with the finding that autochthonous DOM was the dominant source of DOM in this study. We hypothesise that in estuaries with high loadings of inorganic nutrients relative to DOM, production and degradation of DOM within the estuary will dominate the metabolism of DOM and control both concentration and characteristics.

Marotta, H., Spanish Scientific Research Council, Esporles, Spain, humbertomarotta@gmail.com;
Duarte, C. M., Spanish Scientific Research Council, Esporles, Spain, carlosduarte@ifisc.uib.es;
Sobek, S., Swiss Federal Institute of Technology Zurich, Zurich, Switzerland, sebastian.sobek@env.ethz.ch;
Bento, L., Federal University of Rio de Janeiro, Rio de Janeiro, Brazil, luizjb@gmail.com;
Enrich-Prast, A., Federal University of Rio de Janeiro, Rio de Janeiro, Brazil, aeprast@biologia.ufrj.br

RE-EVALUATING THE ROLE OF TROPICAL LAKES IN GLOBAL CO_2 EMISSIONS

We re-assess here the global relationship between water temperature, dissolved organic carbon (DOC) and pCO_2 in lakes, using a global data set expanded to include far more tropical lakes than originally included. DOC was positively related to pCO_2 in all analyzed quartiles, but temperature showed different relationships, a significant positive and negative regression in the higher and lower quartiles respectively (quantile regression, $p<0.05$), indicative of an increase in pCO_2 range with increasing temperature. Indeed, tropical lakes showed a higher median pCO_2 than temperate lakes did. We used our results to re-asses the global role of lakes as CO_2 sources to the atmosphere to yield a higher efflux rate to the atmosphere, around 34 mmolC m^{-2} d^{-1} for tropical lakes, compared to an average of 20 mmolC m^{-2} d^{-1} globally.

Martinetto, P., Universidad Nacional de Mar del Plata, Mar del Plata, Argentina, pmartin@mdp.edu.ar;
Botto, F., Universidad Nacional de Mar del Plata, Mar del Plata, Argentina;
Iribarne, O. O., Universidad Nacional de Mar del Plata, Mar del Plata, Argentina

THE RELATIVE CONTRIBUTION OF MARINE AND LAND-DERIVED NUTRIENT SOURCES IN COASTAL FOOD WEBS OF MAR CHIQUITA COASTAL LAGOON AREA, ARGENTINA

Shifts in nutrients availability often lead to modifications in the species composition and abundances with potential alteration of the food web. The watershed associated to Mar Chiquita coastal lagoon is affected by intensive agricultural activity and by a small summer tourist village. If nutrients from land are incorporated into the food web is unknown. We used N and C isotopic signatures of primary producers from fresh-water contributors and from coastal adjacent areas to determine marine and land-derived nutrients in the food web. We also determined isotopic signatures in organisms collected in these sites from both the benthos and the water column. $\delta^{15}N$ in primary producers showed differences among sites and trophic steps but did not show a linear trend from land to coast. Signatures of benthos-associated organisms and fishes inside the lagoon showed variations coupled to the specific signatures of producers collected in each site. POM and zooplankton also showed coupling to site but no between benthic and water column components. These results indicate that in this system the contribution of nutrients has local effect with low interchange among sites.

MARUO, M., The University of Shiga Prefecture, Hikone, Shiga, Japan, maruo@ses.usp.ac.jp;
TOKUNAGA, M., The University of Shiga Prefecture, Hikone, Shiga, Japan;
NAGAOKA, K., The University of Shiga Prefecture, Hikone, Shiga, Japan;
OHTA, K., The University of Shiga Prefecture, Hikone, Shiga, Japan;
OBATA, H., Ocean Research Institute, University of Tokyo, Nakano, Tokyo, Japan

ROLE OF HUMIC SUBSTANCES IN METAL COMPLEXATION IN FRESHWATER OF LAKE BIWA (JAPAN)

The concentrations and stability constants of copper complexing ligands in water of Lake Biwa (Japan) were determined by cathodic stripping voltammetry. As potential complexing ligands for copper, humic substances were separated from water samples in the lake and their complexing capacities were determined. In late autumn 2007, a weak thermocline existed at 23m in depth. Copper complexing capacities of both original water and separated humic substance varied with depth, while concentration of humic substance did not. In the epilimnion, copper complexing capacities of original water samples were around 150 nmol/l, while those of humic substances were around 100nmol/l. In hypolimnion, both capacities were estimated to be very low. At the bottom, copper complexing capacity was high but the contribution of humic substance was low. This suggests the possible supply of different types of humic substances from sediments. Based on these facts, speciation of copper and iron (redox) was also investigated.

Matsumoto, G. I., MBARI, Moss Landing, USA, mage@mbari.org;
Ferguson, A., MBA, Montrey, USA

In 2007, the Monterey Bay Aquarium Research Institute (MBARI) and the Monterey Bay Aquarium (MBA) partnered in this collaborative effort to generate an interactive exhibit that portrays excitement of deep-sea exploration and technology. This exhibit takes the visitor on an amazing adventure combining high-definition video of incredible deep-sea animals with the hands-on experience of using underwater robots and other high-tech tools to explore the ocean's depths. The exhibit provides the public to participate in three different missions: photographing deep sea animals,

mapping underwater mountains and monitoring the surprisingly rich and varied sea life around a sunken whale carcass. During the time spent at this exhibit, the visitor learns about the cutting-edge research conducted each day at the Monterey Bay Aquarium Research Institute. This presentation will provide an overview of the process involved in this collaboration as well as a glimpse of the exhibit itself.

McCarthy, M. J., Université du Québec à Montréal, Montréal, Canada, markm@mail.utexas.edu;
Bird, D. F., Université du Québec à Montréal, Montréal, Canada, bird.david@uqam.ca;
Gardner, W. S., The University of Texas Marine Science Institute, Port Aransas, USA, wayne.gardner@mail.utexas.edu

SEDIMENT-WATER INTERFACE N TRANSFORMATIONS IN MISSISQUOI BAY, LAKE CHAMPLAIN (QUÉBEC): EVIDENCE FOR ALTERNATIVE PATHWAYS TO NITRIFICATION-DENITRIFICATION

Nitrogen (N) transformations at the sediment-water interface were evaluated in Missisquoi Bay, Lake Champlain, using continuous-flow sediment core incubation and stable isotope techniques. Sampling occurred in June and August 2007. Potential denitrification rates at two sites, determined using stable isotope additions and membrane inlet mass spectrometry, ranged from 160 to 560 µmol N m-2 h-1. Higher potential denitrification rates versus net N2 fluxes suggest that denitrifiers may be limited by available substrate despite high nitrate concentrations. N2 fixation rate estimates cannot account for this difference. Potential dissimilatory nitrate reduction to ammonium (DNRA) was observed at the nearshore site, but rates were low relative to denitrification. Nitrate induced ammonium flux (NIAF) at both sites suggests that DNRA was under-estimated. Ammonium cation exchange in the sediments may explain this phenomenon. Isotope pairing results indicate that anaerobic ammonium oxidation (anammox) may have occurred in sediments and, if present, accounts for 3-6% and 11-27% of total sediment N2 flux at the nearshore and offshore sites, respectively. Microbial identification techniques are necessary to confirm the presence and activity of bacteria capable of DNRA and anammox.

McCauley, E., University of Calgary, Calgary, Canada, mccauley@ucalgary.ca;
Lutscher, F., University of Ottawa, Ottawa, Canada, flutsche@uottawa.ca;
Anderson, K. E., University of California Riverside, Riverside, USA, kurt.anderson@ucr.edu;
Nisbet, R. M., University of California Santa Barbara, Santa Barbara, USA, nisbet@lifesci.ucsb.edu

SPATIAL SCALES AND ENVIRONMENTAL IMPACTS IN ADVECTIVE SYSTEMS

Nutrient uptake length, spiraling length, and response lengths are spatial scales that emerge from biological processes and interactions in advective environments. How can these spatial scales be used to interpret the impact of point-source and non-point source inputs from urban environments on river systems? We review recent theoretical work, and synthesize existing empirical studies on uptake lengths, spiraling lengths, and response lengths. We discuss advantages and limitations of analysis of equilibria and of transitory dynamics for interpreting spatial and temporal responses of biological populations and community responses. Using observations from the Red Deer and Bow Rivers in Alberta, we evaluate linkages between these spatial scales and ecosystem properties (e.g. critical oxygen levels, eutrophication).

McClain, C., Monterey Bay Aquarium Research Institute, Moss Landing, USA, cmcclain@mbari.org;
Boyer, A., University of New Mexico, Albuquerque, USA, aboyer@unm.edu

THE ISLAND RULE AND THE EVOLUTION OF BODY SIZE IN THE DEEP SEA

When isolated on islands, small-bodied species exhibit gigantism and large-bodied species become dwarfed. Here, we show that the island rule is part of more generalized phenomena can be observed in non-insular but analogous systems like the deep sea. Like islands, the deep sea is characterized by low absolute food availability that constrains organismal size. Data indicate that in two radically different clades, gastropods and elasmobranches, genera with small-bodied shallow-water species have significantly larger deep-sea representatives, while the opposite is true for genera that are large-bodied in shallow water. Bathymetric body size clines within the deep sea are also consistent with predictions based on the island rule.

McCrackin, M. L., Arizona State University, Tempe, USA, mlmccrac@asu.edu;
Elser, J. J., Arizona State University, Tempe, USA, j.elser@asu.edu

DENITRIFICATION IN SEDIMENTS OF NORWEGIAN LAKES ACROSS A GRADIENT OF ATMOSPHERIC NITROGEN DEPOSITION

Microbially-mediated denitrification is recognized as an important process that may ameliorate the effects of nitrogen (N) loading by permanently removing excess N inputs. In this study, we measured denitrification and nitrous oxide (N_2O) emission rates in sediments from 32 Norwegian lakes at the high and low ends of a gradient of atmospheric N deposition. We also measured denitrification rate in response to experimental additions of organic carbon (C), N (as nitrate), and P (as phosphate). Both unenriched denitrification (0-103.9 µmol N m^{-2} h^{-1}) and N_2O emission rates (-0.1-5.0 µmol N_2O-N m^{-2} h^{-1}) were significantly greater in sediments of lakes subject to high rate of N deposition, compared to lakes subject to low deposition. Further, denitrification and N_2O emission rates were positively related (R^2=0.404). All lakes had significantly higher denitrification rates in N and combined CNP treatments relative to other treatments, but there was no difference in response between N and CNP treatments. Our results suggest that sediment denitrification can mitigate the effects of N loading, but also increases emissions of a potent greenhouse gas.

McDonald, C. P., Michigan Technological University, Houghton, USA, cpmcdona@mtu.edu;
Urban, N. R., Michigan Technological University, Houghton, USA, nurban@mtu.edu

AN INFORMATION-THEORETIC APPROACH TO PLANKTON FUNCTIONAL TYPE MODELING

Plankton Functional Types (PFTs) are often employed in aquatic ecosystem models in an attempt to simulate the niche dynamics arising from interactions of multiple plankton groups (e.g., classes, size fractions) with their environment. One criticism of this approach is that it has the potential to introduce into the model levels of complexity (degrees of freedom) which cannot be supported by the available data, presenting the risk of overfitting. Here, we apply Akaike's Information Criterion (AIC) to a set of DYRESM-CAEDYM ecosystem models constructed for Trout Lake, WI, USA. Models which include varying numbers of PFTs are calibrated to common multivariate data, and the most likely model configuration (given the data) is identified from the set. The methodology presented here may be applied to a wide variety of aquatic modeling applications, and provides a quantitative framework for assessing the appropriate level of model complexity based on the available amount of information for a given system.

McEwen, D. C., North Dakota State University, Fargo, ND, USA, daniel.mcewen@ndsu.edu;
Butler, M. G., North Dakota State University, Farog, ND, USA, malcolm.butler@ndsu.edu

APPLICATION OF METABOLIC THEORY TO THE DETERMINATION OF LIFE-SPAN, GROWTH RATE, AND SECONDARY PRODUCTION OF BENTHIC MACROINVERTEBRATES

Accurate estimation of secondary production by macroinvertebrates requires that density measurements be matched with estimates of both the rate of growth and the time needed to complete development. Determining precise growth rates and developmental times from field data can be difficult, and often estimates are derived from sparse data. Here we apply relationships from the recently developed metabolic theory of ecology (MTE) to predict growth rates and developmental times under different temperature regimes. We also express the converse, where we calculate effective temperature as a function of field-derived estimates of growth rates and developmental times. Models are calibrated using macroinvertebrates from arctic tundra ponds near Barrow, Alaska, including *Chironomus* larvae with a 7-year life-span, the longest developmental period reported for any aquatic insect. Since the MTE explicitly requires terms for temperature, it lends itself to generating hypotheses regarding potential impacts of climatic warming on

the macroinvertebrate fauna. We show how the MTE can provide new ways of approaching the often difficult task of estimating secondary production of macroinvertebrates.

McGowan, S., University of Nottingham, Nottingham, United Kingdom, suzanne.mcgowan@nottingham.ac.uk;
Leavitt, P. R., University of Regina, Regina, Canada, peter.leavitt@uregina.ca;
Barker, P., Lancaster University, Lancaster, United Kingdom, p.barker@lancaster.ac.uk;
Turner, E., Lancaster University, Lancaster, United Kingdom, e.turner3@lancaster.ac.uk;
Maberly, S., CEH, Lancaster, Lancaster, United Kingdom, scm@ceh.ac.uk

IMPROVED ASSESSMENT OF CULTURAL EUTROPHICATION USING LIMNOLOGICAL AND PALEOLIMNOLOGICAL RECORDS FROM LAKE WINDERMERE

Lake Windermere has one of the world's longest phytoplankton monitoring records and a renowned history of cultural eutrophication. We analysed pigments (chlorophylls and carotenoids) and stable isotopes in a sediment sequence from the North Basin of the lake. Our aims were first to compare how sedimentary pigments and phytoplankton counts recorded lake primary production and second to determine the enrichment history of the lake since the 1700s. Comparisons of sedimentary pigments with monitored phytoplankton since 1945 showed that pigments recorded similar patterns as phytoplankton biovolumes, but that the magnitude of change sometimes differed. This discrepancy was greatest for those groups that inhabit deep waters (e.g. Oscillatoriaceae), and reflected that pigments record algal production throughout the entire water column rather than solely the epilimnion. Pigments and isotopes showed that cultural enrichment of Lake Windermere began during the late 1800s, when production of Oscillatoriaceae exceeded that during the late 20th century. Together these results demonstrate how paleolimnology can supplement long-term monitoring records by improving estimates of whole-lake primary production and providing a longer temporal perspective.

McKnight, D. M., University of Colorado, Boulder, USA, diane.mcknight@colorado.edu;
Miller, M., University of Colorado, Boulder, USA, matthew.p.miller@colorado.edu;
Chapra, S., Tufts University, Somerville, USA;
Williams, M., University of Colorado, Boulder, USA, mark.williams@colorado.edu;
Borgnis, E., San Francisco State University, San francisco, USA

PHOTOCHEMICAL TRANSFORMATION OF HUMIC DOM QUALITY IN AN ALPINE LAKE

The chemical character of dissolved organic matter (DOM) in alpine lakes changes seasonally. In Green Lake 4, an alpine lake in the Rocky Mountains, DOM from shallow soils and wetlands is flushed into the lake during snowmelt. During summer, phytoplankton growth is an in-lake DOM source with distinct chemical characteristics. Further, photochemical transformation may change the chemical quality of lake DOM. An unusual sustained mid-summer rainstorm in 2006 flushed wetland DOM into Green Lake 4 and provided an opportunity to study photochemical transformation of DOM. In the nearby wetland, the DOC concentrations in lysimeter samples were ~20 mg/L, much greater than in the lake. Characterization of DOM by fluorescence spectroscopy, PARAFAC, and fractionation methods provided measures of DOM source and redox state. We found that reduced fulvic acid quinones were produced in the wetland and transported downstream. We used a lake mixing model based on 18O as a conservative tracer to evaluate the in-lake change in humic DOM following snowmelt and the mid-summer rainstorm. Comparison of predicted humic DOM with measured concentrations showed that substantial degradation occurred. The humic DOM remaining in the lake became progressively more oxidized, suggesting photochemical transformation as an important process. The loss of humic DOM in the lake influences the light regime and potentially the structure and function of the alpine lake ecosystem.

McMeans, B. C., University of Windsor, Windsor, Canada, mcmeans@uwindsor.ca;
Svavarsson, J., University of Iceland, Reykjavik, Iceland, jorundur@hi.is;
Fisk, A. T., University of Windsor, Windsor, Canada, afisk@uwindsor.ca

ESTABLISHING TROPHIC LINKS IN A MARINE ECOSYSTEM THROUGH INTEGRATION OF ESTABLISHED AND NOVEL TRACERS

Understanding the structure of food webs is crucial for predicting the effects of climate change on organisms. Stable isotope studies often rely on only carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) to structure marine food webs. The ability of mercury (Hg) to act as an additional tracer of feeding interactions was assessed in species sampled from the waters surrounding Iceland. Values of δ^{13} C in fish muscle increased on a gradient from offshore/pelagic to inshore/benthic species and $\delta^{15}N$ increased from zooplanktivors to piscivores, agreeing with previous knowledge concerning the feeding behavior of species. Log [Hg] increased with $\delta^{15}N$ in the Iceland food web and Hg data provided additional insights into feeding behavior. For example, the $\delta^{15}N$ value of *Lycodes frigidus*, a deep-water teleost, suggested a high trophic position, but the lower Hg suggested that *L. frigidus* was feeding at a lower trophic position that more closely agreed with published diet information for *L. frigidus*. Our results indicate that the inclusion of additional tracers, like Hg, aid in the correct interpretation of stable isotope data and the accurate structuring of food webs.

McNamara, M. E., Stony Brook University, Stony Brook, USA, memcnama@ic.sunysb.edu;
Lonsdale, D. J., Stony Brook University, Stony Brook, USA, dlonsdale@notes.cc.sunysb.edu;
Cerrato, R. M., Stony Brook University, Stony Brook, USA, rcerrato@notes.cc.sunysb.edu

SHIFTING CTENOPHORE ABUNDANCE AND THE IMPLICATIONS FOR LARVAL BIVALVE MORTALITY IN LONG ISLAND, NY ESTUARIES

The ctenophore Mnemiopsis leidyi is an ecologically important gelatinous predator in temperate coastal environments, where populations appear to be increasing in abundance and may be undergoing shifts in their normal seasonal distribution. Peak mean biovolume estimates of M. leidyi in Long Island estuaries in 2006 revealed ctenophore abundance values that were a factor of two to five times higher than previous studies conducted two decades ago. Furthermore, peak M. leidyi densities occurred two to three months earlier than previously documented abundances, suggesting a possible shift in the seasonal maxima of M. leidyi in Long Island estuaries. In 2006, peak abundances of M. leidyi overlapped with peak spawning events of the commercially-important hard clam, Mercenaria mercenaria. The dramatic increase in ctenophore abundance encountered during this study resulted in substantially higher daily ingestion rates of M. mercenaria larvae by M. leidyi populations than previously estimated values. Increasing ctenophore abundance, especially at times when they were not historically abundant may have significant consequences for marine food webs. Current populations of M. leidyi represent a major source of larval mortality of M. mercenaria which may inhibit recovery of hard clam populations and reinforce the low abundance state of hard clams in Long Island estuaries.

Mehner, T., Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, mehner@igb-berlin.de;
Busch, S., Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, busch@igb-berlin.de;
Freyhof, J., Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, freyhof@igb-berlin.de;
Helland, I. P., Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, helland@igb-berlin.de;
Kasprzak, P., Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Stechlin-Neuglobsow, Germany, daphnia@igb-berlin.de;
Reese, C., Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Stechlin-Neuglobsow, Germany, c.reese@igb-berlin.de

PHYSICAL FORCING BY TEMPERATURE GRADIENTS IN DEEP LAKES MODIFIES INTERACTION STRENGTH BETWEEN PELAGIC POPULATIONS

Habitat choice of animals results from the trade-off between predation risk and feeding opportunity. Recently, physical factors have been added as triggers of vertical distribution in pelagic populations. In Lake Stechlin (Germany), the night-time population depths of planktivorous fish (Coregonus spp.) were highly correlated with the seasonally fluctuating water temperature during one year. We expanded the single-year approach by regressing population depths to the average water temperature for both fish (19 observations) and their main zooplankton prey (Bosmina spp.) (29 observations). We predicted the population depths from the temperature for an independent test year for which empirically derived depth distributions were available. The average vertical distances in population depths between predator and prey were highly correlated between predicted and empirical distributions. Accordingly, temperature was a main predictor of animalÃƒÆ'¢Ã¢Ã¢â‚¬Å¡Ã¢Ã¢â‚¬Å¾¢s vertical distribution. Contribution of prey species to predatorÃƒÆ'¢Ã¢Ã¢â‚¬Å¡Ã¢Ã¢â‚¬Å¾¢s diet significantly correlated with the vertical distance between interacting populations. Since fish and B.longirostris were found in layers with relatively constant temperature all over the year, species-specific metabolic requirements force the animals to choose certain thermal habitats, thus modifying interaction strengths.

Mergeay, J., KULeuven, Leuven, Belgium, joachim.mergeay@bio.kuleuven.be;
Verschuren, D., UGent, Ghent, Belgium, Dirk.verschuren@ugent.be;
De Meester, L., KULeuven, Leuven, Belgium, luc.demeester@bio.kuleuven.be

SPECIES SORTING, APPARENT NEUTRALITY AND LASTING PRIORITY EFFECTS: PALEO-ECOLOGICAL LESSONS FROM INHERENTLY DYNAMIC ECOSYSTEMS

The composition of ecological communities depends on the interaction between dispersal limitation and the efficiency of species sorting. The outcome of this has been hotly debated over the past few years, with fervent believers and non-believers of the neutral model of ecology. We took advantage of a detailed paleolimnological record of an extremely climate-sensitive lake to reconstruct the process of community assembly over time and replicated in time, as communities were reassembled after each catastrophic change. We contrasted two major components of lake communities (benthos: Chironomids; zooplankton: Daphnia) to assess the relative importance of neutral processes in community assembly in these two groups. Our results show that the assembly of Chironomids was strongly influenced by deterministic processes. The Daphnia community, however, seemed much more influenced by stochastic events, especially during lake transgressions. A more detailed analysis, however, indicated that species sorting nevertheless affected the community composition during regression phases, and that the apparent neutrality during transgressions was largely determined by priority effects established during lowstand episodes, likely mediated by extensive local dormant egg banks.

Meyer, E. I., University of Muenster, Muenster, Germany, meyere@uni-muenster.de;
Magdalinski, N., University of Muenster, Muenster, Germany, nmagdalinski@web.de;
Kaschek, N., University of Muenster, Muenster, Germany, kaschekn@uni-muenster.de;
Riss, H. W., University of Muenster, Muenster, Germany, riss@uni-muenster.de

DROUGHT EVENTS AFFECT DECOMPOSITION OF CPOM IN A KARST STREAM: EVIDENCE FROM EXPERIMENTAL EXPOSURE OF WOOD SURROGATES AND LEAVES

In our studies in a Central European karst stream we investigated how the different flow patterns affect the decomposition of CPOM, and to which extent this process is influenced by macroinvertebrates. We incubated alder leaves and beech wood spatula in coarse and fine mesh bags along a downstream flow gradient reflecting permanent, temporary, and drought situations. Over the 45-day-study breakdown and invertebrate colonization of both wood and leaves was highest at the permanent site. No significant differences in CPOM decomposition could be measured between the temporary and the dry site. Breakdown of wood was very low at the temporary and the dry site. Access of macroinvertebrates resulted in faster decomposition of leaves at all sites. The fauna was dominated by aquatic taxa at the permanent site and by terrestrial taxa at the dry site. We concluded that frequency and duration of flow and drought periods at the least colonized temporary site were too unvafourable for both aquatic and terrestrial invertebrates, and that at the temporary and dry sites the local weather conditions interfered with the decomposition process.

Meysman, F., Vrije Universiteit Brussel (VUB), Brussel, Belgium, filip.meysman@vub.ac.be

MODELLING ORGANIC MATTER PROCESSING IN MARINE SEDIMENTS: SEEING THE FOREST FOR THE TREES

Sedimentary organic matter processing plays a crucial role in the short-term and long-term carbon cycle of the ocean, and therefore it is crucial to quantitatively understand what controls the rate of organic matter processing in marine sediments. In current biogeochemical models, the overall effect of mineralization is typically condensed into a single decay constant k (units inverse of time). In reality however, organic matter decomposition results from the metabolic activity of a very complex benthic food web. A variety of micro-organisms are involved (aerobic bacteria, denitrifiers, sulphate reducers, etc) as well as diverse community of invertebrates, which influence organic matter processing through metabolism and transport activities (sediment mixing, bio-irrigation). So how to link simple decay constants to the complex functioning of the underlying food web? To this end, we examined a recently proposed hypothesis from non-equilibrium thermodynamics, which states that "complex systems tend to maximize their entropy production". When applied to sediment food webs, one obtains a theoretical relation for the decay coefficient as a function of the flux of organic matter to the sediment. Intriguingly, this prediction closely fits the available data on decay coefficients in marine environments.

Mezek, T., National Institute of Biology, Ljubljana, Slovenia, tadej.mezek@gmail.com;
Arts, M. T., Environment Canada - National water research Institute, Hamilton, Canada, Michael.Arts@ec.gc.ca;
Sverko, E., Environment Canada - National water research Institute, Hamilton, Canada, Ed.Sverko@ec.gc.ca;
Aaron Fisk, A., University of Windsor, Windsor, Canada, afisk@uwindsor.ca;
Capretta, F., McMaster University , Hamilton, Canada, capretta@mcmaster.ca

POLYMETHYLENE-INTERRUPTED FATTY ACIDS (PMI-FA) AS BIOMARKERS IN FRESHWATER ECOSYSTEMS?

It is now well accepted that fatty acids (FA) can, under some circumstances, be used as trophic markers (FATM) in food web studies. However, differing requirements amongst species as well as species-specific transformations of ingested FA often complicate straightforward analysis. Recently we revealed the existence of uncommon FAs, termed polymethylene interrupted fatty acids (PMI-FA), in invasive freshwater mollusks (Dreissena spp.) in the Great Lakes. We provide evidence which suggests that these PMI-FA are exclusively synthesized by Dreissenids and that they accumulate, intact, along specific trajectories within the food web. For example, we identified several PMI-FA in invertebrates (i.e. Mysis relicta, Diporeia spp.) which spend time scavenging in and on the organic detritus blanketing Dreissenid colonies. We also assayed for PMI-FA in piscivores such as largemouth bass (Micropterus salmoides) and found, as expected, relatively low PMI-FA levels. On the other hand, lake whitefish (Coregonus clupeaformis); a species which is known to consume Dreissenids and which comprises the largest remaining commercial fishery on the Great Lakes, had high levels of PMI-FA.

Michaud, S., Fisheries and Oceans Canada, Mont-Joli, Canada, sonia.michaud@dfo-mpo.gc.ca;
Levasseur, M., Université Laval, Québec, Canada, maurice.levasseur@bio.ulaval.ca;
Scarratt, M. G., Fisheries and Oceans Canada, Mont-Joli, Canada, michael.scarratt@dfo-mpo.gc.ca;
Luce, M., Université Laval, Québec, Canada, myriam.luce.1@ulaval.ca;
Royer, S. J., Université Laval, Québec, Canada, sarah-jeanne.royer.1@ulaval.ca

DISTRIBUTION OF DIMETHYLSULFIDE AND DIMETHYLSULFONIOPROPIONATE IN THE CANADIAN ARCTIC

We conducted seawater measurements of the climatically active gas dimethylsulfide (DMS) and its precursor dimethylsulfoniopropionate (DMSP) during the fall of 2007 from the west coast of Greenland to the

Beaufort Sea. 2007 was a year of record low sea-ice extent in the Arctic basin. The expedition took place on the Canadian research icebreaker CCGS Amundsen as part of the new Arctic Surface Ocean Lower Atmosphere Study (SOLAS) research project funded by the Canadian International Polar Year (IPY) Program, and supported by the ArcticNet network. Measurements were conducted at five depths at 26 fixed stations and every 2 h from the ship's sub-surface water pumping system. Concentrations of DMS ranged from below the level of quantification (0.03 nmol l-1) to ca. 4 nmol l-1, averaging 0.58 nmol l-1. DMSPt varied from 0.3 to 52 nmol l-1. Both DMSP and DMS concentrations exhibited a gradual westward decrease with the lowest concentrations measured in the Beaufort Sea in November, although this may be related to seasonal progression rather than geographic effects. Our results show that waters of the Canadian Archipelago represent a weak source of DMS to the atmosphere during that time of the year.

Millard, K. E., Acadia University, Wolfville NS, Canada, koreenmillard@gmail.com;
Redden, A. M., Acadia University, Wolfville NS, Canada, anna.redden@acadiau.ca;
Hopkinson, C., Applied Geomatics Research Group, NSCC, Lawrencetown NS, Canada, chris.hopkinson@nscc.ca;
Webster, T., Applied Geomatics Research Group, NSCC, Wolfville NS, Canada, timothy.webster@nscc.ca;
Stewart, H., Wapusk National Park, Churchill MB, Canada, heatherm.stewart@pc.gc.ca

USE OF HIGH RESOLUTION LIDAR DATA IN THE ASSESSMENT OF POTENTIAL SITES FOR SALT MARSH RESTORATION

Over the past 300 years, approximately 80% of salt marshes in the upper Bay of Fundy have been altered, largely by the installation of dykes and other barriers. Salt marsh restoration at several locations is now being considered. This work uses geomatics tools to model restoration processes of salt marshes following breaching of dykes at selected sites in the megatidal and turbid coastal waters of Cumberland Basin, New Brunswick, Canada. Salt marsh formation and growth is controlled primarily by land elevation and the saltwater inundation tolerances of marsh vegetation. High resolution LiDAR digital elevation models, GPS and remotely sensed imagery were used to assess physical features at three proposed restoration sites and a reference marsh. The process of restoration was modeled using GIS and geomatics techniques. Modelling showed that the elevation behind barriers at two of the three sites was too low for the re-establishment of salt marsh grasses. Sediment accumulation was then modeled to determine the time required for the proposed restoration sites to become suitably elevated to support salt marsh vegetation.

Milligan , T. G., Fisheries and Oceans Canada, Dartmouth NS, Canada, milligant@mar.dfo-mpo.gc.ca;
Law, B. A., Fisheries and Oceans Canada, Dartmouth NS, Canada, lawb@mar.dfo-mpo.gc.ca;
Yeats, P. A., Fisheries and Oceans Canada, Dartmouth NS, Canada, yeatsp@mar.dfo-mpo.gc.ca;
Amirault, B. P., Fisheries and Oceans Canada, Dartmouth NS, Canada, amiraultb@mar.dfo-mpo.gc.ca

THE ROLE OF FLOCCULATION IN THE UPTAKE OF ARSENIC AND MERCURY BY CLAMS.

Arsenic has been found at levels of concern for human health in shellfish from Seal Harbour NS. The source of this contamination is mine tailings from historic gold mining operations in the Seal Harbour watershed. In addition to arsenic the abandoned mine sites have extremely high levels of mercury which is also reaching the marine environment. The mechanism for the uptake of arsenic and mercury by marine benthic organisms is not well understood. One possible pathway is the ingestion of metal-bearing flocs, which are loose agglomerations of organic and inorganic material found in the ocean and, in some cases, rivers and lakes. Flocs are a preferred food source for suspension feeding organisms like clams and mussels as they provide an efficient way of ingesting high quality carbon. In 2006, bottom sediment samples were collected in Seal Harbour with a specially designed corer that preserves the sediment water interface. Immediately after sampling, the cores were subjected to increasing shear stresses using a Gust erosion chamber and the material eroded from the surface was analysed for disaggregated inorganic grain size and metals concentration. Results show that at low shear stress arsenic and mercury are suspended in flocs making these metals available for ingestion by suspension feeders.

Mohamed, M. N., University of Waterloo, Waterloo, Canada, mmohamed@uwaterloo.ca;
Taylor, W. D., University of Waterlo, Waterloo, Canada, wdtaylor@uwaterloo.ca

A META-ANALYSIS OF TERRESTRIAL CARBON SUBSIDIES TO LAKE PLANKTONIC FOOD WEBS

The relative contribution of allochthonous and autochthonous production in zooplankton nutrition has been of interest since the net heterotrophy of lakes was recognized to be common. We culled the literature for ^{13}C stable isotope data of lake $^{13}CO_2$, ^{13}C-POC, and ^{13}C-zooplankton. Our hypothesis was that, in the absence of phytoplankton CO_2-limitation, POC and zooplankton signature would reflect the CO2 signature if they were autochthonous. With increasing allochthonous C, however, their ^{13}C signature will be increasingly influenced by the allochthonous ^{13}C signature (-28) and decreasingly dependent on the CO2 signature. We found that POC signature showed a strong influence of allochthonous C, inferring that it was close to 50% allochthonous on average. However, zooplankton signatures were strongly related to the CO_2 signatures, and we estimate that their carbon was mostly autochthonous. Therefore, while terrestrial inputs form a major portion of POC, zooplankton C, on average, is largely autochthonous.

Moore, M. V., Wellesley College, Wellesley, USA, mmoore@wellesley.edu;
Hampton, S. E., NCEAS, University of California, Santa Barbara, Santa Barbara, USA, hampton@nceas.ucsb.edu;
Izmest'eva, L. R., Irkutsk State University, Irkutsk, Russian Federation, root@bio.isu.runnet.ru

POTENTIAL EFFECTS OF CONTEMPORARY CLIMATE CHANGE ON LAKE BAIKAL, SIBERIA

Lake Baikal is responding to climate change. During the past 60-100 years, surface water temperatures warmed significantly (top 25-m), and the ice-free season lengthened by 18 days. By the end of this century, the projected climate will be considerably warmer and wetter, particularly in winter. Ice cover and transparency, water temperature, wind dynamics and mixing, and nutrient inputs are the key abiotic variables that will shift as climate changes, in turn, eliciting a host of biotic responses. Among the abiotic variables, changes in ice cover and transparency may have the greatest effects on ecosystem structure and function because of the diverse ways ice affects the lake's primary producers and the Baikal seal. In summer, warmer surface waters and enhanced stratification may inhibit the vertical migration of deep-dwelling cold-water stenotherms (i..e, *Macrohectopus*, pelagic amphipods and *Comephorus*, golymyanka) into the photic zone at night, thereby disrupting trophic linkages. We conclude that climate change greatly affects ecosystem functioning in L. Baikal and that these effects will likely be exacerbated by other increasing anthropogenic stressors.

Moore-Gibbons, C. E., Memorial University of Newfoundland, St. John's, Canada, cmooregibbons@mun.ca;
Ziegler, S., Earth Sciences Department, Memorial University of Newfoundland, St. John's, Canada, sziegler@esd.mun.ca;
Anderson, R., Science Branch, Department of Fisheries and Oceans, St. John's, Canada, AndersonRo@dfo-mpo.gc.ca;
Rivkin, R., Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, Canada, rrivkin@mun.ca;
Keats, K., Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, Canada;
Whalen, R., Science Branch, Department of Fisheries and Oceans, St. John's, Canada

THE INFLUENCE OF RIVERINE INPUT ON DISSOLVED ORGANIC MATTER CYCLING AND MICROBIAL COMMUNITIES IN THE LAKE MELVILLE ESTUARY, LABRADOR, CANADA.

The Lower Churchill River hydroelectric development proposed for Labrador, Canada, highlights the need to understand the influence

this major river exerts on the biogeochemistry and trophodynamics of its estuary, Lake Melville. We examined the relative importance of riverine and marine dissolved organic matter (DOM) supply to the Lake Melville food web. A survey was conducted to assess DOM source and composition, and bacterial and zooplankton abundance and composition across the estuarine salinity gradient. The bacterial and zooplankton communities varied with depth suggesting the riverine and marine waters supplied and supported different communities. The mixed layer exhibited increases in both dissolved organic carbon (DOC) and d13C of dissolved inorganic carbon (DIC) at mid-salinities, relative to a conservative distribution, suggesting increased autochthonous DOC near the marine-riverine interface. Waters below the mixed layer, however, exhibited the opposite trend in DOC and d13C-DIC at mid-salinities suggesting microbial uptake of DOC near the marine-riverine interface. Further, the mixing of these sources in the estuary supported communities differing from the end members suggesting that riverine input influenced the biogeochemistry and food web of this estuary.

Mouret, A., Université Bordeaux 1, Bordeaux, France, a.mouret@epoc.u-bordeaux1.fr;
Anschutz, P., Université Bordeaux 1, Bordeaux, France, p.anschutz@epoc.u-bordeaux1.fr;
Deborde, J., Université Bordeaux 1, Bordeaux, France, j.deborde@epoc.u-bordeaux1.fr;
Lasemi, S., Université Bordeaux 1, Bordeaux, France;
Labrousse, B., Université Bordeaux 1, Bordeaux, France;
Polsenaere, P., Université Bordeaux 1, Bordeaux, France;
Canton, M., Université Bordeaux 1, Bordeaux, France;
Wawrzykowski, M., Université Bordeaux 1, Bordeaux, France;
Poirier, D., Université Bordeaux 1, Bordeaux, France

SPATIAL HETEROGENEITY OF DIAGENETIC PARAMETERS IN A COASTAL ENVIRONMENT (ARCACHON BAY, SW FRANCE)

The Arcachon Bay is a 156 km^2 mesotidal lagoon located on the French Atlantic coast, where intertidal zone covers more than 66% of the surface area. Previous studies have demonstrated that seasonal dynamics is the predominant factor on variability of such diagenetic parameters in vegetated tidal mudflats, whereas in bare sediments, spatial heterogeneity, inducing by bioturbation and topography, seems to be predominant. Recently, a study has been carried out to characterize this spatial heterogeneity of redox species in superficial sediments of two unvegetated tidal mud-flats. At each site, five 1m-side squares have been randomly delimited at low tide. In each square, 3 cores have been randomly collected. Statistical analysis has been used to quantify the spatial heterogeneity at different scales. The distinction between temporal and spatial heterogeneity allows to better interpret redox profiles and have a better understanding of diagenetic processes in this highly dynamic ecosystem. A similar study is currently carried out on the marine slope of Bay of Biscay (France) in order to compare the spatial heterogeneity in these two distinct marine environments.

Munawar, M., Fisheries & Oceans Canada, Burlington, Canada, mohi.munawar@dfo-mpo.gc.ca;
Fitzpatrick, M. A., Fisheries & Oceans Canada, Burlington, Canada, mark.fitzpatrick@dfo-mpo.gc.ca;
Lorimer, J., Fisheries & Oceans Canada, Burlington, Canada

MICROBIAL FOOD WEB DYNAMICS AS INDICATORS OF ECOSYSTEM HEALTH IN BAY OF QUINTE AND HAMILTON HARBOUR, LAKE ONTARIO: APPLICATION / SUCCESS OF LONG TERM PROJECTS

The Bay of Quinte and Hamilton Harbour are both shallow embayments of Lake Ontario which have suffered impairments from anthropogenic stressors including eutrophication, invasive species and sediment contamination. As part of remediation efforts, Fisheries & Oceans Canada began intensive, bi-weekly, microbial food web studies in the Bay of Quinte in 2000 and Hamilton Harbour in 2002 in order to evaluate the structure and function of these ecosystems. Despite broad based similarities, the microbial food web of the Bay of Quinte was dominated by heterotrophic nanoflagellates, whereas Hamilton Harbour was dominated by phytoplankton indicating unique energy transfer regimes. This presentation will discuss how these ongoing monitoring programs are being used to assess ecosystem health and provide guidance for remediation efforts.

Murphy, R. J., Memorial University, St. John's, Canada, rmmrphy@mta.ca;
Penney, S., Memorial University, St. John's, Canada, sabrinapenney2@hotmail.com;
Rivkin, R. B., Memorial University, St. John's, Canada, rrivkin@mun.ca

SPATIAL VARIATION IN THE STRUCTURE AND FUNCTION OF MARINE MICROBIAL COMMUNITIES RESULTING FROM PREDICTED CLIMATE CHANGE IN THE LABRADOR SEA

Global climate change will affect temperature and nutrient supply patterns in the World's Oceans. Heterotrophic bacteria are important in the cycling and transformation of organic carbon, and their growth and production are controlled by both temperature and nutrient availability. To determine environmental factors that control bacterial dynamics and community structure, seawater dilution cultures of natural marine bacteria from the Labrador Sea were incubated at a range of in situ temperatures (1.7–6.6°C) and bacterial abundances (1.2–1.9 x10^8> cells/L). Six experiments were conducted in three biogeochemical provinces to examine the spatial variability in structural and functional responses of these microbial communities to grazer, temperature, and organic carbon manipulations. There was a general response of increased bacterial growth and biomass production with warmer temperatures and increased organic carbon supply, and there were significant differences in the magnitude of these responses across spatial scales both within and between provinces (all $p < 0.001$). Thus, climate-driven physical changes in the upper ocean can have spatially-variable effects on biological systems, a result that will have biogeochemical implications.

Nakayama, T., National Institute for Environmental Studies, Tsukuba, Japan, nakat@nies.go.jp

EFFECT OF FRESHWATER OVER-EXPLOITATION ON SEAWATER INTRUSION IN GRAIN-CROPPING PLAIN AREA

North China Plain (NCP) is one of the most important grain cropping areas in China, and includes some megalopolis such as Beijing and Tianjin. This region has changed from water-rich in the 1950's to water-poor area at present by the intensified water use conflicts, which indicates various ecosystem degradations such as dry-out Yellow River, nearly closed Hai River, and groundwater degradation and seawater intrusion. The author has developed the NIES Integrated Catchment-based Eco-hydrology (NICE) model. The model reproduced excellently the hydrologic/heat budgets, crop productivity, and trend of groundwater degradation over the previous half century, including cone depressions occurred around the bigger cities, which the previous research could not reproduce. The simulated result of density current and solute transport processes made clear that these freshwater cycle changes have caused the serious seawater intrusion and the decrease of crop productivity beside the coastal area, which could be shown in NDVI estimated by satellite images. This study is very important for evaluation of ecosystems and environments on the moving edge of freshwater and marine. References;Nakayama,ECOMOD,doi:10.1016/j.ecolmodel.2008.02.017,2008. Nakayama&Watanabe,WRR,doi:10.1029/2004WR003174,2004. Nakayama&Watanabe,HESSD,3,2101-2144,2006. Nakayama&Watanabe,HP,doi:10.1002/hyp.6684,2007. Nakayama, et al.,HP,doi:10.1002/hyp.6142,2006. Nakayama, et al.,STOTEN,doi:10.1016/j.scitotenv.2006.11.033,2007.

Nandi, M., Ryerson University, Toronto, Canada, mnandi@ryerson.ca;
Bostan, V., Ryerson University, Toronto, Canada, vbostan@ryerson.ca;
Laursen, A., Ryerson University, Toronto, Canada, alaursen@ryerson.ca;
McCarthy, L., Ryerson University, Toronto, Canada, l3mccart@ryerson.ca

CIPROFLOXACIN EFFECTS ON NITROGEN CYCLING IN AQUATIC SEDIMENTS

These experiments were designed to assess the effects of ciprofloxacin (cipro) on the function and composition of microbial populations in freshwater environments. Cipro is a broad-spectrum fluoroquinolone antibiotic used in the treatment of both human and veterinary pathogenic diseases. Previous studies reported the presence of cipro in aquatic environments. This study investigates whether cipro has adverse effects on environmental bacteria which perform critical ecosystem processes associated with nitrogen cycling. Microcosms containing sediment and synthetic lake water were amended with a series of environmentally relevant concentrations of cipro ranging from 0 to 2.5 mg/kg. Nitrogen

cycling processes were measured using a combination of stable isotope techniques ($^{15}NO_3^-$ dilution) and flux measurements (NH_4^+, NO_3^-, NO_2^-). Results of preliminary experiments have shown that ammonia and nitrate flux rates were lower in the treated microcosms compared to the reference microcosms. This would indicate that the presence of cipro resulted in reduced rates of nitrification and ammonification.

Nelson, C. E., University of California, Santa Barbara, USA, cr_nelson@lifesci.ucsb.edu;
Sadro, S., University of California, Santa Barbara, USA, sadro@lifesci.ucsb.edu;
Melack, J. M., University of California, Santa Barbara, USA, melack@lifesci.ucsb.edu

THE INFLUENCE OF STREAM INPUTS AND LAKE PROCESSES ON BACTERIAL COMMUNITY STRUCTURE AND DISSOLVED ORGANIC MATTER COMPOSITION IN HIGH-ELEVATION LAKE CHAINS

We examined spatiotemporal heterogeneity in bacterioplankton community composition (BCC; using PCR-based phylogenetic fingerprinting) and the composition of dissolved organic matter (DOM; using scanning fluorometry) at the landscape scale in high-elevation catchments of the Sierra Nevada (California, USA). A seasonal study compared BCC in two connected cirque lakes and their inlets and found that lake:inlet community similarity declined with increasing residence time in both lakes as snowmelt progressed. However, the headwater lake maintained < 50% similarity to its inlet even during peak snowmelt flushing (residence time < 5d) while the downstream lake maintained > 50% similarity to both its inlet and the upstream lake. Seventeen lake chains were sampled to examine how landscape position influenced BCC and DOM among lakes and their connecting streams. Headwater lakes were less similar to their inlet streams than downstream lakes. Headwater inlet BCC was distinct from all downstream samples. The similarity between lakes within a chain was inversely proportional to geographic distance for both BCC and DOM. Evidence from headwater lakes suggests within-lake environmental processes maintain a BCC and DOM distinct from large terrigenous inputs.

Neuheimer, A. B., Dalhousie University, Halifax, Canada, anna.neuheimer@phys.ocean.dal.ca;
Gentleman, W. C., Dalhousie University, Halifax, Canada, wendy.gentleman@dal.ca;
Galloway, C., Dalhousie University, Halifax, Canada

TO EAT HER OWN: CANNIBALISM, CLIMATE AND COPEPOD NAUPLII

Early life stages of the copepod *Calanus finmarchicus* are major prey for larval fish throughout the North Atlantic. On Georges Bank, peak naupliar abundance co-occurs with fish spawning in March/April, but naupliar abundance declines dramatically in May and increases again in June. Explaining this temporal trend is critical to predicting effects of climate on fish and their food. Here, causal factors are diagnosed by simulating the seasonal cycle of *C. finmarchicus* nauplii with a population dynamics model that uses GLOBEC data for temperature- and food-dependent development rates, egg production rates, and female abundance. Use of field-estimated mean mortality rates results in modeled abundance that is erroneous by over an order of magnitude. This data/model discrepancy cannot be explained by food limitation or variation in egg production. Instead, time-varying mortality rates are required to reproduce observed naupliar densities. These temporal variations in mortality are correlated with *C. finmarchicus* female abundance, implying cannibalism as a major regulatory factor of naupliar abundance. The influence of climate on this biological control of secondary production, as well as implications for field programs are discussed.

Nielsen, L. T., University of Copenhagen, Copenhagen, Denmark, ltnielsen@bio.ku.dk;
Hallegraeff, G. M., University of Tasmania, Hobart, Australia, hallegraeff@utas.edu.au;
Jakobsen, H. H., DTU Aqua, Charlottenlund, Denmark, hhj@difres.dk;
Hansen, P. J., University of Copenhagen, Copenhagen, Denmark, pjhansen@bio.ku.dk

WILL OCEAN ACIDIFICATION INFLUENCE SPECIES COMPOSITION AND PRODUCTION IN MARINE PLANKTON COMMUNITIES?

The atmospheric CO_2 concentration has been rising for the last decade, and will continue to do so at least into the foreseeable future. However, our knowledge on the impact on species composition and production of plankton communities is scarce. By applying an array of different methods, we investigated the effects of decreased pH and elevated CO_2 on the succession of natural plankton communities during 14 day incubation periods. The methods include (1) light microscopy cell counts of 25 of the most dominant taxa, (2) photo pigment analysis by HPLC and CHEMTAX and (3) algal species and size category quantification by FlowCAM. Experiments were conducted in 2.5 L transparent bottles mounted on a plankton wheel, and phytoplankton communities from Oresund, Denmark and Derwent estuary, Australia were subject to four different pH/CO_2 levels (pH 8.3, 8.0, 7.7 & 6.3). Algal species and sizes were largely unaffected by pH within the predicted 100 year range, whereas pH 6.3 significantly altered species composition. The same was true for results on POC, PON and for photosynthesis measured by ^{14}C and PAM fluorometry.

Niggemann, J., University of Aarhus, Department of Biological Sciences, Section for Microbiology, Aarhus, Denmark, jutta.niggemann@biology.au.dk;
Lomstein, B. A., University of Aarhus, Department of Biological Sciences, Section for Microbiology, Aarhus, Denmark, bente.lomstein@biology.au.dk;
Sturm, M., Eawag, Dübendorf, Switzerland, sturm@eawag.ch;
Schubert, C. J., Eawag, Kastanienbaum, Switzerland, carsten.schubert@eawag.ch

COMPOSITION AND DEGRADATION OF ORGANIC MATTER IN LAKE BAIKAL - A COMBINED WATER COLUMN-SEDIMENT STUDY

Degradation and transformation of settling particles in the water column determine the amount and the composition of organic matter reaching the sediment. Considering its great depth and the oxygenated water column, Lake Baikal shares important characteristics with deep ocean environments. However, dominant microbial processes that drive organic matter degradation are different in freshwater compared to seawater systems and this might be reflected in the composition of altered organic matter. We analysed organic matter from the water column (sediment traps at 18 different water dephts from 50-1350 m) and in the underlying sediment. Bulk organic matter composition and diagenetic changes in major compound classes (amino acids and fatty acids) were similar to what has been reported from oceanic studies. Different diagenetic indicators typically applied in marine studies succesfully traced ongoing degradation of organic material with increasing water depth and in the sediment. Apparently, the presumed differences in microbial degradation processes do not leave a characteristic imprint on organic matter composition. This emphasizes the significance of other regulation mechanisms for differences in organic matter preservation in lakes compared to oceans.

Ning, N. S., La Trobe University, Wodonga, Australia, nathan.ning@csiro.au;
Nielsen, D. L., Murray Darling Freshwater Research Centre, Wodonga, Australia, daryl.nielsen@csiro.au;
Hillman, T. J., La Trobe University, Wodonga, Australia, hillman.albury@bigpond.com;
Suter, P. J., La Trobe University, Wodonga, Australia, p.suter@latrobe.edu.au

RESTING STAGE AND ACTIVE ZOOPLANKTON DYNAMICS IN SLACKWATER ZONES OF AN AUSTRALIAN FLOODPLAIN RIVER

Resting stage (RS) and active (ACT) zooplankton dynamics were examined concurrently in slackwater zones of an Australian floodplain river between November 2005 and November 2006. Whilst a number of studies have investigated the importance of dormancy and benthic-pelagic coupling for zooplankton inhabiting lakes and ponds, similar knowledge for riverine zooplankton is lacking. Results from this study indicate that more than 50 % of the ACT taxa sampled produced RS's, and that for most of these taxa, RS production was greatest in late spring. Taxa fell into three major groups with respect to benthic-pelagic coupling: 1) those that produced their maximum number of RS's in association with their ACT population maxima, 2) those that produced their maximum number of RS's in association with their ACT population minima, and 3) those that did not demonstrate any obvious relationships between their ACT and RS populations. This study suggests that the majority of the zooplankton taxa

inhabiting Australian floodplain rivers can enter dormancy, and hence, are capable of persisting through unfavourable abiotic and biotic conditions.

Nishimura, O., Tohoku University, Sendai, Japan, osamura@eco.civil.tohoku.ac.jp;
Sakamaki, T., University of British Columbia, Vancouver, Canada, takashi.sakamaki@ubc.ca

DYNAMIC EQUILIBRIUM OF SEDIMENT ORGANIC CONTENT IN ESTUARINE TIDAL FLATS: CONCEPTUAL APPLICATION FOR CONSERVATION AND RESTORATION

Sediment organic content is an important factor for macrobenthos community structure in tidal flats. In stations of an estuarine tidal flat system where macrobenthos biota had been maintained stably, our investigations demonstrated that the sediment organic content had a dynamic equilibrium state; it fluctuated continuously but stayed within a specific range. The cycle period and range of the variations in sediment organic content and its physical mechanisms differed distinctly between non-cohesive and cohesive sediments. At stations where sediment resuspension and wash-outs of sediment organic matter at springtides did not occur regularly, the sediments were cohesive, hence maintaining higher sediment organic contents compared with stations with non-cohesive sediments. Based on these results, we proposed conceptual models for physical processes maintaining the dynamic equilibrium of sediment organic content and the relationship between frequency of sediment resuspension and long-term averages of sediment organic content. Dynamic equilibrium of sediment properties is a key factor for maintenance of benthic communities, hence such factor must be conceptually incorporated into conservation and restoration strategies of estuarine ecosystems.

NIXON, S. W., UNIVERSITY OF RHODE ISLAND, Narragansett, RI, USA, swn@gso.uri.edu;
GRANGER, S. L., UNIVERSITY OF RHODE ISLAND, Narragansett, RI, USA, granger@gso.uri.edu;
BUCKLEY, B. A., UNIVERSITY OF RHODE ISLAND, Narragansett, USA, bbuckley@gso.uri.edu;
FULWEILER, R. W., LOUISIANA STATE UNIVERSITY, Baton Rouge, LA, USA, wally1@lsu.edu

BENTHIC-PELAGIC COUPLING IN A CHANGING NARRAGANSETT BAY

One of the most important pulses in temperate coastal marine ecosystems is the deposition of organic matter from the winter-spring phytoplankton bloom. A changing climate has altered the phenology of blooms in Narragansett Bay such that the traditional winter-spring bloom is often delayed or absent altogether. We have used large benthic mesocosms to study the effects of altering the timing and magnitude of simulated bloom deposition on benthic metabolism (oxygen uptake, nutrient regeneration) and juvenile winter flounder growth. The changing bloom phenology has markedly weakened benthic -pelagic coupling as shown by the experiments and associated field measurements.

Nobre, A. M., IMAR, CMA. DCEA, Faculty of Sciences and Technology/UNL, Almada, Portugal, ana@salum.net;
Ferreira, J. G., IMAR, CMA. DCEA, Faculty of Sciences and Technology/UNL, Almada, Portugal, joao@hoomi.com

ECOLOGICAL AND ECONOMIC ASSESSMENT OF INTEGRATED MULTITROPHIC AQUACULTURE

An integrated ecological-economic modeling approach (differential Drivers-Pressure-State-Impact-Response) is applied to assess the role of bivalve shellfish in integrated multitrophic aquaculture (IMTA). The FARM model was used to evaluate two scenarios: fish production in monoculture; IMTA combining fish and oysters. The changes of shifting from monoculture to IMTA are: (i) Increase of drivers production value (24000 euro.yr^{-1}); (ii) decrease in pressures due to the net removal of phytoplankton and organic detritus by shellfish filtration (-6.8 ton_N.yr^{-1}); (iii) the state of the ecosystem was not simulated given the smaller scale of this analysis. However a positive impact is expected given the decrease in pressure. Compared with standalone fish production, IMTA presents a positive externality estimated as 82000 euro.yr^{-1} for nutrient reduction, and 500 euro.yr^{-1} for CO2 absorption by phytoplankton filtered by oysters; (iv) overall there is a gross gain in adopting the IMTA system (107 x10^{3}euro.yr^{-1}) which includes not only an economic measure of the drivers but also the indirect value of environmental effects. This modeling approach can be particularly valuable for decision makers to evaluate coastal management scenarios.

Nobre, C., University of Massachusetts - Dartmouth / SMAST, New Bedford, USA, carolinanobre@gmail.com;
Gangopadhyay, A., University of Massachusetts - Dartmouth / SMAST, New Bedford, USA, avijit@umassd.edu

THE IMPACT OF NAO ON THE GULF OF MAINE TEMPERATURE AND SALINITY FIELDS DURING 1995-1998

The North Atlantic Oscillation (NAO) is understood to have a large impact on the North Atlantic circulation and variability, especially in the Gulf Of Maine (GOM) region. This work aims to determine the connections between the NAO and the variations in temperature and salt in the GOM by generating four-dimensional high-resolution (5km) physical fields during 1995-1998. These fields are a result of melding basin scale model (ROM) fields and GLOBEC period SST data sets using multi-scale objective analysis (OA). The Regional Slope Water Index (RSWI) is used as an indicator of the modal state of the slope water system with positive (negative) values corresponding to maximum (minimum) modal states. The OA fields generated are validated with in-situ measurements and match well with the data. The correlation of temperature and salinity fields and their corresponding RSWI with the NAO index is used to quantify the influence of the latter on these fields, especially on the Labrador Current advection into the GOM region during 1997-1998.

Noe, G. B., U.S. Geological Survey, Reston, USA, gnoe@usgs.gov;
Harvey, J. W., U.S. Geological Survey, Reston, USA, jwharvey@usgs.gov;
Larsen, L. G., University of Colorado, Boulder, USA, laureloak@gmail.com

ORGANIC SEDIMENT INFLUENCES ON PHOSPHORUS FRACTIONATION AND TRANSPORT IN A PEATLAND

Sediment dynamics have important implications for phosphorus (P) biogeochemistry and transport in Everglades wetlands despite a clear water column. Suspended sediment held 31% of total P while its concentration was low (1.5 mg/L) and particle size was small (9 µm) across Everglades peatlands. Sequential chemical extraction of suspended sediment identified that particulate P was relatively labile and that P fractionation changed with particle size. Fine suspended particles (<100 µm) were dominated by microbial P (65%) with little refractory organic P (2%), while coarse suspended particles (>100 µm) held proportionally less microbial P (39%) and more refractory P (37%) but were less abundant and had lower P density than finer particles. A field experiment with enhanced flow velocities did not change P fractionation in suspended sediment. Volume concentrations (µL/L) of suspended sediment increased 450% and mean particle size increased 200%, however, fractionation of all particles was unvarying and largely microbial P (58%) with little refractory P (10%). Thus, advection of labile particulate P increased greatly. Restoration actions intended to increase sheetflow velocity will also transport more labile P downstream with sediment.

Noe, S. U., Insitute of Paleontology, University of Erlangen-Nuremberg, Erlangen, Germany, noe@pal.uni-erlangen.de;
López Correa, M., Institute of Paleontology, University of Erlangen-Nuremberg, Erlangen, Germany, lopez@pal.uni-erlangen.de;
Montagna, P., ICRAM, Central Istitute for Marine Research, Rome, Italy, paolomontagna@hotmail.com;
McCulloch, M., RSES-ANU, Research School of Earth Sciences, Canberra, Australia;
Freiwald, A., Institute of Paleontology, University of Erlangen-Nuremberg, Erlangen, Germany, andre.freiwald@pal.uni-erlangen.de

PAIRED STABLE O/C ISOTOPES AND TRACE ELEMENTS IN A DEEP-WATER BAMBOO CORAL SKELETON FROM CHATHAM RISE: METABOLIC VERSUS ENVIRONMENTAL CONTROLS

A 12 mm thick cross section of a modern bamboo coral skeleton (*Keratoisis* sp.) from Chatham Rise off New Zealand (650 m) was analysed for its

stable oxygen and carbon isotopes, using a micromill (100 µm sample spacing). Trace elements were measured with LA-ICP-MS (10 µm steps) in a parallel transect. This coral with annual banding represents a 30 year record, subdivided in a juvenile and an adult stage. The juvenile phase consists of organic-rich Mg-calcitic fascicles, exhibiting the most depleted positively correlated $\delta^{18}O$ and $\delta^{13}C$ values and the highest Mg/Ca and Li/Ca values. This phase is controlled by the coral metabolism affecting the biomineralization. The adult phase (~25 years) is composed of organic-poor calcite fascicles. Mg/Ca and Li/Ca variations are tested as paleotemperature tracers. The adult phase oxygen isotope signal closely reproduces the annual mean temperature of 7.5 degrees Celsius and indicates seasonal variations of 2.5 degrees Celsius. Carbon isotopes show an ontogenetic decrease of about 1 per mil indicative of metabolic carbon uptake. Short-term $\delta^{13}C$ fluctuations appear correlated with P/Ca changes and may hence indicate variations of paleoproductivity and nutrient flux.

Normand, C., Université du Québec à Rimouski, Rimouski, Canada, claude_normand@yahoo.ca;
Nozais, C., Université du Québec à Rimouski, Rimouski, Canada, christian_nozais@uqar.qc.ca;
Caron, A., Université du Québec à Rimouski, Rimouski, Canada, alain.caron@uqar.qc.ca

BENTHIC INVERTEBRATES AS INDICATORS OF HUMAN IMPACTS ON 22 LAKES IN EASTERN QUÉBEC: A CATCHMENT APPROACH

The ways catchments of lakes are used are not well considered in management decision and, therefore, increasing human population around lakes often exceeds carrying capacity. By studying the benthic macroinvertebrate communities, we evaluated the strength of relationships among lakes and human development, especially land-use. Benthic macroinvertebrates are indeed good bioindicators since they are linked to habitat conditions, which are well influenced by the lake's catchment. We sampled benthic macroinvertebrate communities and various chemical (phosphorus, DOC, nitrogen, etc.) and environmental (catchment's land-use, macrophytes, substrate, etc.) variables of 22 inhabited canadian lakes in eastern Quebec, representing a range of different watershed land-use. Preliminary results point out that the relative richness and relative abundance of the macroinvertebrate taxa are significantly correlated with several chemical, physical habitat and landscape variables. Our study supports the paradigm that catchment's land use greatly influences lakes and that macrobenthic species distribution can be used to measure this influence.

North, R. L., University of Waterloo, Waterloo, Canada, rlnorth@sciborg.uwaterloo.ca;
Smith, R. E., University of Waterloo, Waterloo, Canada, rsmith@sciborg.uwaterloo.ca;
Hecky, R. E., University of Minnesota, Duluth, USA, rhecky@d.umn.edu;
Depew, D. C., University of Waterloo, Waterloo, Canada, ddepew@sciborg.uwaterloo.ca;
León, L. F., University of Waterloo, Waterloo, Canada, lfleonvi@scimail.uwaterloo.ca;
Charlton , M. N., Aquatic Ecosystem Management Research Branch, National Water Research Institute, Burlington, Canada, Murray.Charlton@ec.gc.ca;
Guildford, S. J., University of Minnesota, Duluth, USA, sguildfo@d.umn.edu

CHANGES IN THE SPATIAL DISTRIBUTION OF SESTON AND NUTRIENT CONCENTRATIONS IN THE EASTERN BASIN OF LAKE ERIE

In the eastern basin of Lake Erie in 1973, chla and nutrient concentrations were higher nearshore resulting in an improved light environment offshore. With increased population growth, P loading controls, and the invasion of dreissenids, the distribution of seston and nutrient concentrations between nearshore and offshore have changed. The changes in spatial structure in the eastern basin of Lake Erie was assessed by comparing seston and nutrient concentrations in pre-dreissenid (1973-1985) versus post-dreissenid (1990-2003) years in both the nearshore and offshore. This is the first basin-scale analysis of changes in chla concentrations, light conditions, and nutrient chemistry including P, N, and Si; as well as phytoplankton P limitation. We conclude that dreissenid grazing is changing the distribution of seston and nutrient concentrations between the nearshore and offshore of the eastern basin of Lake Erie. This was evidenced by lower chla concentrations in the nearshore, which are most likely due to a combination of photoacclimation by the phytoplankton and dreissenid grazing. Dissolved nutrient concentrations were higher in the nearshore post-dreissenids, with a higher dissolved N:P ratio. This suggests a combination of nutrient excretion by dreissenids as well as diminished nutrient demand by phytoplankton, which is counterbalanced by the nutritional needs of benthic macrophytes in the nearshore.

O'Connor, E. M., Trent University, Peterborough, Canada, eavanoconnor@trentu.ca;
Ferrey, C. B., Trent University, Peterborough, Canada, clintonferrey@trentu.ca;
Dillon, P. J., Trent University, Peterborough, Canada, pdillon@trentu.ca

MODELING MERCURY CONCENTRATIONS IN FISH OF THE MUSKOKA RIVER WATERSHED - A MASS BALANCE APPROACH USING DISSOLVED ORGANIC CARBON AND MERCURY MODELS

Landscape, hydrological, and limnological factors were evaluated as factors affecting the variation in Hg levels in fish in lakes remote from point sources. Spatial attributes of catchments were derived using GIS techniques and were combined with DOC mass balance models to estimate DOC fluxes for 859 hydrologically-connected lakes of a large watershed (Muskoka River) in southern Ontario. Using modeled parameters and a relationship between colour fluxes and Hg fluxes, Hg fluxes were also estimated. Using backward stepwise regression with measures of lake dystrophy, acidity, ionic content, modeled lake Hg concentrations and modeled Hg loading to lakes as independent variables, pH and DOC best predicted Hg concentrations in fish in a subset of lakes. When dystrophy variables (e.g., DOC, colour) were removed, mercury concentrations in fish were significantly related to Hg loadings and either calcium or pH. The results suggest that Hg loadings are responsible in part for the bioavailability of Hg, but lake dystrophy and pH are more important.

O'Driscoll, N. J., Acadia University, Wolfville, Canada, nelson.odriscoll@acadiau.ca;
Poissant, L., Environment Canada, Montreal, Canada, Laurier.Poissant@ec.gc.ca;
Canario, J., National Institute for Fisheries and Sea Research IPIMAR, Lisbon, Portugal, jcanario@ipimar.pt;
Lean, D. R., University of Ottawa, Ottawa, Canada, dlean@uottawa.ca

DOES ICE COVER AND SEDIMENT DIFFUSION AFFECT DISSOLVED GASEOUS MERCURY DISTRIBUTION IN FRESHWATERS?

Field experiments were performed to assess the effects of sediment diffusion and ice cover on mercury distribution with depth in a fluvial freshwater lake (Lake St. Louis, Beauharnois, QC). The lake system was compared to in-situ mesocosms comprised of open bottom and closed bottom cylinders in order to isolate a portion of the water column. Low concentrations of dissolved gaseous mercury were observed in surface water under the ice (Mean 27.6 pg L^{-1}; s.d. = 7.2; n = 26) with no discernable diurnal pattern. However DGM concentrations were found to be substantially higher in samples of surface ice (mean 73.6 pg L^{-1}; s.d. = 18.9; n = 6) and snowfall (mean 368.2 pg L^{-1}; s.d. = 115.8; n = 4). DGM depth profiles showed a small increase in DGM towards the surface in all treatments during the day. In addition, the open-bottom cylinder (no advection) found increases with depth (an increase of 30 to 70 pg L, $^{-1}$ over 1 meter). We propose that that DGM gradients resulting from sediment diffusion are affected by advection under the ice.

Olin, J. A., University of Windsor, Ontario, Canada, olin@uwindsor.ca;
Simpfendorfer, C. A., James Cook University, Townsville, Australia, colin.simpfendorfer@jcu.edu.au;
Heupel, M. R., James Cook University, Townsville, Australia, michelle.heupel@gmail.com;
Fisk, A. T., University of Windsor, Ontario, Canada, afisk@uwindsor.ca

TRACKING SPECIES RESPONSE TO CHANGES IN SALINITY USING FATTY ACIDS AND STABLE ISOTOPES

Effects on community structure and function from natural and anthropogenic factors are often difficult to detect and quantify. Use of chemical tracers provides an opportunity to investigate these effects on food webs, by defining predator-prey interactions, in combination with

existing environmental conditions. Salinity variations in the Charlotte Harbor-Pine Island Sound Estuary of southwestern Florida, specifically the Caloosahatchee River, have been documented to follow a seasonal pattern and vary widely (0-30 ppt) as a result of water management practices. Contrary to this situation, the Myakka River, in the northern portion of this estuary, is not subjected to water management practices and maintains a polyhaline state. These alterations likely affect productivity, population dynamics, community composition, food web structure and place stress on obligate-estuarine species, creating a circumstance that simulates global climate change predictions of increased rainfall. We determined the food web dynamics of juvenile bull sharks, *Carcharhinus leucas*, a high trophic level euryhaline species, inhabiting both Rivers, through analysis of fatty acids and stable isotopes, as a means to examine the influence of salinity on the feeding ecology of the bull shark.

Olsen, Y. S., The Ecosystems Center, MBL / Boston University Marine Program, Woods Hole, USA, yolsen@bu.edu;
Fox, S. E., The Ecosystems Center, MBL, Woods Hole, USA, sefox@mbl.edu;
Valiela, I., The Ecosystems Center, MBL, Woods Hole, USA, ivaliela@mbl.edu

CHANGES IN FOOD WEB STABLE ISOTOPES WITH SMALL INCREASES IN NITROGEN LOADS AND OVER SMALL SPATIAL SCALES

Anthropogenic nutrient loading from watersheds to coastal waters alters receiving ecosystems. To examine the effects of terrestrial nitrogen inputs on estuarine producers and consumers and energy flow through food webs, we carried out studies using N and C stable isotopes in subestuaries of Waquoit Bay, MA, subject to a range of relatively low nitrogen loads from 5 to 30 kg N ha^{-1} yr^{-1} owing to different watershed land covers. Despite the low nitrogen loading to these estuaries, producers and consumers showed patterns of increasing $\delta^{15}N$ and decreasing $\delta^{13}C$ with increasing nitrogen load. To investigate changes in food webs in adjacent estuarine habitats, we compared isotopes of consumers from seagrass beds and adjacent macroalgal mats. $\delta^{15}N$ of consumers from the two habitats did not differ, but $\delta^{13}C$ signatures showed different energy flows in the food webs with consumer signatures reflecting the major producer in each of the two habitats. Stable isotopes are effective in revealing early signs of eutrophication, and food webs can differ at spatial scales on the order of meters with consumers shifting feeding from seagrass to macroalgae.

Ostermaier, V., Austrian Academy of Sciences, Mondsee, Austria, vosterma@assoc.oeaw.ac.at;
Kurmayer, R., Austrian Academy of Sciences, Mondsee, Austria, rainer.kurmayer@oeaw.ac.at

GENOTYPE DETERMINED MICROCYSTIN NET PRODUCTION OF *PLANKTOTHRIX RUBESCENS* IN ALPINE LAKES

Microcystins are a group of toxic heptapeptides produced by cyanobacteria, they are synthesized non-ribosomally encoded by the microcystin (*mcy*) synthetase gene cluster. Due to the variation of the molecule structure a large number of microcystin chemotypes is known, however their regulation under natural conditions is not understood. Earlier studies revealed that certain enzyme modules, so-called adenylation (A)-domains show recombinations resulting in structural changes of the microcystin molecule, i.e. the replacement of N-methyl-dehydroalanine (Mdha[7]) by dehydrobutyrine (Dhb[7]) in position 7 or the replacement of arginine (Arg[2]) by homotyrosine (Hty[2]) in position 2 of the molecule. During the years 2005, 2006 different microcystin genotypes were quantified in 12 lakes of the Alps in Austria, Germany and Switzerland by means of quantitative real-time PCR (the TaqMan Assay) and their abundance was related to the microcystin production as measured by HPLC. Over a wide range in population density (40 - 400,000 *Planktothrix* filaments l^{-1}) Dhb[7]-genotypes/chemotypes were most abundant while Hty[2]-genotypes/chemotypes occurred in lowest proportion only. The abundance of all microcystin genotypes/chemotypes varied independently from the population density.

Packman, A. I., Northwestern University, Evanston, USA, a-packman@northwestern.edu;
Jerolmack, D. J., University of Pennsylvania, Philadelphia, USA, sediment@sas.upenn.edu;
Battin, T. J., University of Vienna, Vienna, Austria, tom.battin@univie.ac.at;
Tank, J. L., University of Notre Dame, Notre Dame, USA, jtank@nd.edu;
Sivapalan, M., University of Illinois, Urbana, USA, sivapala@uiuc.edu;
Wörman, A., The Royal Institute of Technology, Stockholm, Sweden, worman@kth.se;
Brooks, P. D., University of Arizona, Tucson, USA, brooks@hwr.arizona.edu;
Rosi-Marshall, E. J., Loyola University, Chicago, USA, erosi@luc.edu;
Rhoads, B. L., University of Illinois, Urbana, USA, brhoads@uiuc.edu;
Pakula, M. E., Northwestern University, Evanston, USA, m-pakula@northwestern.edu

SPATIAL AND TEMPORAL SCALES ASSOCIATED WITH NUTRIENT AND CARBON TRANSFORMATIONS IN RIVERS

The metabolism of nutrients and carbon in rivers is tremendously important to both aquatic ecosystem function and to large-scale biogeochemical dynamics. A critical question at the present time is how human perturbations change the balance between retention, internal processing, and export of nutrients and carbon at the continental scale. Most available information on the coupled physical, chemical, and biological processes that control solute and particle dynamics has been obtained at particular scales, such as at the grain scale, reach scale, etc. It has proven extremely difficult to relate the information gained from these types of investigations to estimates of nutrient and carbon processing at the river network scale. Improved conceptual and theoretical frameworks are needed to evaluate coupled process interactions over the full range of scales that are important in large, complex, and dynamic river systems. Here we articulate the inherent link between spatial and temporal scales associated with a variety of processes that influence nutrient and carbon dynamics in rivers, and provide a synthetic framework for analysis of the integrated effects of these processes on large-scale evolution of watersheds.

Painter, S. C., Ocean Biogeochemistry and Ecosystems, National Oceanography Centre, Southampton, United Kingdom, scp@noc.soton.ac.uk;
Pidcock, R. E., School of Ocean and Earth Sciences, University of Southampton, Southampton, United Kingdom, remp103@noc.soton.ac.uk;
Allen, J. T., Ocean Biogeochemistry and Ecosystems, National Oceanography Centre, Southampton, United Kingdom, jta@noc.soton.ac.uk

DECIPHERING BIOCHEMICAL SIGNALS IN THE OCEANIC EUPHOTIC ZONE: ECOSYSTEM RESPONSES OR MESOSCALE INFLUENCES?

There is often a clear trade-off between spatial coverage and temporal assessment in many oceanic studies of the euphotic zone. Repeated observations from a single location suffer from a lack of spatial awareness and similarly, spatial surveys often lack the ability to investigate temporal changes. We present results from the Porcupine Abyssal Plain (PAP) pelagic observatory in the NE Atlantic, which includes both a spatial hydrographic survey with coupled biogeochemical measurements and a time series of productivity measurements from the centre of the surveyed area. This approach revealed the influence of a cyclonic eddy and associated filamentary structures on the productivity of the euphotic zone and clearly suggests that frontal zones between mesoscale structures or between water masses are key regions of enhanced productivity. This understanding of mesoscale variability around the observatory site enabled us to explain properly the sharp changes in biogeochemistry observed in daily primary production rates from the central sampling location, allowing us to conclude that the observed temporal signal in productivity was largely an artefact of mesoscale motions.

Pajk, F., National Institute of Biology, Ljubljana, Slovenia, franja.pajk@nib.si;
Simcic, T., National Institute of Biology, Ljubljana, Slovenia, tatjana.simcic@nib.si;
Brancelj, A., National Institute of Biology, Ljubljana, Slovenia, anton.brancelj@nib.si

CHARACTERISTICS OF A DAPHNIA POPULATION IN AN EUTROPHIC SUBALPINE LAKE: A FIVE YEAR STUDY

Abundance, biomass, size distribution, fecundity and vertical distribution of Daphnia hyalina were studied in an eutrophic subalpine Lake Bled (Slovenia). Samples were collected once a month from 1988 to 1992. Data are analysed in relation to seasonal changes in water temperature, oxygen and chlorophyll a concentration and water transparency. The summer stratification period lasted 5 to 7 months with the highest temperatures in August. Daphnia

density was low at the onset of stratification in April/May and peaked in July/August. In some years there was also a pronounced winter peak. Juveniles were present year-round. Proportion of ovigerous females peaked at the beginning and end of the stratification, probably reflecting food conditions. Number of eggs per ovigerous female was highest in spring an early summer. Size at maturity, estimated through the minimum length of ovigerous females, was negatively correlated with water temperature. Daphnia were found deeper in mid summer than at the beginning and end of stratification; adults deeper than juveniles. Most of the Daphnia population characteristics correlated with water temperature. However, results indicate complex interactions between environmental factors.

Pannard, A., GRIL, UQAM, Montréal, Canada, alex_pannard@hotmail.com;
Beisner, B. E., GRIL, UQAM, Montréal, Canada, beisner.beatrix@uqam.ca;
Bird, D., GRIL, UQAM, Montréal, Canada, bird.david@uqam.ca;
Bormans, M., CNRS UMR 6553, Rennes, France, myriam.bormans@univ-rennes1.fr;
Planas, D., GRIL, UQAM, Montréal, Canada, planas.dolores@uqam.ca

MIXING OF METALIMNETIC WATERS BY FIRST AND SECOND VERTICAL MODE INTERNAL WAVES IN A SMALL SHALLOW LAKE: CONSEQUENCES FOR PHYTOPLANKTON DYNAMICS

A time series of the thermal structure (144 day-1) and the current profile (216 day-1) in a small dimictic lake (Bromont Lake, Quebec, Canada) revealed the occurrence of recurrent internal waves or seiches. Daily variability in wind intensity and direction induced 2 to 3 cycles of a first vertical mode seiche (V1H1), which then supported a second vertical mode seiche (V2H1). The dissipation of energy during the second vertical mode being low, the V2H1 was observed to occur over a few days, until a new V1H1 was induced by a strong enough diurnal wind. The presence of the second vertical mode in the lake can be explained by the general shape of the thermal density structure with a large metalimnion and the possibility of resonance between the diurnal component of wind and the V2H1. Some layers within the metalimnion are exposed to horizontal wave currents, but without vertical homogenization. As a consequence for the metalimnetic phytoplankton populations, mean light availability and nutrient fluxes should be increased in this "movement layer", leading to a higher biomass and diversity in the phytoplankton community. The short-term dynamic of phytoplankton community will also be characterized in terms of primary production, biomass and species composition.

Parker, F. M., Virginia Institute of Marine Science, Gloucester Point, USA, frank.parker@noaa.gov;
Anderson, I. C., Virginia Institute of Marine Science, Gloucester Point, USA, iris@vims.edu

TRACKING THE UPTAKE AND FATE OF MICROBIAL CARBON AND NITROGEN IN EUPHOTIC SEDIMENTS: A DUAL ISOTOPIC APPROACH

Euphotic sediment microbes (i.e., bacteria and benthic microalgae [BMA]) are both facilitators for C and N cycling processes and sinks for C and N immobilization into biomass. Here we present results from seasonal dual stable isotopic tracer (DI^{13}C and $^{15}NH_4^+$) experiments that quantify microbial production in terms of C and N, partition that production between water column and porewater sources in the light and dark, and trace the fate of that production into secondary consumers. Our results show that euphotic sediment microbes are an important link in estuarine benthic-pelagic coupling, BMA play a critical role in the euphotic sediment microbial loop, and benthic bacteria are the dominant microbial pool for C and N immobilization into biomass. BMA fix excess C, most of which originates from the water column; the excess organic C is rapidly metabolized by sediment bacteria that require additional sources of inorganic N in order to build biomass. Macrofaunal retention of microbially derived C and N varies seasonally and depends upon feeding type. Together, our results suggest strong linkages between benthic autotrophic and heterotrophic C and N pools.

Parrish, C. C., Ocean Sciences Centre, Memorial University of Newfoundland, St. Johnâ€™s, Canada, cparrish@mun.ca;
Thompson, R. J., Ocean Sciences Centre, Memorial University of Newfoundland, St. Johnâ€™s, Canada;
Deibel, D., Ocean Sciences Centre, Memorial University of Newfoundland, St. Johnâ€™s, Canada;
Saliot, A., Laboratoire de Physique et Chimie Marines, Université Pierre et Marie Curie, Paris, France

LIPID CLASSES, FATTY ACIDS, STEROLS AND DIOL ETHERS IN A COLD OCEAN COASTAL FOOD WEB DURING THE SPRING DIATOM BLOOM

Lipids were measured in plankton and settling particulate matter during the spring bloom in Conception Bay, Newfoundland, to determine the source and quality of material settling from the upper mixed layer. Lipids were also measured in 19 species of suprabenthic and benthic invertebrates from five phyla to determine nutritional content and trophic relationships in response to the sinking bloom. The maximum fluxes occurred at the bloom maximum and over half the PUFA survived transit through the water column. Zooplankton sterols accounted for 40-43% of sterols in plankton and settling matter, while sterols from algae were 50-53%, of which macroalgal sterols accounted for 9-12%. In the benthos, the mysid *Erythrops erythrophtalma* contained, on average, the largest amount of lipid (6% ww). The euphausiid *Thysanoessa raschii* had the highest proportions of ω3 fatty acids (41%). Higher plant sterols were significant contributors to sea cucumber sterols while macroalgae sterols contributed significantly to the sterols of the mysid *Pseudomma truncatum*. The asteroid, *Ctenodiscus crispatus* possessed an unusual series of lipids identified by mass spectrometry as saturated diol ethers with carbon numbers ranging from C_{16}-C_{26}.

Parslow, J., CSIRO, Hobart, Australia, John.Parslow@csiro.au;
Cressie, N., The Ohio State University, Columbus, USA, ncressie@stat.osu.edu;
Campbell, E., CSIRO, Perth, Australia, Eddy.Campbell@csiro.au

MARINE BIOGEOCHEMICAL MODELS IN A BAYESIAN HIERARCHICAL FRAMEWORK

Modelers and model users attach increasing priority to rigorous quantitative analyses of error in marine biogeochemical models. Initiatives range from analyses of alternative metrics for 'goodness of fit', to data assimilation into operational models, to parameter estimation. However, the treatment of error in many of these initiatives is arguably selective or ad hoc. A Bayesian Hierarchical Framework permits the development of a consistent probabilistic analysis of error and uncertainty in models and model predictions, dealing explicitly with uncertainty in prior parameter estimates, in model processes, and in observations. Bayesian inference techniques can then be developed to derive posterior distributions for model parameters and derived properties (e.g. predictions of system state), given a set of observations. This paper presents preliminary results in reformulating simple biogeochemical models in a Bayesian Hierarchical Framework. We show that this leads to reconsideration of traditional model process formulations, and of the relationship between model predictions and observations. The prospects for extending these approaches to spatially-resolved, coupled physical-biogeochemical models are discussed.

Pascal, P. Y., LIENSS (CNRS-Université de La Rochelle), La Rochelle, France, pypascal@univ-lr.fr;
Dupuy, C., LIENSS (CNRS-Université de La Rochelle), La Rochelle, France, cdupuy@univ-lr.fr;
Richard, P., LIENSS (CNRS-Université de La Rochelle), La Rochelle, France, pierre.richard01@univ-lr.fr;
Niquil, N., LIENSS (CNRS-Université de La Rochelle), La Rochelle, France, nathalie.niquil@univ-lr.fr

BACTERIA IN BENTHIC FOOD WEB OF INTERTIDAL MUDFLAT

Bacteria are highly abundant and productive in mudflat sediment. By analogy with pelagic systems, it has frequently been suggested that bacteria play an important role in benthic food web. However, studies dealing with benthic bacterivory are rare and give conflicting results. The aim of our study was to evaluate the trophic fate of benthic bacteria in Brouage intertidal mudflat (Marennes-Oleron Bay, France) through the year. ^{15}N enriched bacteria were used as tracer to perform *in situ* grazing experiments 11 times through the year. We focused on the main grazers of the study area: nematodes, copepods, foraminifera and the mudsnail *Hydrobia ulvae*. The measured trophic fluxes between microbial and metazoan compartments were converted as annual average carbon flows that were used to build a steady state food web model, along with

unknown fluxes estimated by inverse analysis. Despite their abundance and production, benthic bacteria did not constitute a resource preferentially ingested. The food web was principally based on herbivorous pathway whereas the bacterial pathway was limited. This food web model is in accordance with those generally observed in eutrophic pelagic systems.

Passy, S. I., UT Arlington, Arlington, USA, sophia.passy@uta.edu

COMMUNITY AND ENVIRONMENTAL FORCES DRIVE THE DENSITY-BODY SIZE RELATIONSHIP IN THE POPULATIONS OF STREAM DIATOMS

The relationship between population density and body size, described as a Ã¢Ë†â€™¾ power law in protists to mammals, is central to ecology. In diatom communities from the major watersheds in the US, however, this relationship exhibits a highly variable power law exponent (b). Here, this variability is attributed to autogenic forces, arising from the community itself and environmental stimuli, altering both community composition and allometry. Partial regressions revealed that the exponent b was positively correlated with species richness, nutrient supply, and their covariance. Low values of b, indicating that small species were much more populous than large species, were detected in species-poor communities under low nutrient supply. Conversely, high values of b were found in fertilized, species-rich systems. Nutrient elevation increases species richness by providing favorable conditions for eutrophic species, which tend to be large. Higher species richness means stronger resource competition when large species have an advantage and establish great densities. These findings suggest that the density-body size relationship in diatoms does not conform to a biologically universal power law but reflects the local biotic and abiotic conditions.

Paterson, M. J., Fisheries & Oceans Canada, Winnipeg, Canada, Michael.Paterson@dfo-mpo.gc.ca;
Findlay, D., Fisheries & Oceans Canada, Winnipeg, Canada, wjfindlay@shaw.ca;
Podemski, C. L., Fisheries & Oceans Canada, Winnipeg, Canada, Cheryl.Podemski@dfo-mpo.gc.ca;
Wesson, L. J., Fisheries & Oceans Canada, Winnipeg, Canada, Laurie.Wesson@dfo-mpo.gc.ca

THE EFFECTS OF NUTRIENT LOADING FROM AN EXPERIMENTAL RAINBOW TROUT CAGE FARM ON THE PLANKTON COMMUNITY OF A FRESHWATER LAKE

In recent decades, there has been increased interest in the development of a freshwater aquaculture industry in Canada, but potential ecosystem impacts are poorly understood. At the Experimental Lakes Area in northwestern Ontario, we established a rainbow trout cage farm in a small lake after two years of pre-impact study. Operation of the farm increased loading of phosphorus (P) to the lake by 6.5X. Most of the added P accumulated in lake sediments or in the hypolimnion and P concentrations and phytoplankton biomass in the epilimnion increased only 2X. The greatest changes occurred in spring, when P accumulating in the hypolimnion was mixed into the epilimnion, resulting in dense blooms of dinoflagellates. Large changes in bacteria were not observed. Over 5 years of farm operation, an increasingly large proportion of the hypolimnion became anoxic, which resulted in reductions in *Mysis* habitat and densities. To date, large changes in zooplankton populations have not been observed. Modeling is currently ongoing to effectively extrapolate results from this small lake to larger lakes more suitable for aquaculture operations.

Pau, J. H., University of South Florida, St. Petersburg, USA, jpaul@marine.usf.edu;
McDaniel, L., University of South Florida, St. Petersburg, USA, mcdaniel@marine.usf.edu

PROPHAGES AND GTAS IN MARINE MICROBIAL GENOMES: BIOINFORMATICS AND FUNCTION

Bacteriophages are recognized as numerous and important components of oceanic food webs principally because of their lytic capabilities. The subtle changes that temperate phages impart to their hosts in the oceans are far less understood. Screening 102 marine bacterial genomes for prophages yielded sixty prophage-like elements, 21 of which strongly resembled Gene Transfer Agents (GTAs) of α-Proteobacteria. The remaining 39 putative prophages had a relatively high incidence of transcriptional regulatory and repressor-like proteins (~2/40kb prophage sequence) compared to lytic marine phages (~0.25/40 kb phage sequence). We propose that marine prophages directly contribute to host survival in unfavorable environments by suppression of unneeded metabolic activities. GTA's may assist in host survival by providing a mechanism for gene transfer that is under the regulatory control of the host bacteria. To document gene transfer activity of GTAs, purified GTA particles from naladixic acid resistant Roseovarious nubinhibens could transfer ab resistance chromosomal genes to wild type R. nubinhibens. Because of the ubiquitous nature of GTA-containing α-Proteobacteria we surmise that GTAs may play an important role in horizontal gene transfer in the ocean.

Paver, S. F., University of Illinois at Urbana-Champaign, Urbana, USA, paver@uiuc.edu;
Chang, Y., University of Illinois at Urbana-Champaign, Urbana, USA, ychang47@uiuc.edu;
Kent, A. D., University of Illinois at Urbana-Champaign, Urbana, USA, kent@uiuc.edu

MOLECULAR CHARACTERIZATION OF FRESHWATER MICROBIAL FOOD WEB INTERACTIONS

Synchrony has been observed in bacterial and phytoplankton community dynamics in lakes. A potential explanation is that phytoplankton populations influence the bacterial community through exudate quality and quantity. In order to investigate the direct influence of phytoplankton-mediated resources on bacterial community composition, heterotrophic bacterial populations were characterized using a functional gene involved with oxidation of glycolate, a phytoplankton-specific exudate. Glycolate oxidase D-subunit gene (*glcD*) sequences were recovered from freshwater microbial communities. These sequences were distinct from previously characterized marine *glcD* sequences, and many were closely related to the *glcD* sequence of the cosmopolitan freshwater bacterial genus *Polynucleobacte*. Different sequence clusters were detected among lakes and within the same lake through time. A terminal restriction fragment length polymorphism protocol was designed using freshwater sequences to investigate the dynamics of glycolate-utilizing bacterial populations, and compare these dynamics with phytoplankton community succession. Examining population dynamics of bacteria able to use glycolate will provide insight into the specific influence of phytoplankton on the composition and dynamics of freshwater bacterial communities and address our hypotheses about the mechanisms underlying synchronous dynamics of freshwater microbial communities.

Pearce, C., Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, Canada, PearceC@pac.dfo-mpo.gc.ca

SPATIAL AND TEMPORAL EFFECTS ON THE BENTHIC ENVIRONMENT OF INTERTIDAL GEODUCK CLAM (PANOPEA ABRUPTA) AQUACULTURE AND HARVEST

The geoduck clam is the largest burrowing clam in the world and adults of this species live a metre or more below the sediment surface. In order to extract these clams, harvesters use high-pressure water hoses to liquefy the surrounding sediment. This type of disturbance could have profound effects on the local benthic environment, but little research has examined this issue. We seeded a small-scale (3 x 20 m) intertidal plot with juvenile clams and later harvested it using industry standard techniques. We took sediment samples within the harvest zone and at varying distances from the area of impact (5, 10, 25, 50 m) at various time points (ranging from a month prior to seed out-planting through to 12 months post-harvest). We examined various sediment qualities (grain size, percent organics, total organic carbon, total nitrogen, sulphide concentration, and redox) as well as infaunal diversity and numbers. Preliminary results show that many of the measured variables were not significantly affected by either the culture or harvesting process. Significant effects of harvest (e.g. sediment grain size) were generally short-lived and near field.

Peart, L. W., Consortium for Ocean Leadership/IODP, Washington, DC, USA, lpeart@oceanleadership.org;
Slough, S. W., Texas A&M University, College Station, TX, USA, sslough@tamu.edu;
Buchholtz, C., John Jay High School, San Antonio, TX, USA, Calvin.Buchholtz@nisd.net

USING MULTI-MEDIA TECHNOLOGIES TO COLLECT MEANINGFUL DATA FOR GAUGING THE EFFECTIVENESS AND IMPACT OF SCIENCE EDUCATION OUTREACH

Science education outreach shares many characteristics with Free-Choice Learning, especially as they relate to the purposive design that encourages individual learner's control over their own learning rather than pre-determined course or program objectives. As such, new program evaluation methodologies must be examined for efficacy in such settings. Qualitative methodologies champion the power of 'participant voice' to allow participants to tell their own stories. This is especially powerful when the researcher and participants openly collaborate (Hollingsworth, Dybdahl, & Minarik, 1993). Video evaluations allow research/program evaluators the opportunity to present participant stories faithfully and forcefully in a format that informs effectiveness and impact in ways that quantitative measures lack.

Pepin, P., Fisheries and Oceans Canada, St. John's, Canada, pepinp@dfo-mpo.gc.ca;
Børsheim, Y. K., Institute of Marine Research, Bergen, Norway;
Harrison, W. G., Fisheries and Oceans Canada, Dartmouth, Canada, harrisong@dfo-mpo.gc.ca;
Li, W. K., Fisheries and Oceans Canada, Dartmouth, Canada;
Maillet, G. L., Fisheries and Oceans Canada, St. John's, Canada;
Sakshaug, E., University of Trondheim, Trondheim, Norway;
Skogen, M. D., Institute of Marine Research, Bergen, Norway;
Yeats, P. A., Fisheries and Oceans Canada, Dartmouth, Canada

PHYTOPLANKTON PRODUCTION AND GROWTH IN THE SUB-ARCTIC NORTH ATLANTIC: A COMPARISON OF THE LABRADOR SEA-NEWFOUNDLAND SHELF AND THE BARENTS-NORWEGIAN SEAS

The NORCAN (NORway-CANada Comparison of Marine Ecosystems) project has as one of its objectives a series of review papers that compare and contrast the structure and function of ecosystems (plankton to whales) of the sub-arctic North Atlantic, focusing on the Labrador-Newfoundland shelves and basins and the Barents-Norwegian Seas. This presentation will highlight some of the major similarities and differences in variability, community structure and productivity of phytoplankton in the western and eastern North Atlantic based on observations and basin-scale biophysical modelling. The influence of major growth-limiting factors such as solar radiation, ice, surface mixing and nutrients are the bases for this comparative analysis. Current status and anticipated trends in phytoplankton growth cycles as a consequence of regional climate change will also be discussed.

Perez-Fuentetaja, A., Buffalos State College, Buffalo, NY, USA, perezfa@buffalostate.edu;
Lupton, S., University at Buffalo, Buffalo, NY, USA, sjlupton@buffalo.edu;
Clapsadl, M., Buffalo State College, Buffalo, NY, USA, clapsamd@buffalostate.edu;
Aga, D., University at Buffalo, Buffalo, NY, USA, dianaaga@buffalo.edu

ENDOCRINE DISRUPTING CHEMICALS IN EASTERN LAKE ERIE MALE CARP AND VITELLOGENIN RESPONSE

Male carp from Lake Erie were analyzed to determine if there was a relationship between plasma, muscle and liver levels of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) with respect to the presence of the biomarker vitellogenin (VTG). VTG levels in male carp from Lake Erie were compared to VTG levels in females and also to control males from two pristine lakes. VTG levels in male carp did not correlate to the concentrations of PCB or PBDE, but these contaminants were correlated to biological features. The concentrations of total PCBs in muscle were positively correlated to fish length, age and gonad weight (dominant congeners PCB138, PCB153). The concentrations of total PBDEs in plasma were negatively correlated to fish length and age, indicating higher metabolic rates of PBDE in older carp. VTG levels in males from Lake Erie were correlated to fish size, age and gonad weight, but were not significantly different from the VTG levels in males from the control lakes. Caution should be exercised when using VTG as a biomarker for endocrine disruption across fish species.

Perga, M. E., UMR CARRTEL, Thonon les Bains, France, perga@thonon.inra.fr;
Reyss, J. L., LSCE, Gif sur Yvette, France, jean-louis.reyss@lsce.ipsl.fr;
Desmet, M., ENTPE, Vaulx en Velin, France, marc.desmet@inrp.fr

PALEOLIMNOLOGICAL APPROACH OF HUMAN IMPACTS ON LAKE FOOD WEBS: THE EXAMPLE OF LAKE ANNECY (FRANCE).

Lake Annecy underwent three perturbations during the last 150 years: 1. Introduction of the zooplanktivoorus whitefish (*Coregonus lavaretus*) in 1886; 2. Moderate eutrophication during the 60's; 3. Re-oligotrophication in a context of climate warming. The impacts of these perturbations on the pelagic food web were studied from a paleo-ecological approach. Nutrient inputs from the watershed started as soon as the late XIXth century but intensified from the early 1940's, resulting in higher biomasses and taxonomic changes within phytoplankton. Whitefish introduction resulted in a transient, short-term impact on zooplankton communities as long as the lake was ultra-oligotrophic and in a delayed, long-term response after the lake got eutrophicated. Nutrient concentrations controlled *Daphnia sp.* sp. abundances and whitefish predation their average size. From the late 1940's until 2005, *Daphnia sp.* sp. average size has decreased by 33% as a consequence of a continuous increase in whitefish predation pressure. Whitefish predation pressure indirectly facilitated higher abundances and diversity of *Bosmina* species and drove a cascading effect down to the phytoplankton level. Lake Annecy is still responding dynamically to a century-old perturbation.

Peters, J., Institute for Hydrobiology and Fisheries Science, Hamburg University, Hamburg, Germany, janna.peters@uni-hamburg.de;
Clemmesen, C., IFM-Geomar, Leibniz Institute of Marine Sciences, University Kiel, Kiel, Germany, cclemmesen@ifm-geomar.de;
Baumann, H., Institute for Hydrobiology and Fisheries Science, Hamburg University, Hamburg, Germany, hannes.baumann@uni-hamburg.de;
Voss, R., IFM-Geomar, Leibniz Institute of Marine Sciences, University Kiel, Kiel, Germany, rvoss@ifm-geomar.de;
Hagen, W., Marine Zoology, University of Bremen, Bremen, Germany, whagen@uni-bremen.de

DIETARY IMPACTS ON CONDITION AND GROWTH OF SPRAT LARVAE - WHAT CAN WE LEARN FROM LIPIDS?

Timing of food supply as well as dietary quality play pivotal roles for growth and survival of larval fish. Lipid analyses combined with growth proxies, e.g. RNA:DNA ratios, provide a valuable tool to link feeding history - reflected by fatty acid markers - with physiological condition. This study, conducted within the German-GLOBEC project, compares interseasonal differences as well as habitat-specific characteristics of lipid content, fatty acid composition and RNA:DNA ratios of sprat (*Sprattus sprattus*) larvae from the central Baltic Sea and the southern North Sea by individual-based measurements. Successful recruits identified by otolith microstructure analysis of Baltic sprat juveniles originated from late spawning events in June and July 2002. This window of survival was determined by adequate food supply at the changeover to larger food particles (*Acartia* spp. copepodids) as indicated by conditional factors. Fatty acid patterns were characterised, when compared to larvae from the North Sea, by much weaker diatom signals as well as lower portions of essential fatty acids (ARA, EPA, DHA), apparently reflecting different food-web bases. Implications of these habitat-specific differences in food quality are discussed.

Petruniak, J. L., York University, Toronto, Canada, jpetruni@yorku.ca;
Yan, N. D., York University, Toronto, Canada, nyan@yorku.ca;
Hipsey, M., Centre for Water Research/University of Western Australia, Perth, Australia, hipsey@cwr.uwa.edu.au

THE MECHANICS OF *BYTHOTREPHES LONGIMANUS* PATCH FORMATION AND THE IMPLICATIONS FOR NATURAL FLUVIAL DISPERSAL

Bythotrephes longimanus (Crustacea, Cercopagidae) is a cladoceran zooplanktivore that invaded the North American Laurentian Great Lakes region more than 25 years ago. Since its introduction, it has spread rapidly with

detrimental consequences to pelagic biodiversity. Human-assisted dispersal vectors have been widely recognized while the occurrence and frequency of natural dispersal events is largely unknown. Before predictions can be made on the natural fluvial dispersal of *Bythotrephes*, we must first understand what conditions are conducive to the onset of fluvially-driven dispersal events. Analysis of the spatial distribution of *Bythotrephes* in Harp Lake, ON, Canada, reveals a consistent pattern of patchiness across a variety of spatial and temporal scales with no significant pattern of zonal preference in the lake. Preliminary modeling results suggest that the spatial distribution of *Bythotrephes* is the result of a relationship between wind-induced hydrodynamic forces and the diel vertical migration pattern of *Bythotrephes*. By understanding the mechanics of *Bythotrephes* patch formation, predictions can be made about the periodicity of fluvial dispersal opportunities.

Petticrew, E. L., University of Northern British Columbia, Prince George, Canada, ellen@unbc.ca

MECHANISMS FOR THE RETENTION AND RECYCLING OF MARINE DERIVED NUTRIENTS IN FISH BEARING STREAMS

Marine-derived nutrients are delivered to most of British Columbia's coastal and interior river channels and floodplains with the return and die-off of Pacific salmon. A mechanism for the retention of these marine-derived nutrients has been determined through a series of studies in natural and artificial spawning channels and in large scale flumes. Particle size characterization of both the suspended and gravel-stored sediment in these systems indicates that a flocculation-mediated delivery of nutrients is occurring. In the presence of abundant bacteria, associated with the decay of fish carcasses, fine-grained sediments are flocculating with the organic matter altering the settling behaviour of these particles. Further compaction of the settled sediment occurs, improving conditions for in-channel decay and release of nutrients. Analysis of the isotopic C and N signatures indicates the prevalence of salmon organic matter in aggregated sediment both during and following the spawn. This mechanism for increased sedimentation ensures that some portion of the nutrient pulse associated with the fish die-off is retained in the river channel promoting future productivity for the river and the fish stocks.

Phillips, I. D., Saskatchewan Watershed Authority, Saskatoon, Canada, iain.phillips@swa.ca;
McMaster, G., Saskatchewan Watershed Authority, Regina, Canada, glen.mcmaster@swa.ca;
Leavitt, P. R., University of Regina, Regina, Canada, peter.leavitt@uregina.ca

NEW APPROACHES TO PRAIRIE BIO-MONITORING: INCORPORATING NITROGEN STABLE ISOTOPES WITH COMMUNITY ANALYSIS FOR SOURCE AND CONSEQUENCE IN WATERSHED MANAGEMENT

The ability to identify ultimate sources of nutrients that lead to eutrophication and general fouling of surface water quality is of foremost interest to restore or create healthier aquatic ecosystems. We combine benthic macro-invertebrate bio-assessment and nitrogen (N) stable isotope analysis of the primary consumer trophic level for use in water quality management in the Northern Great Plains. During the summer and fall of 2006 we sampled throughout southern Saskatchewan, Canada, and developed a preliminary test site analysis-based bio-monitoring program. In addition, our isotope results indicate differing degrees of N enrichment attributable to local land-use practices (urban, livestock and crop agriculture) which compliment our community results and provide evidence for necessary management action around particular land-use practices. We recommend methods of incorporating this new technique into existing bio-monitoring programs as primary consumer N isotope enrichment shows promise in enabling watershed managers to better identify land-use activities which act as major contributors of N in lotic ecosystems.

Phillips, V. J., University of Alberta, Edmonton, Canada, vphillip@ualberta.ca;
St. Louis, V. L., University of Alberta, Edmonton, Canada, vince.stlouis@ualberta.ca

HISTORICAL CHANGES IN MERCURY LOADINGS TO REMOTE HIGH ALPINE LAKES IN THE CANADIAN ROCKY MOUNTAINS

Despite considerable research on the historical changes in mercury loadings to lakes throughout the northern hemisphere, little research has been conducted on historical changes within North American high alpine systems. As a result of their remote nature and the lack of local sources of pollution, alpine lakes may be useful in assessing the relative influence of atmospheric deposition versus geological sources of mercury. Furthermore, alpine lakes may provide additional information on the cycling of mercury at high elevations. Using sediment cores from lakes throughout the Canadian Rocky Mountains, we have reconstructed changes in mercury loadings over the past 200-300 years. We also evaluated the influence of various environmental factors, including latitude, geology, vegetation, glacier proximity, and several climate parameters, on mercury loadings. The results will identify the historical changes in mercury loadings in high alpine areas, as well as provide insight into the regional and global mercury cycle.

Piehler, M. F., The University of North Carolina at Chapel Hill, Institute of Marine Sciences, Morehead City, USA, piehler@unc.edu;
Smyth, A. R., The University of North Carolina at Chapel Hill, Institute of Marine Sciences, Morehead City, USA, arsmyth@email.unc.edu;
Thompson, S. P., The University of North Carolina at Chapel Hill, Institute of Marine Sciences, Morehead City, USA, sthompso@email.unc.edu

IMPACTS OF ECOSYSTEM ENGINEERS ON ESTUARINE NITROGEN CYCLING

Anthropogenic impacts and climate change can alter estuarine intertidal and shallow subtidal habitat distribution. Among the key ecosystem services provided by these habitats is nutrient processing. Predicting the changes in ecosystem services that will result from habitat shifts requires an understanding of the services delivered by the individual habitats. We measured benthic fluxes of nutrients and denitrification in representative intertidal and shallow subtidal estuarine habitats in Bogue Sound, NC, USA. Denitrification rates and fluxes of nutrients were quantified in flow-through incubations of cores from habitats with ecosystem engineers (salt marsh, seagrass and oyster reef) and without ecosystem engineers (intertidal flat and subtidal flat). Rates of denitrification (membrane inlet mass spectrometry) were highest in the habitats with ecosystem engineers. Fluxes of ammonium and phosphate were generally low, but were highest in the habitats with ecosystem engineers. Sediment oxygen demand correlated closely with rates of denitrification across all habitats. Continuing to develop habitat-specific mechanistic understanding of the ecosystem services delivered by shallow water estuarine habitats is essential for predicting future ecosystem function.

Piercey, G. L., Memorial University, St. John's, Canada, glennp@mun.ca;
Layne, G. D., Memorial University, St. John's, Canada, gdlayne@mun.ca

A SR/CA VERSUS TEMPERATURE RELATIONSHIP IN COD OTOLITHS USING SECONDARY ION MASS SPECTROMETRY (SIMS)

As evidence of small localized populations of cod accumulates, it becomes important to determine detailed migration patterns, enabling optimal fisheries management It appears common for these local populations to have migration routes through water bodies with large temperature contrasts. Althought not universally applicable to all fish species, Sr/Ca thermometry has been demonstrated possible in cod otoliths. Furthermore, the relatively wide daily growth rings (2 to 4 µm) in cod otoliths, coupled with the high spatial resolution of SIMS (10 to 15 µm) can provide weekly to bi-weekly resolution. The high spatial resolution and superior precision of SIMS has proven advantageous in a variety of other marine biomineralization studies (e.g.; corals, foraminifera). Otoliths were analyzed from cod raised in 32 ppt seawater with daily water temperature recorded from egg hatch (2004) to egg harvest (2007); permitting a laboratory-derived Sr/Ca versus temperature calibration. In addition, Mg, Ba and Na were evaluated for possible relationship to water temperature. Mg/Ca displays an apparent inverse relationship with Sr/Ca and therefore should be routinely evaluated in conjunction with Sr/Ca thermometry.

Pizarro, H. N., EGE - FCEN - Universidad de Buenos Aires - CONICET, Buenos Aires, Argentina, hay@ege.fcen.uba.ar;
Vera, M. S., EGE - FCEN - Universidad de Buenos Aires - CONICET, Buenos Aires, Argentina;
Sylvester, M., EGE - FCEN - Universidad de Buenos Aires, Buenos Aires, Argentina;
Bustingorry, J., IIB-INTECH - CONICET, Chascomùs, Argentina;
Escaray, R., IIB-INTECH - CONICET, Chascomùs, Argentina;
Ferraro, M., IIB-INTECH - CONICET, Chascomùs, Argentina;
Pérez, G., IIB-INTECH - CONICET, Chascomùs, Argentina;
Rodríguez, P. L., EGE - FCEN - Universidad de Buenos Aires, Buenos Aires, Argentina;
Mugni, H., ILPLA - CONICET, Florencio Varela, Argentina;
Bonetto, C., ILPLA - CONICET, Florencio Varela, Argentina;
Zagarese, H., IIB-INTECH-CONICET, Chascomùs, Argentina

ROUNDUP® (GLYPHOSATE FORMULATION) EFFECTS ON FRESHWATER PERIPHYTON: EXPERIMENTAL APPROACH USING MESOCOSMS

Glyphosate formulation (Roundup®) effects on periphyton community were studied by means of six experimental mesocosms ($25m^2 \times 1m$): three were treated with 6 mg l^{-1} of Roundup® and 3 were considered control (without herbicide). Artificial substrates were used in each mesocosm for periphyton colonization and collected 8, 14, 20 and 34 days after addition. Dry weight, ash-free dry weigth, chlorophyll *a*, primary production as well taxonomic composition and density of live and dead algae were analised. All periphytic variables for treated mesocosms showed lower values during the entire experiment ($p<0.05$; MannWhitney test). Significant differences ($p<0.05$; Friedman test) were detected among sampling dates for variables at control mesocosms but not always for the treated ones. In mesocosms with Roundup® algal composition turned to the increase of cyanobacteria while density of dead algae was significantly higher ($p<0.05$, MannWhitney test). The observed changes in the structure and functionality of periphyton are consistent with a direct toxicological effect of glyphosate formulation. Given the importance of the periphyton community in shallow aquatic systems, glyphosate effects on periphyton are likely to spread through the whole aquatic food web.

Platt, T., Bedford Institute of Oceanography, Dartmouth, NS, Canada, tplatt@dal.ca;
Sathyendranath, S., Dalhousie University, Halifax, NS, Canada, shubha@dal.ca

SPECTRAL RADIOMETRY: AN ICON OF OCEANOGRAPHY

During the past 25 years, the availability of high resolution, spectral radiometry (ocean colour) has had a profound impact on aquatic science. The synoptic basin-scale view of the oceans provided by this method has been an inspiration and a way forward for research in many fields of oceanography, both research and operational. The spatial structure, as well as the temporal evolution, of the chlorophyll fields has been instructive. Sophistication in the interpretation of ocean colour imagery continues to increase, and we can look forward to the sustained impact of these data on aquatic science during the next 25 years.

Plourde, S., Department of Fisheries and Oceans, Intitute Maurice-Lamontagne, Mont-Joli, Canada, stephane.plourde@dfo-mpo.gc.ca;
Pepin, P., Department of Fisheries and Oceans, Northwest Atlantic Fisheries Center, St. John's, Canada, pierre.pepin@dfo-mpo.gc.ca;
Head, E., Department of Fisheries and Oceans, Bedford Institute of Oceanography, Dartmouth, Canada, erica.head@dfo-mpo.gc.ca

REGION-SPECIFIC MORTALITY, SURVIVAL AND RECRUITMENT OF CALANUS FINMARCHICUS IN THE NORTHWEST ATLANTIC

The Vertical Life Table method was used to estimate stage-specific daily mortality rates and survival (%) in C. finmarchicus sampled as part of the Canadian Atlantic Zonal Monitoring Program (AZMP) in the northwest Atlantic. The combined daily mortality rate from egg to C1 was estimated using population egg production rate (PopEPR) derived from region-specific empirical relationships between egg production rate and ambient food biomass. Daily mortality rate from egg to C1 was generally 2-3 times greater than in later copepodid stages. Stage-specific mortality rates and survival (%) showed significant regional and seasonal differences resulting in distinct survival trajectories for cohort development, suggesting that populations experience different predation regimes across the AZMP region. An index of the daily recruitment to C1 was positively related to survival from egg to C1 but not with PopEPR, indicating that top-down processes (including cannibalism) play a key role in the control of population dynamics. Our results emphasise the key role of top-down processes in C. finmarchicus population dynamics and stress the need to understand the factors controlling mortality across its range of distribution.

Podlaska, A., Stony Brook University/SoMAS, Stony Brook, USA, apodlask@ic.sunysb.edu;
Lopez-Gasca, M., Stony Brook University/SoMAS, Stony Brook, USA, mariela.lopez-gasca@msrc.sunysb.edu;
Li, X. N., Stony Brook University/SoMAS, Stony Brook, USA, xiaonli@ic.sunysb.edu;
Taylor, G. T., Stony Brook University/SoMAS, Stony Brook, USA, gtaylor@notes.cc.sunysb.edu

IMPORTANCE OF SULFUR INTERMEDIATES IN CHEMOAUTOTROPHIC MICROBIAL PRODUCTION IN ANOXIC CARIACO BASIN

During four cruises (2006-2007), we investigated the water column community structure of the permanently anoxic Cariaco Basin using FISH, CARD-FISH, and T-RFLP methods. At two selected depths within redoxcline we carried out stimulation experiments with 50 uM thiosulfate, sulfite, and elemental sulfur amendments. Changes in community structure were assessed using the same molecular tools. Dominant chemoautotrophs appear to be epsilon- and beta-proteobacteria, and Archaea. Thiosulfate amendments stimulated dark carbon assimilation by as much as 85-fold, sulfite by as much as 19- fold and elemental sulfur by as much as 35-fold depending on depth and cruise. Cell growth rates computed from microscopic observations yielded similar stimulations.

Poister, D., St. Norbert College, De Pere, USA, david.poister@snc.edu;
Kurth, A., St. Norbert College, De Pere, USA, alys.kurth@snc.edu;
Farrell, A., St. Norbert College, De Pere, USA, andrew.farrell@snc.edu;
Lang, K., St. Norbert College, De Pere, USA, kassie.lang@snc.edu

AULACOSEIRA DYNAMICS IN A WISCONSIN LAKE

Aulacoseira abundance and colony size were measured weekly during spring and autumn bloom periods in Trout Lake, Wisconsin, U.S.A. In addition, several chemical and biological variables thought to influence *Aulacoseira* dynamics were assessed. Results of the field-based observations were complimented with controlled laboratory experiments to evaluate the effects of competition and nutrient depletion on *Aulacoseira* growth. Relative to the autumn bloom period, *Aulacoseira* were generally larger and more abundant in spring prior to the termination of the bloom in June. Results indicate that competition for non-silica nutrients limited *Aulacoseira* abundance in spring but did not appear to cause of the observed increase in colony size.

Polsenaere, P., Bordeaux 1, Talence, France, p.polsenaere@epoc.u-bordeaux1.fr;
Abril, G., Bordeaux 1, Talence, France, g.abril@epoc.u-bordeaux1.fr;
Bretel, P., Bordeaux 1, Talence, France, p.bretel@epoc.u-bordeaux1.fr

The coastal ocean has been largely ignored in global carbon budgeting efforts, even if the related fluxes of carbon and nutrients are disproportionately higher in comparison with their surface area (Smith and Hollibaugh, 1993). The Arcachon lagoon is a tidal flat of 180 m2 located in the west of Europe (44°40 N, 1°10 W). It comprises the most important eelgrass meadow (75 m2) of Europe. The objective of this study is to use automatic CO2 fluxes measurements by the Eddy-correlation (EC) technique to access to the net production of the tidal flat. This bench-mark method in terrestrial ecosystems has never been applied in the coastal zone. It allows us to characterize the metabolic state of the lagoon (sink or source of atmospheric CO2), and to identify the relevant environmental factors which affect the CO2 fluxes and carbon balance. A first EC system deployment was carried out in the lagoon (Cassy) during the PNEC experiment (end of September 2008). We plan to use the EC technique further inside the lagoon to cover a representative area of eelgrass meadows from April 2008, every two months.

Poulain, A. J., MIT, Cambridge, USA, poulain@mit.edu;
Newman, D. K., MIT, Cambridge, USA, dkn@mit.edu

COUPLING MICROBIAL OXIDATION OF FE(II) TO PHOTOOXIDATION OF NATURAL ORGANIC MATTER AS A STRATEGY FOR GROWTH BY RHODOBACTER CAPSULATUS SB1003

The metabolically diverse purple non-sulfur bacterium, Rhodobacter capsulatus SB1003, grows poorly when ferrous iron [Fe(II)] is the sole electron source, and hence, might be expected to contribute negligibly to Fe(II) oxidation in anoxic environments. Recent work showed that R. capsulatus can grow using the products of the photooxidation of organic compounds it would typically be unable to metabolize (i.e. citrate or NTA). This process is enabled via light-dependent enzymatic oxidation of Fe(II) providing the ferric iron [Fe(III)] involved in the photochemical reaction. To further understand this unique coupling we are: i) identifying the genetic basis of this process using random transposon mutagenesis, ii) assessing the potential of complex natural organic matter to be metabolized after Fe(III)-dependent photodegradation and iii) characterizing the kinetics of growth and Fe redox processes. Preliminary results suggest that fulvic acids have the potential to enable Fe(II) oxidation and to support growth. Blue to UV radiations are most likely involved in the photochemical reaction and further experiments will determine the optimum light regimen for both microbial and photochemical reactions and assess whether these reactions require spatial coupling. The results will allow us to characterize the environments in which these reactions occur and further assess the diversity of molecular pathways involved in phototrophic Fe(II) oxidation.

Proia, L., Institute of Aquatic Ecology, University of Girona, Girona, Spain, lorenzo.proia@udg.edu;
Romaní, A. M., Institute of Aquatic Ecology, University of Girona, Girona, Spain, anna.romani@udg.es;
Sabater, S., Institute of Aquatic Ecology, University of Girona, Girona, Spain, sergi.sabater@udg.edu

NUTRIENTS AND LIGHT CONTROL BIOFILM STRUCTURE AND FUNCTIONING IN A FORESTED STREAM

The evolving structure and function of a benthic biofilm was studied in a forested Mediterranean stream in relation to differences in light and nutrients (N,P). Structural descriptors (algal biomass, Live/dead bacteria ratio and Extracellular Polymeric Substances) were analyzed during colonization, in parallel to functional parameters (Photosynthetic efficiency, Extracellular Phosphatase and Peptidase activities). These two sets of parameters were used to describe the evolution of the biofilm under high light and low light conditions in both enriched and unenriched stream reaches, over 50 days. Additional samples were collected for analysis with Confocal Scanner Laser Microscopy (CSLM) to determine potential changes in biofilm architecture. Physiological responses of the biofilm to different light and nutrient conditions were more significant than changes in biofilm structure. Photosynthesis and peptidase activity were enhanced with light and nurients while phosphatase decreased at high nutrient conditions. Thicker biofilms and higher Chla concentrations were common under high light and enriched conditions. CLSM observations provided a view of the biofilm depth profile and dominating groups (algae, bacteria, cyanobacteria) location into polysaccharide material during biofilm formation at the different studied conditions.

QIN, B., Nanjing Institute of Geography & Limnology, Nanjing, China, qinbq@niglas.ac.cn

MACROPHYTE DOMINANCE ECOSYSTEM RESTORATION AND CHANGES IN ENVIRONMENTAL CONDITIONS IN EUTROPHIC LAKES

Lake pollution and eutrophication become a big issue in China. Restoration of ecosystem with macrophyte dominance is thought an effective method for control of eutrophication and clarity of water quality. Up to date, few cases of lake restoration have been successfully implemented. The reason is that lake restoration just limited in aquatic vegetation planting, and the changes of environmental conditions were completely ignored. It is blindness that lake restoration practices emphasized on the macrophyte restoration without full understanding of the relationship between the macrophyte growth and around conditions. In fact, lake ecological restoration needs some pre-conditions. Based on the principle of the environmental condition determines the ecosystem type, the changes of environmental conditions have been emphasized for the shifts of ecosystem. For the lake ecosystem shift from algal dominant system to macrophyte dominant system, these environmental conditions include weak wind-induced wave, high transparency, low nutrient loadings, decrease in plankti-benthivorous fish and increase in predatory fish, removal of organic material rich sediment, etc. It is not feasible for lake macrophyte restoration when the nutrient loading is still high. It is put forward, therefore, lake restoration must be conducted under the condition of control of nutrient loading, i.e. control the input of pollutant firstly and ecological restoration secondly.

Quiñones-Rivera, Z. J., Louisiana State University, Baton Rouge, USA, zquino1@lsu.edu;
Wissel, B., University of Regina, Regina, Canada, bjoern.wissel@uregina.ca;
Rabalais, N., LUMCON, Chauvin, USA, nrabalais@lumcon.edu;
Justić, D., Louisiana State University, Baton Rouge, USA, djusti1@lsu.edu

PHYSICAL AND BIOLOGICAL CONTROLS OF OXYGEN DYNAMICS IN THE NORTHERN GULF OF MEXICO: A STABLE ISOTOPE APPROACH

The northern Gulf of Mexico exhibits the second largest hypoxic zone in the world's oceans, which is caused by freshwater and nutrient influx from the Mississippi River. To separate physical and biological effects on dissolved oxygen patterns, we applied a dual-budget approach using oxygen concentrations and stable isotopes. For the first time, this study provided routine insight into productivity and respiration dynamics in surface and bottom waters on large temporal and spatial scales, where traditional methods are limited by time-consuming incubations. Regression analyses showed that biological parameters (POC, C:N, nutrients) were important for surface oxygen dynamics during all seasons. Effects of physical factors were less apparent, except during severe physical disturbances (tropical storms, cold fronts). In contrast, bottom water oxygen dynamics showed clear signs of high oxygen depletion in summer due to strong stratification of the water column. Furthermore, benthic respiration was the dominant sink for oxygen during the summer, while frequent mixing during fall and winter increased the importance of water-column respiration. These analyses reveal the mechanisms that drive the partitioning of oxygen sources and sinks in aquatic ecosystems.

QUIJON, P. A., UNIVERSITY OF PRINCE EDWARD ISLAND, CHARLOTTETOWN, Canada, pquijon@upei.ca;
MALYSHEV, A., BIOLOGY DEPARTMENT, UNIVERSITY OF PRINCE EDWARD ISLAND, CHARLOTTETOWN, Canada, amalyshev@upei.ca;
GREGORY, G., BIOLOGY DEPARTMENT, UNIVERSITY OF PRINCE EDWARD ISLAND, CHARLOTTETOWN, Canada, ggregory@upei.ca;
DESREUX, J., BIOLOGY DEPARTMENT, UNIVERSITY OF PRINCE EDWARD ISLAND, CHARLOTTETOWN, Canada, fdesreux@upei.ca;
MACNAIR, N., PEI DEPARTMENT OF FISHERIES AND AQUACULTURE, CHARLOTTETOWN, Canada, ngmacnair@gov.pe.ca

THE COMMUNITY EFFECTS OF A COASTAL INVASIVE PREDATOR: ASSESSING THE ROLE OF HABITAT AND NATIVE COUNTERPARTS

The interactions of mid-trophic level predators such as decapod crustaceans have broad ramifications for the organization of benthic communities. Phenomena like the spread of invasive species offer an opportunity to examine these interactions. This study reviews the spread of the European green crab, Carcinus maenas, along coastal Prince Edward Island (PEI), and examines its influence on distinctive benthic habitats dominated by two prominent native counterparts: the rock crab (Cancer irroratus) and the mud crab (Dispanopeus sayi). Several years of data suggest that green crab populations originally established in eastern PEI have been gradually, but consistently, moving towards western shores and increasing the spatial overlap with rock crabs and mud crabs. Inclusions of adult green crabs alone or in combination with rock crabs suggest that the interactions between these species attenuate the typically strong role played by green crabs on structured sandy habitats. In contrast, inclusions of juvenile green crabs and (adult) mud crabs of comparable sizes in mussel clumps, suggest that this native species is less influential and would unlikely contain the disruptions caused by spreading green crab populations.

Rabalais, N. N., Louisiana Universities Marine Consortium, Cocodrie, USA, nrabalais@lumcon.edu

COASTAL EUTROPHICATION WILL BE AGGRAVATED BY CLIMATE CHANGE

Under anticipated climate scenarios, more and more coastal systems will likely become eutrophic, with accompanying hypoxia and noxious algal blooms. The continued and accelerated export of nitrogen and phosphorus to the coastal ocean is the trajectory to be expected unless societal intervenes. Global climate change within the range predicted to occur in the 21st century could have profound consequences to hypoxia and other negative impacts in the coastal ocean. The discharge of several rivers would increase, nutrient loads would increase, and stratification would strengthen from increased freshwater inflow. Increases in surface water temperature would strengthen the summer pycnocline, enhance stable water columns. In both scenarios, hypoxia is more likely to occur or expand from its present condition and the conditions would improve for more noxious and harmful algal blooms. On the other hand, warmer Atlantic Ocean temperatures could also increase tropical storm activity and severity resulting in more mixing and reaeration events. Whichever occurs, increased freshwater discharge, flux of nutrients and water temperature are likely to have important, but as yet not clearly identifiable, influences on eutrophication in coastal waters.

Ramcharan, C. W., Laurentian University, Sudbury, Canada, cramcharan@Laurentian.ca

A REVIEW OF MODELS TO PREDICT GRAZING RATES OF FRESHWATER ZOOPLANKTON

Twenty-five years ago the study of zooplankton grazing was a very active area of research. We learned about the effects of food level and time of day, and the overarching importance of body size. We also discovered differences between calanoid copepods and cladocerans in selection of food particles. These and other factors that affect zooplankton grazing rates were incorporated into predictive mathematical models. These models first appeared in the 1960's but the most recent models were published as far back as the early 1990's. Has interest in these models waned because they're already quite successful? Perhaps the opposite is true and the modeling approach was abandoned because of failure? Have other approaches now replaced estimation of grazing rates using models? Have we learned all we can from the modeling approach? I address these questions with a retrospective of grazing rate studies as well as with statistical analyses of patterns in published grazing rate models. Overall, I find that mathematical models are fairly successful at predicting grazing rates. However, longer-term incubations for grazing experiments reduce variability and are an important improvement.

Ramey, A., Rutgers University, Institute of Marine and Coastal Sciences, New Brunswick, NJ, USA, ramey@imcs.rutgers.edu

CLIMATE VARIABILITY AND TEMPORAL TRENDS IN ABUNDANCE OF A DOMINANT POLYCHAETE ON THE NORTHWEST ATLANTIC CONTINENTAL SHELF

There are several examples of the effects of climate variability phenomena (e.g. El Niño, North Atlantic Oscillation) on marine communities and the relative abundance of individual species in those communities. The availability of three benthic community datasets from the northwest Atlantic continental shelf (Boston Harbor, Massachusetts Bay and Belmar, New Jersey) provided an opportunity to look at coast wide changes in species abundance. This study focuses on one widespread polychaete species, Polygordius jouinae, which is often the numerical dominant in coarse sandy sediments on the continental shelf. This species is semelparous with a life span of only 1-2 years, and it is inferred to have a relatively long lived planktotrophic larval stage. Thus the expectation is that its abundance would be particularly susceptible to year-to-year changes in circulatory patterns, temperature and productivity. Data analysis reveals a concomitant decline of abundance and strong significant correlations between worm density and the Atlantic Multi-decadal Oscillation (AMO) at all three sites (1996-2002). Possible reasons for this correlation are investigated using satellite SST, and Chl a data as well as data on river discharge.

Randall, R. G., Fisheries and Oceans Canada, Burlington, Canada, robert.randall@dfo-mpo.gc.ca;
Minns, C. K., DFO Scientist Emeritus & Adj. Professor Dept., Toronto, Canada, ken@minns.ca;
Brousseau, C. M., Fisheries and Oceans Canada, Burlington , Canada, christine.brousseau@dfo-mpo.gc.ca

COASTAL EXPOSURE AS A PREDICTOR OF THE PRODUCTIVE CAPACITY OF LITTORAL FISH HABITAT IN THE GREAT LAKES

Coastal exposure (fetch distance) as a predictor of fish biomass was used to evaluate the productive capacity of littoral habitat in the Great Lakes. Regression trees were developed using fish and habitat survey data from coastal wetlands, harbours and natural shorelines, and were validated using independent data. Habitat features that influence fish distribution, including the density of aquatic macrophytes, water temperature and substrate size, were related to maximum fetch distance in a consistent manner in the model and validation data sets. Macrophyte density could be predicted from fetch distance and substrate size. Fetch was a coarse but significant predictor of the biomass of five species of fishes, chosen as test species because of their contrasting habitat preferences. Two fish community indices, an Index of Biotic Integrity and a Habitat Productivity Index, were also related to coastal fetch. For all fish response variables, classification was improved if fetch was used together with associated habitat attributes as predictors. Knowledge of site exposure can be used to determine and map first-order estimates of the productive capacity of coastal habitats of the Great Lakes.

Reed, A. H., Seafloor Sciences Branch, Naval Research Laboratory, Stennis Space Center, MS, USA, allen.reed@nrlssc.navy.mil;
Thompson, K. E., Chemical Engineering Dept., Louisiana State University, Baton Rouge, LA, USA, karsten@lsu.edu;
Willson, C. S., Civil Engineering Dept., Louisiana State University, Baton Rouge, LA, USA, cwillson@lsu.edu

QUANTIFYING CONSOLIDATION AND GRANULAR INTERACTIONS IN MARINE SANDS FROM X-RAY MICROFOCUS COMPUTED TOMOGRAPHY IMAGES

Packing of granular media determines the magnitude of many properties within sedimentary systems, such as fluid flow, chemical transport, and sediment compressibility. To address packing characteristics, high-resolution (~10 micron) X-ray microfocus computed tomography (XMCT) images were created of varied sediment types. Sand shapes ranged from rounded (i.e., ooids and glass beads) to subrounded (i.e., accusands) to subangular (i.e., quartz beach-sand) to angular (i.e., shell hash). Sand grains within these images were discretized and the geometrical properties of those grains were quantified. Additionally, and more importantly, grain contacts were evaluated and quantified at varied degrees of sediment consolidation. As grain angularity and packing density are increased, contact areas and contact numbers per grain increase significantly. This study furthers understanding on the complex geometrical fabrics within sandy sedimentary systems.

Reed, D., University of Utrecht, Utrecht, Netherlands, Daniel.Reed@dal.ca;
Boudreau, B. P., Dalhousie University, Halifax, Canada, bernie.boudreau@dal.ca

CONSIDER A THEORETICAL WORM

Infauna, through their ecological activities, redistribute sediment components, including natural and anthropogenic tracers. Such mixing has traditionally been characterized mathematically as a diffusion process. The resulting values of the diffusion coefficient, D_B, from steady-state radiochemical tracers have displayed a correlation with the tracer's half-life. For transient tracers, D_B is typically time dependent. A popular interpretation of these observations is that short-lived or newly introduced tracers are associated with fresh organic matter and, therefore, mixed more rapidly. We employ an individual-based model (Lattice-Automaton Bioturbation Simulator) to mimic mixing in sediments. This model allows us to control the type and intensity of mixing from theoretical infauna. We show that, even when the mixing is identical for all tracers and particles, the observed trends are to be expected if the number of mixing events is less than that required for the validity of the diffusion model. No differential mixing is needed to produce these observations.

Reed, R. E., NC State University, CAAE, Raleigh, USA, rereed@unity.ncsu.edu;
Dickey, D. A., NC State University, Dept. of Statistics, Raleigh, USA;
Burkholder, J. M., NC State University, CAAE, Raleigh, USA;
Kinder, C. A., NC State University, CAAE, Raleigh, USA;
Arellano, C., NC State University, Dept. of Statistics, Raleigh, USA

TEMPORAL AND SPATIAL VARIABILITY IN HIGH RESOLUTION, CROSS-ESTUARINE PHYSICAL-CHEMICAL STRUCTURE IN A EUTROPHIC ESTUARY

Worldwide, estuaries increasingly are affected by stressors such as eutrophication and long- and short-term climatic effects (sea level rise, hurricanes). New technologies such as water-column profilers and autonomous vehicles have enabled acquisition of massive high-resolution physical, chemical and biological datasets to characterize temporal and spatial variability. Seasonal site and site-x-depth comparisons were made to examine physical-chemical structure in a representative eutrophic Neuse River Estuary (NRE), a tributary of Pamlico Sound, USA. The NRE is a shallow, wide, bar-built, predominantly wind-mixed lagoonal system with reduced tidal action, highly stratified conditions, and high sedimentation rates and nutrient loadings. A network of automated platforms was installed at cross-estuarine sites, and statistical methods such as exploratory data analyses, time-series, and multivariate analysis of variance were used to examine factor interactions and cross-estuarine structure. Statistically significant site and inter-site seasonal and event-driven differences were documented in the physical-chemical structure, and varied according to sampling period. These studies address the need for the development and application of innovative statistical methods to examine large datasets to describe and quantify estuarine variability at multiple temporal and spatial scales.

Renz, J., Senckenberg Research Institute, German Centre of Marine Biodiversity Research, Hamburg, Germany, jrenz@senckenberg.de;
Stegert, C., University Hamburg, Institute for Oceanography, Hamburg, Germany, stegert@ifm.uni-hamburg.de;
Moll, A., University Hamburg, Institute for Oceanography, Hambrg, Germany, moll@ifm.uni-hamburg.de

LIFE CYCLE OF PSEUDOCALANUS ELONGATUS IN THE GERMAN BIGHT: A SYNTHESIS OF OBSERVATIONS, FIELD EXPERIMENTS, AND MODEL SIMULATIONS

Stage resolving population models of copepods are a useful tool to simulate the abundance of key copepod species for prey fields of commercially used larval and adult planktivorous fish. These models use a multitude of parameters which need a robust dataset. A zero dimensional, stage structured population model of Pseudocalanus elongatus developed during the early phase of the German GLOBEC project was embedded in the three-dimensional ecosystem model to simulate abundance data of P. elongatus for the year 2004 in the German Bight. Here we would like to present a synthesis of model simulations and field observations from a station grid in the southern North Sea during an intensive field study between February and October 2004. We took data on length of copepodite stages and experiments on reproductive parameters (egg production, hatching success, sex ratio) performed during the field campaign to optimize the literature based parameterization of the population model. New model simulations are presented and the potential of the model to realistically simulate the life cycle of Pseudocalanus in the North Sea is discussed.

Retamal, L., INRS Eau, Terre et Environnement, Québec, Canada, leira.retamal@ete.inrs.ca;
Laurion, I., INRS Eau, Terre et Environnement, Québec, Canada, isabelle.laurion@ete.inrs.ca;
Dupont, C., INRS Eau, Terre et Environnement, Québec, Canada, christiane.dupont@ete.inrs.ca

MICROBIAL DYNAMICS AND DISSOLVED ORGANIC MATTER IN SUPERSATURATED THERMOKARST PONDS

The role of thermokarst ponds on carbon flux is now a major concern among polar scientists because of the increasing number of ponds generated by the thawing of permafrost. This pool of carbon is now made available to aquatic microbial and photochemical degradation. Microbial respiration in this ecosystem will transfer an unknown fraction of this carbon to the atmosphere, affecting the global carbon budget. We investigated the relationships between planktonic microbial activity and the quality of dissolved organic matter (DOM) in a series of 9 subarctic ponds (DOC from 3.1 to 9.7 mg L-1). DOM was characterised by synchronous fluorescence and by stable isotope analyses. The production to respiration ratio (P:R) indicates that these ponds are net heterotrophic systems that were all supersaturated in CO2 and CH4. However, CO2 flux was negatively correlated to primary production. Primary to bacterial production ratio (P:B) tends to increase with DOC and was significantly correlated with the allochthonous fraction of DOM. This work is part of a Subarctic-Arctic comparison studying carbon flux in this freshwater system under the influence of climate change.

Rex, J. F., University of Northern British Columbia, Prince George, Canada, jfrex@shaw.ca;
Petticrew, E. L., University of Northern British Columbia, Prince George, Canada, ellen@unbc.ca

POST-SPAWNING FLOCCULATION IN PACIFIC SALMON-BEARING STREAMS: BACTERIAL LINKS TO NUTRIENT CYCLING VIA PARTICULATE SETTLING

Spawning Pacific salmon are a valuable source of organic matter and marine derived nutrients (MDN) for their natal streams. Salmon organic matter (SOM) based sediment flocs originate from the combination of organic matter released during spawning as well as post-spawning carcases and inorganic suspended sediments. This study simulates the delivery of MDN by flocs to streambeds during the post-spawn period using SOM and suspended sediment concentrations similar to central interior British Columbia salmon streams. The simulation occurred in a 30m*2m*2m re-circulating flume seeded with a gravel cobble mixture similar to regional Pacific salmon-bearing streams. Under these controlled conditions it was found that SOM based flocculation was bacterially mediated as identified by a significant increase in attached bacterial levels ($p < 0.05$) after addition of SOM with clay. Further, as bacterial levels increased so did the effective particle size of flume-bed captured fine sediments (> 100 microns) along with their nitrogen content and biochemical oxygen demand. These findings infer that salmon derived sediment flocs form in the presence of SOM with clay and that they effectively deliver MDN to the streambed.

Reyes, E., East Carolina University, Greenville, USA, reyese@ecu.edu

FORECASTING LONG-TERM RESPONSE OF NORTH CAROLINA WETLANDS TO TRENDS AND DISTURBANCES RELATED TO CLIMATE CHANGE

North Carolina coastal wetlands are highly susceptible to flooding and erosion as their regional topographic gradient is very small and thus, can be lost due to a combination of several climate and regional factors. Presently, there is a need to examine the pattern of the relationship between accelerated sea-level rise and coastal habitat changes and land loss. A coupled hydrodynamic and habitat watershed simulation model was developed to explore long-term habitat response for a representative basin for the Pamlico Sound estuary under present environmental and future global warming scenarios. The process-based models linked hydrodynamic, biological and soil modules across spatial and temporal scales to examine the response of the Neuse River coastal forest and marsh vegetation succession and survival to increased storm frequency and intensity, variable precipitation and drought and sediments inputs, and increased sea-level rise. This model integrated present environmental conditions and, by modifying those conditions in a step-wise manner, its results could be used as a casuistic management tool for predicting the effects of regional impacts on structural landscape level changes

Richoux, N. B., Rhodes University, Grahamstown, South Africa, N.Richoux@ru.ac.za;
Froneman, P. W., Rhodes University, Grahamstown, South Africa, W.Froneman@ru.ac.za

TROPHIC ECOLOGY OF ZOOPLANKTON COMMUNITIES AT THE SUBTROPICAL CONVERGENCE, INDIAN OCEAN

The Subtropical Convergence (STC), a frontal region which represents the northern border of the Southern Ocean, is characterized by elevated biological activity. As such, the STC is thought to play an important role in the ocean carbon cycle, and it may act as a biogeographical barrier to

zooplankton. Stable isotope signatures ($\delta^{13}C$, $\delta^{15}N$) were used to assess regional differences in the trophodynamics of zooplankton communities between 41° and 42° south, where the cool nutrient-rich subantarctic waters meet the warm nutrient-poor subtropical waters. Significantly enriched values of $\delta^{15}N$ were noted in populations of all the major zooplankton groups inhabiting the warm northern waters (max surface temp 21°C), including the euphausiids, salps, amphipods, copepods, ostracods, pyrosomes, pteropods and chaetognaths, compared with those in the cool southern waters (min surface temp 11°C). Similar patterns of delta^{15}N in particulate samples collected throughout the region suggest that the large changes in zooplankton $\delta^{15}N$ values across the frontal region may be driven by variations within the phytoplankton communities. Signatures of $\delta^{15}C$ within the different zooplankton groups, however, did not exhibit a distinctive north to south pattern.

Richter, C., Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven, Germany, claudio.richter@zmt-bremen.de;
Khokiattiwong, S., Phuket Marine Biological Center, Phuket, Thailand;
ORCAS Team

SOLITON-ENHANCED MIXING IN THE ANDAMAN SEA

A striking feature of the Andaman Sea is the occurrence of very large amplitude internal waves. These solitary-like waves (or solitons) are generated by the ebb and flow of water across the shallow ridges of the Andaman-Nicobar island arc and propagate along the density discontinuity between warm surface and colder deep waters with speeds of ~2 m/s and amplitudes of up to 80 m. Here, we show that the dissipation of the solitons' energy in shoaling water enhances pelagic-benthic coupling along the continental margin, due to turbulent mixing near the sea bed, entrainment of interstitial and subpycnocline nutrients, and formation of bores. These 'solibores' supply nutrients into the surface layer which fuel pelagic productivity, but low temperature and low aragonite saturation state impedes coral development in shallow waters. Because solitons are ubiquitous in the Andaman Sea and elsewhere, they may be an important yet so far overlooked mechanism structuring marine communities in tropical waters.

Riessen, H. P., SUNY College at Buffalo, Buffalo, USA, riessehp@buffalostate.edu

SIZE-SELECTIVE PREDATION BY INVERTEBRATE PLANKTIVORES: HOW MUCH GENERALIZATION IS POSSIBLE?

One of the more ingrained principles in aquatic ecology is that invertebrate planktivores are size-selective predators that consume small body-sized zooplankton, mainly prey < 1.0 mm in body length. This generalization, which was first formulated in the early 1970's, is a pivotal component in the theoretical framework we have constructed to understand the structure and function of planktonic populations and communities. While we apply this generalization to all invertebrate planktivores, it is originally based on studies that were largely limited to carnivorous copepods. Unlike planktivorous fish, however, invertebrate planktivores represent a wide range of taxonomically different animals that vary greatly in feeding mechanism and body size. These differences result in feeding patterns that only loosely resemble the clear and simple generalization on which we base our understanding of planktonic food webs. I will examine the variation in feeding patterns exhibited by invertebrate planktivores, how well each fits the accepted generalization of size-selective predation, and propose a new framework that will provide a more realistic model for the role these predators play.

Risk, M. J., McMaster University, Durham, Canada, riskmj@mcmaster.ca;
Sherwood, O., Memorial University
Nairn, R., Baird and Associates
Gibbons, C., Baird and Associates
Cotsapas, L., RPI
Montello, T., RPI

SHALLOW ANTIPATHARIANS MAP SEWAGE PLUMES: JEDDAH, SAUDI ARABIA

A multidisciplinary study of sewage discharge off Jeddah, Saudi Arabia, used traditional water quality parameters, coupled with stable isotopic analysis (ratios of C and N) of the skeletons of Antipatharia found on offshore reefs in depths as shallow as 2m. These organisms usually are found much deeper. The isotopic values enhanced the "snapshot" of conditions provided by traditional methods, but the real value lay in using the skeletal values to go back in time. We were able to trace the history of sewage loading off this coastline over the past 50 years, data which are invaluable in remediation work. In fact, the isotopic data were found to provide a better overall picture than the traditional measures. High-precision sampling of selected skeletons allowed annual stratigraphic resolution. This suggests that, at sites lacking longterm water quality data, analysis of the skeletons of organisms can build up a satisfactory picture of water quality over the past several decades.

Rivkin, R. B., Memorial University of Newfoundland, St. John's, Canada, rrivkin@mun.ca

MICROZOOPLANKTON IN THE WORLD OCEAN: COMPARISONS OF RESPONSE DURING MESOSCALE IRON ENRICHMENT EXPERIMENTS TO A GLOBAL SYNTHESIS.

High Nutrient, Low Chlorophyll regions, where primary production is limited by the supply of Fe, comprises about 30% of the World Oceans. Climate models predict changes in Fe supply in the future ocean, and although mesoscale Fe enrichment experiments have been carried out for over 15 years, there are very few comprehensive studies of microheterotrophs. Microzooplankton consume a large fraction of prokaryotic autotrophs and heterotrophs and small eukaryotic microplankton production in the upper ocean, and thus directly mediate the cycling carbon and nitrogen, and influence the production and degradation of key climate active gases. Here, we have assembled a large data base on microzooplankton activity and biomass in the World Ocean and compare these characteristics with the same parameters for the responses of microzooplankton during mesoscale iron enrichments experiments. Our preliminary meta-analysis shows that there are no fundamental differences for microzooplankton during Fe enrichment experiments, and that their impact reflects enhanced biomasses rather than a change in their 'physiology' or ingestion parameters. This should simplify incorporation of microzooplankton into prognostic models of the future ocean.

Robinson, D. H., San Francisco State University, San Francisco, USA, dhr@sfsu.edu;
Kropuenske, L. R., Stanford University, Stanford, USA, lindsey@stanford.edu;
van Dijken, G. L., Stanford University, Stanford , USA, gertvd@stanford.edu;
Mills, M. M., Stanford University, Stanford , USA, mmmills@stanford.edu;
Arrigo, K. R., Stanford University, Stanford , USA, arrigo@pangea.stanford.edu

PHOTOADAPTIVE STRATEGIES INFLUENCE THE GEOGRAPHICAL DISTRIBUTION OF TWO MAJOR SOUTHERN OCEAN PHYTOPLANKTON BLOOM FORMERS

Concern over climate change has focused attention on the Southern Ocean, where biological and physical processes promote extensive CO_2 flux to ocean. Biological CO_2 drawdown is strongly influenced by phytoplankton taxonomic composition. In the Ross Sea, which accounts for 25-30% of annual production, twice as much CO_2 per phosphate is taken up where *Phaeocystis antarctica* (haptophyte) dominates compared to regions where diatoms dominate. These taxa are ubiquitous in the Southern Ocean, forming large blooms around the Antarctic continent. However, their distributions are geographically distinct: diatoms dominate where sea ice melt creates shallow mixed layers (< 20 m), whereas *P. antarctica* dominate more deeply mixed waters (>40-60 m). The correlation between species distribution and mixed layer suggests that light influences taxonomic composition. In laboratory studies, we compared the photoadaptive strategies of *P. antarctica* and the Antarctic diatom *Fragilariopsis cylindrus* under static and simulated-mixing illumination conditions. Measurements of photosynthesis, fluorescence quenching, and photosynthetic and photoprotective pigments were made to determine if strategies employed by these two taxa could explain their distribution and help predict phytoplankton community response to climate-related changes.

Rodríguez, P. L., EGE, FCEyN, Universidad de Buenos Aires, Buenos Aires, Argentina, patriciar@ege.fcen.uba.ar;
Vera, M. S., EGE, FCEyN, Universidad de Buenos Aires, Buenos Aires, Argentina, msolangevera@ege.fcen.uba.ar;
Pizarro, H., EGE, FCEyN, Universidad de Buenos Aires, Buenos Aires, Argentina, hay@ege.fcen.uba.ar

PRIMARY PRODUCTION COMPARISON BETWEEN PHYTOPLANKTON AND PERIPHYTON IN TWO SHALLOW LAKES FROM ARGENTINA

Phytoplankton and periphyton production were assessed in two lakes from the Paraná floodplain (Argentina). The study was carried out monthly during 2006-2007 in Grande lake (GL), free of floating macrophytes (FM) and an oxbow lake (OL) 100% covered by FM from winter onwards. P-I curves were performed employing ^{14}C methodology. In GL, maximum photosynthetic rate (Pmax) and assimilation number (PBmax) were always significantly highest for phytoplankton; similar trend was observed for light efficiency. Light limitation was not observed after spring, neither phytoplankton nor periphyton. In OL there were no significant differences between communities in terms of photosynthetic parameters; phytoplankton was light limited since winter to summer, with 100% FM coverage and periphyton was light limited in winter. Pmax and efficiency were significantly highest in GL, however no differences were observed comparing these parameters normalized to chlorophyll *a*. There were no differences among periphyton parameters at both lakes. Phytoplankton productivity in OL was higher than in GL before FM development and lower after it. Phytoplankton would be better adapted to restricted light conditions than periphyton probably owing to buoyancy and motility.

Rohrlack, T., Norwegian Institute for Water Research, Oslo, Norway, thomas.rohrlack@niva.no;
Blikstad-Halstvedt, C., Norwegian Institute for Water Research, Oslo, Norway, cbl@niva.no;
Utkilen, H., Norwegian Institute for Public Health, Oslo, Norway, hans.utkilen@niva.no

THE FINE STRUCTURE OF CYANOBACTERIAL POPULATIONS AND ITS ECOLOGICAL SIGNIFICANCE

In biological research, the species is usually recognized as the major ecological unit. In line with that, a population is seen as a group of individuals of one species that interact in a similar way with their environment and so constitute an ecological entity. Here, we present a body of evidence questioning the appropriateness of this concept for the freshwater cyanobacterium Planktothrix. Using oligopeptides as markers, we show that a given cyanobacterial population can comprise distinct subpopulations. These differ in seasonal dynamics, depth distribution, toxicity, capacity to affect grazers, and probably other characteristics. Accordingly, major properties of cyanobacterial populations including their toxicity mainly depend on the subpopulation structure. A comprehensive understanding of cyanobacterial populations can therefore only be achieved in studies at subpopulation level. Moreover, the occurrence of ecologically distinct subpopulations may also allow a more effective adaptation to variations in environmental conditions, providing a possible explanation for the high stability of cyanobacterial populations.

ROLLAND ANNE, M. P., INRA, Thonon-les-bains, France, rolland@thonon.inra.fr;
BERTRAND, F., IRMA, Strasbourg, France, fbertran@math.u-strasbg.fr;
STEPHAN, J., INRA, Thonon-les-bains, France, jacquet@thonon.inra.fr

POWERFUL STATISTICAL TOOLS TO ANALYZE PHYTOPLANKTON DYNAMICS IN THE MARNE RESERVOIR (SEINE CATCHMENT AREA, FRANCE)

Phytoplankton identification and counts using light microscopy are very time-consuming. Hence, the possibility to obtain the information concerning its evolution over various time and space scales, in order to reduce the sampling effort, is very likely. It is noteworthy however that reaching this precise information, that corresponds to 'where' and 'when' the samples have to be taken within an ecosystem, requires the acquisition of data for a wide range of species at regular intervals of the year and at different stations. For the last two decades, some efforts have been made to develop new statistical tools in order to describe with precision communities' dynamics. As a good example, multitable methods have been created specifically to analyze several data tables simultaneously. We will show, from a two-year survey of the phytoplanktonic community sampled at different stations that 1) the partial triadic analysis allows to identify a single station representative of the whole system as well as three key periods of sampling along one year; 2) the statis method allows to highlight some key environmental variables associated to this phytoplankton dynamics.

Rooker, J. R., Texas A&M University, Galveston, USA, rookerj@tamug.edu;
Secor, D. H., University of Maryland, Solomons, USA, secor@cbl.umces.edu;
Scholesser, R., Texas A&M University, Galveston, USA, fear_no_fish_36@hotmail.com;
Neilson, J. D., Department of Fisheries & Oceans, St. Andrews, Canada, NeilsonJ@mar.dfo-mpo.gc.ca

TRANS-ATLANTIC MIXING AND SPAWNING FIDELITY OF BLUEFIN TUNA: EVIDENCE FROM STABLE ISOTOPES IN OTOLITHS

Stable carbon and oxygen isotopes in otoliths were used to investigate trans-Atlantic movement and spawning fidelity of Atlantic bluefin tuna. Otolith $\delta^{13}C$ and $\delta^{18}O$ of yearling bluefin tuna from six different year classes were characterized to validate the approach and assess inter-annual variation in these markers. Otolith $\delta^{18}O$ of yearlings from the eastern nursery (Mediterranean Sea/E. Atlantic Ocean) was enriched relative to individuals from the western nursery (Gulf of Mexico[GOM]/W. Atlantic Ocean), while otolith $\delta^{13}C$ was similar between nurseries. Temporal variability in otolith $\delta^{13}C$ and $\delta^{18}O$ of bluefin tuna was observed; nevertheless, cross-validated classification to eastern and western nurseries was high (88%). Otolith $\delta^{13}C$ and $\delta^{18}O$ of yearlings were then used as a baseline sample (eastern and western nursery signature) to predict the origin of adolescents and adults from presumed mixing zones in the western Atlantic, and adults from spawning grounds in both the Mediterranean and GOM. Mixed stock analysis based on milled otolith cores (corresponds to yearling period) indicated that over 50% of the adolescent bluefin tuna collected from the US Atlantic originated from the eastern nursery, suggesting that trans-Atlantic movement of adolescents was high with the eastern population supporting fisheries in US waters. In addition, natality was well developed with over 90% of the adult bluefin tuna collected in the Mediterranean or GOM derived from the same nursery.

Rose, G. A., Memorial University of Newfoundland, St. John's, Canada, grose@mi.mun.ca;
Nelson, R. J., Institute of Ocean Sciences, Sidney, Canada, NelsonJo@pac.dfo-mpo.gc.ca

ON THE ORIGIN OF FISH STOCKS: WHENCE THE SMITH SOUND COD?

In April 1995 the largest extend aggregation of northern Atlantic cod (Gadus morhua) was detected in Smith Sound, Newfoundland. The origin of these fish and their potential for range expansion was investigated using historical, demographic and genetic data. Historical information suggests that Smith Sound was never an important cod area prior to 1995. The founder year-classes were spawned in 1989, 1990, and 1992, when little local spawning was evident but major spawning was observed in the adjacent Bonavista Corridor. Six nuclear microsatellite loci were assessed from 791 cod collected from over-wintering aggregations in Smith Sound, the Corridor and other offshore locations further north and south. Genetic homogeneity could not be rejected in pair-wise tests between Smith Sound, Corridor and Halibut Channel cod (differences strongest between Smith Sound year classes). Overall, the genetic evidence suggests a lack of differentiation and demographic connection between southern groups of spawning northern cod, including those from Smith Sound, the BC, and Halibut Channel. Northern fish differed. We conclude that the Smith Sound cod likely formed as a result of changed southern migration patterns and hence may be a source for future range expansion.

Roskosch, A., Leibniz-Institute for Freshwater Ecology and Inland Fisheries, Berlin, Germany, roskosch@igb-berlin.de;
Lewandowski, J., Leibniz-Institute for Freshwater Ecology and Inland Fisheries, Berlin, Germany, lewe@igb-berlin.de;
Hupfer, M., Leibniz-Institute for Freshwater Ecology and Inland Fisheries, Berlin, Germany, hupfer@igb-berlin.de;
Nuetzmann, G., Leibniz-Institute for Freshwater Ecology and Inland Fisheries, Berlin, Germany, nuetzmann@igb-berlin.de

IMPACTS OF *CHIRONOMUS PLUMOSUS* LARVAE ON PROCESSES IN LAKE SEDIMENTS

Tube-dwelling *Chironomus plumosus* larvae influence exchange and turnover processes in lake sediments. Due to bioirrigation activities the larvae increase the exchange between sediment and the overlying water column several times. Moreover anaerobic sediment is oxidized, microorganism densities are altered and biogeochemical reactions are

affected. In our studies we determine flow velocities through *C. plumosus* burrows, quantify water exchange rates and detect diffusive and advective transport around the burrows. Due to small burrow diameters innovative measurement techniques are required. We adopted novel flow velocity sensors, particle image velocimetry (PIV) and exchange experiments with sodium chloride for our setting to investigate hydrodynamic processes and positron emission tomography (PET) to estimate diffusive and advective transport. Furthermore, the effects on biogeochemical parameters, especially phosphorus immobilization are investigated. For that purpose 2D peeper technique was used and censuses of microorganisms were implemented. In summary, we prove new measurement techniques as helpful to investigate the effects of *C. plumosus* larvae on small-scale, 3-dimensional hydrodynamic and biogeochemical processes. The results show and quantify the great impact of this macrozoobenthos species for processes in lake sediments.

Ross, O. N., University of Essex, Colchester, United Kingdom, onross@essex.ac.uk;
Geider, R. J., University of Essex, Colchester, United Kingdom, geider@essex.ac.uk;
Moore, C. M., National Oceanography Centre, Southampton, United Kingdom, cmm297@noc.soton.ac.uk

A NEW MODEL OF TURBULENT MIXING, PHYTOPLANKTON PHOTOSYNTHESIS AND ACCLIMATION BASED ON FRRF MEASUREMENTS

Phytoplankton photosynthesis under the rapidly fluctuating irradiance which results from turbulent mixing through the vertical light gradient is poorly understood. Ship-based measurements often apply the fast repetition rate fluorescence (FRRF) technique in situ or in vivo to gauge the physiological state of the phytoplankton community and infer some of the physical properties of the water column (such as mixing time scales). We present a new model of photosynthetic electron turnover at photosystem II based on parameters that can be obtained from FRRF measurements. We also include empirical formulations for processes such as photo-protection (from non-photochemical quenching), photo-inhibition and -acclimation. We combine our biological model with a k-epsilon turbulence closure scheme and a 1D Lagrangian particle tracking model to examine the effects of turbulent mixing and mixed layer depth on the plankton physiology and growth.

Roux, M. J., Memorial University, St-John's, Canada, rouxmj@dfo-mpo.gc.ca;
Anderson, M. R., Department of Fisheries and Oceans, St-John's, Canada, m.robin.anderson@dfo-mpo.gc.ca;
Planas, D., Université du Québec à Montréal, Montréal, Canada, planas.dolores@uqam.ca

BI-DIMENSIONAL FEEDING ECOLOGIES AND COMMUNITY STRUCTURE: CONCEPTS AND APPLICATIONS

Spatially discrete carbon sources generate spatially distinct or horizontal energy flows at the consumer level. Together, horizontal (spatially-explicit) and vertical (trophic) energy flows support consumer production and affect community organization. Bi-dimensional feeding ecologies and community structure are conceptual frameworks that integrate trophic and spatial processes on two orthogonal, mobile axis. We demonstrate their relevance and applications using stable isotopes of carbon and nitrogen to trace horizontal littoral-pelagic and vertical energy flows in freshwater fish communities. Consumer bi-dimensional resource utilization vary with species ontogeny and ecosystem features, and can be classified based on the relative importance of these effects. Bi-dimensional food web structures estimated from vertical and horizontal resource use in consumers, likewise vary with community composition and with physical and biological ecosystem features. Integrating spatial processes in the definition of feeding ecologies and community structure thereby translate functional species-environment relationships that can serve as feasible means of evaluating species and food webs sensitivity to changing or altered ecosystem conditions.

Rowe, J. M., University of Tennessee, Knoxville, USA, jrowe2@utk.edu;
DeBruyn, J. M., University of Tennessee, Knoxville, USA, jdebryun@utk.edu;
Saxton, M. A., University of Tennessee, Knoxville, USA, saxton@utk.edu;
Poorvin, L., University of Tennessee, Knoxville, USA, lpoorvin@utk.edu;
Hutchins, D. A., University of Southern California, Los Angeles, USA, dahutch@usc.edu;
Zinser, E. R., University of Tennessee, Knoxville, USA, ezinser@utk.edu;
Johnson, Z. I., University of Hawaii, Manoa, USA, zij@hawaii.edu;
Wilhelm, S. W., University of Tennessee, Knoxville, USA, wilhelm@utk.edu

MARINE VIRUSES ACROSS OCEANIC REGIMES: ANALYSES OF VIRUS-HOST PARAMETERS FROM THE SARGASSO SEA, NORTH ATLANTIC, AND WESTERN PACIFIC

While much is recognized about the importance of marine plankton in global biogeochemical cycles, the influences of viruses that infect them are still not clear. Researchers have learned from examinations on regional spatial scales that viruses are not simply agents of mortality, but can also serve to drive production of other community members through the release of bioavailable nutrients upon host cell lysis. Larger-scale examinations (1000's km) of this relationship as well as of factors that may influence virus-host interactions have been needed to understand these trends on oceanic scales. Samples collected across several ocean regimes (the Sargasso Sea, the North Atlantic and the Equatorial Pacific; >10,000 km in total) during 2 cruises have provided a look at some of the basic virus-host parameters, including virus-like particle abundance and production rates, host abundance and production rates, frequency of visibly infected cells, and minimum burst sizes. Inter-comparisons of these parameters with other physical oceanic metrics indicate that regime-dependent trends exist, with threshold effects in waters of higher productivity.

Royer, T. V., Indiana University, Bloomington, USA, troyer@indiana.edu;
Warrner, T. J., Indiana University, , USA, twarrner@indiana.edu;
Griffiths, N. A., University of Notre Dame, , USA, ngriffi1@nd.edu;
Tank, J. L., University of Notre Dame, , USA, jtank@nd.edu;
Rosi-Marshall, E. J., Loyola University-Chicago, , USA, erosi@luc.edu;
Whiles, M. R., Southern Illinois University, , USA, mwhiles@zoology.siu.edu

BIOGEOCHEMISTRY OF DISSOLVED ORGANIC CARBON IN HEADWATER AGRICULTURAL STREAMS

Relatively little is known about the biogeochemistry of dissolved organic carbon (DOC) in streams draining intensively farmed landscapes, such as the midwestern U.S. We studied DOC dynamics monthly from July 2006-July 2007 in 6 headwater streams in Indiana, USA, in a landscape that is >90% row-crop agriculture. The streams are nutrient-rich and receive water from under-field tile drains. DOC concentrations ranged from 1-6 mg/L in both the streams and the tile drains, with little variation among sites. At times, individual tile drains contributed as much as 2 kg/day of DOC to streams and peak stream loads exceeded 1000 kg/day. Diurnal mass-balance studies along a 200 m reach in 3 streams indicated little net change in DOC loads between day and night even with filamentous algal coverage of 28-50%. Despite filamentous algal blooms, bioavailability of DOC collected pre-dawn and mid-afternoon was consistently low, and chemical measures indicated that most DOC was of terrestrial origin. Agricultural soils were the primary DOC source for streams, and this low quality DOC may impose a constraint on other biogeochemical processes in these systems.

Ruiz, G. M., Smithsonian Environmental Research Center, Edgewater, USA, ruizg@si.edu;
Larson, K., Smithsonian Environmental Research Center, Edgewater, USA, larsonk@si.edu;
McCann, L., Smithonian Environmetnal Research Center, Edgewater, USA, mccannl@si.edu;
Fofonoff, P., Smithsonian Environmental Research Center, Edgewater, USA, fofonoffp@si.edu;
Hines, A. H., Smithsonian Environmental Research Center, Edgewater, USA, hinesa@si.edu;
Hewitt, C. L., Australian Maritime College, Launceston, Australia, chewitt@amc.edu.au

LATITUDINAL PATTERN OF MARINE INVASIONS FOR WESTERN NORTH AMERICA: CURRENT STATUS AND PREDICTIONS.

Available data suggest there is a strong latitudinal pattern in recent marine invasions, with more non-native species documented in temperate marine communities than polar or tropical systems. This geographic pattern of invasion may reflect some historical biases in search effort and taxonomic

knowledge. From 2000-2007, we conducted standardized field surveys of marine sessile invertebrates in estuaries of western North America, to control for search effort. Our results indicate a steep latitudinal gradient exists in non-native species richness, decreasing with increasing latitude (32 to 61 N). In contrast, native species richness shows now relationship with latitude across this same range. Possible mechanisms for the observed invasion pattern across latitudes, operating alone or in combination, include differences in (a) propagule supply, (b) biotic resistance to invasion, (c) environmental resistance to invasion, and (d) disturbance regime. We predict directional shifts in several of these mechanisms, in response to changes in climate and human activities, increasing invasions at high northern latitudes.

Runge, J., University of Maine and Gulf of Maine Research Institute, Portland, USA, jeffrey.runge@maine.edu;
Curtis, A., Bedford Institute of Oceanography, Dartmouth, Canada;
Head, E., Bedford Institute of Oceanography, Dartmouth, Canada;
Johnson, C., Bedford Institute of Oceanography, Dartmouth, Canada;
Jones, R., University of Maine and Gulf of Maine Research Institute, Portland, USA;
Manning, C., University of New Hampshire, Durham, USA;
Pepin, P., Northwest Atlantic Fisheries Centre, St. John's, Canada

COMPARISON OF ZOOPLANKTON COMMUNITY STRUCTURE ACROSS SEASONS AND LATITUDES ALONG THE NW ATLANTIC CONTINENTAL SHELF

Zooplankton samples have been collected and enumerated using common protocols from fixed stations and transects on the Scotian and Newfoundland shelves since 1999 and in the western Gulf of Maine since 2003. The Canadian data form part of the Atlantic Zonal Monitoring Program and the U.S. data represent a contribution from the University of New Hampshire Coastal Observing Center and the NOAA-sponsored Northeast Consortium for cooperative research with the fishing industry. We report here on an initial comparison of seasonal variation and along- and cross-shelf variation in zooplankton diversity, biomass and abundance between the coastal Gulf of Maine and Scotian and Newfoundland shelves. While many of the same species dominate in all regions, there are clear cross-shelf differences in species abundance and in the seasonal timing of peak abundance, translating into pronounced differences in community structure across regions. Using multidimensional scaling, we characterize the along- and cross-shelf gradients and explore relationships between interannual changes in zooplankton species abundance patterns and climate-forced environmental variation.

Ruttenberg, K. C., University of Hawaii/Dept of Oceanography, Honolulu, USA, kcr@soest.hawaii.edu;
Tamburini, F., ETH-Zentrum/Plant Nutrition Institute, Zurich, Switzerland, federica.tamburini@ipw.agrl.ethz.ch

PHOTOREDUCTION OF AEOLIAN FE-OXYHYDROXIDES IN OLIGOTROPHIC SURFACE SEAWATER: IMPLICATIONS FOR BIOAVAILABLE PHOSPHORUS

Sequestration of carbon in organic matter through photosynthesis constitutes the biological pump that regulates atmospheric carbon dioxide concentration with consequent effects on climate over time. The availability of macro (i.e., phosphorus and nitrogen) and micro (i.e., iron) nutrients in ocean surface waters controls this process. While nitrogen is present in the atmosphere (as di-nitrogen gas) and can be converted into a bioavailable form by the process of nitrogen fixation, phosphorus (P) and iron (Fe) can only be supplied to the ocean surface upon (1) upwelling of deep, nutrient-rich waters, and (2) transport of dissolved and particulate material from the continent. Eolian transport is the only vector providing particulate iron to open oligotrophic regions of the ocean. Fe-oxyhydroxides in aeolian dust are also carriers of P, with which they became associated in the soil formation and weathering environment. We present results of photoreduction experiments evaluating the potential release of P to oligotrophic seawater as a consequence of photoreduction of the carrier Fe-oxyhydroxide phases.

Ruzzante, D. E., Dalhousie University, Halifax, Canada, daniel.ruzzante@dal.ca

POPULATION STRUCTURE, CONNECTIVITY, ENVIRONMENT AND LIFE HISTORY DIFFERENCES IN A PELAGIC FISH

The existence of biologically differentiated populations has been credited with a major role in conferring sustainability and in buffering overall productivity of anadromous fish population complexes where evidence for spatial structure is uncontroversial. In this presentation I will describe evidence of correlated genetic and life history (spawning season linked to spawning location) differentiation (and thus of population structure and connectivity) in an abundant and highly migratory pelagic fish, Atlantic herring, Clupea harengus. The existence of genetically and phenotypically diverse stocks despite seasonal mixing strongly implicates natal homing in this species. Using information from genetic markers and otolith morphology, we then estimate the proportional contribution by population components to mixed aggregations. These estimates are then used to identify spatial and temporal differences in life history (migratory behaviour) and habitat use among genetically differentiated migratory populations that mix seasonally. I will finish by examining the relative roles of environmental factors in the structuring of genetic diversity in this species. Our study suggests the existence of more complex patterns of intraspecific diversity than was previously recognized in this species.

Ryan, M. R., Memorial University of Newfoundland, St. John's, Canada, f02mrar@mun.ca;
Gregory, R., Department of Fisheries and Oceans, Science Branch, St. John's, Canada, Gregoryr@DFO-MPO.GC.CA;
Snelgrove, P. V., Memorial University of Newfoundland, St. John's, Canada, psnelgro@mun.ca

WHY DID THE FISH CROSS THE GAP? BETWEEN-PATCH MOVEMENT OF JUVENILE ATLANTIC COD, GADUS MORHUA

Complex habitat has been shown to act as a predator refuge for many juvenile fishes. For juvenile Atlantic cod, *Gadus morhua*, research has shown the importance of habitat configuration of eelgrass *Zostera marina*, however more information is needed on movement decisions made by fish when such habitat is highly fragmented. The present study examines the between-patch movement of juvenile cod and identifies key factors that drive such behaviour. We conducted a mark-recapture study in a small cove in Newfoundland using artificial eelgrass patches with varying between-patch distances. Results show highly variable movement patterns, with individuals recaptured up to 105 m from the point of release and up to 6 days following release, and many individuals not recaptured. Overall, results indicate rapid movement out of the study site, in contrast to predictions of high site fidelity to complex habitat. Laboratory behavioural studies suggest that predator presence is one factor that significantly affects between-patch movements of young fish, and may partially explain the behaviours observed in the field.

Sañé, E., Instituto de Ciencias del Mar, Barcelona, Spain, sane@icm.csic.es;
Isla, E., Instituto de Ciencias del Mar, Barcelona, Spain, isla@icm.csic.es;
Grémare, A., Observatoire Océanologique de Banyuls, Université Pierre et Marie Curie, Banyuls sur Mer, France, antoine.gremare@obs-banyuls.fr

PIGMENTS IN SEDIMENTS BENEATH THE COLLAPSED LARSEN A AND B ICE SHELVES

In austral summer 2006-2007 the R/V Polarstern reached the areas where the former Larsen A and B ice shelves existed in the Eastern Antarctic Peninsula (EAP). Five stations were sampled in the EAP and two in the Western Antarctic Peninsula (WAP). Results from EAP grain size analyses showed in two Larsen B cores that the fraction > 200 µm was 5 to 20 % in the upper 4 cm. In Larsen A and B cores chlorophyll a concentration decreased to zero below the upper 2 cm, whereas in the WAP chlorophyll a was present along the core. In both areas chlorophyll a concentration in the upper 2 cm was similar (0.5-1 µg gDW-1), except in the Larsen B Central station where Chl a concentration was 1.37 ± 0.18 µg gDW-1 in the upper sample of the core and decreased to zero at ~ 3 cm depth. Chlorophyll a vertical distribution evidenced the presence of phytoplanktonic activity in Larsen A and B regions possibly related to the recent ice shelves collapses. Currents and sea ice coverage and dynamics will greatly improve the interpretation of granulometry and chlorophyll a profiles.

Sabater, S., ICRA, Girona, Spain, sergi.sabater@udg.edu;
Artigas, J., Univ. Girona, Girona, Spain, joan.artigas@udg.edu;
Muñoz, I., Univ. Barcelona, Barcelona, Spain, imunoz@ub.edu;
Gaudes, A., Univ. Barcelona, Barcelona, Spain, agaudes@ub.edu;
Urrea, G., Univ. Girona, Girona, Spain, gemmaurrea@gmail.com;
Romani, A., Univ. Girona, Girona, Spain, anna.romani@udg.edu

LONG-TERM NUTRIENT ENRICHMENT IN FORESTED STREAMS DETERMINE CHANGES IN BIOFILMS STOICHOIMETRY

The effects produced by additional nutrient inputs in undisturbed streams of temperate regions can be emphasized during periods of low flow. Mediterranean systems suffer of extended periods of low flow that combined with periods of moderate light availability make possible the existence of autotrophic pulses. Whether this might be reflected or not in the stoichoimetry of biofilms and consumers was investigated in two stream reaches, one of them submitted to long-term moderate enrichment. If effects caused by enhanced nutrients are not transient, they should be reflected in the biomass of primary producers and decomposers, as well as in the elemental composition (stoichoimetry) of the elements involved. The study showed that percent P increased from 0.15 to 0.40, while percent N increased from 1.5 to 3.5 as a result of the enrichment. However, the elemental composition of invertebrates (grazers) did not differ between the two reaches, though remarkably changed between periods of the year.

Sakamaki, T., University of British Columbia, Vancouver, Canada, takshi.sakamaki@ubc.ca;
Shum, J., University of British Columbia, Vancouver, Canada;
Richardson, J. S., University of British Columbia, Vancouver, Canada

SEDIMENT PROPERTIES AND FOOD WEBS OF ESTUARINE TIDAL FLATS REFLECT WATERSHED CHARACTERISTICS: A POM-BASED BIOGEOCHEMICAL STUDY IN THE PACIFIC NORTHWEST COAST

In summer 2006 we surveyed 20 estuarine tidal flats of British Columbia and Washington State, and examined how sediment properties and diets of macrobenthos related to watershed characteristics. The $\delta^{13}C$ and C:N analyses of all estuaries suggested that particulate organic matter (POM) of the tidal flat sediments was dominated by one of 3 different origins of POM (marine phytoplankton, riverine algae, terrestrial POM) or a mixture of 2 or all 3 sources. $\delta^{13}C$ and $\delta^{15}N$ of some macrobenthos species was positively related to $\delta^{13}C$ and $\delta^{15}N$ of sediment POM, indicating that in some of the estuaries, river-transported POM contributed to both sediment POM and macrobenthos diets. Except for tidal flats dominated by terrestrial POM, $\delta^{13}C$ of sediment POM was negatively related to river discharge. Thus, river discharge was an important factor controlling the relative importance of marine phytoplankton and riverine algae in the composition of tidal flat sediment POM. Other parameters (e.g. $\delta^{13}C$, $\delta^{15}N$, C:N of river POM, river gradient) were also tested but were unclear in determining the factors causing the dominance of terrestrial POM in sediment POM.

Salmon, S. U., Centre for Water Research, University of Western Australia, Perth, Australia, ursula.salmon@uwa.edu.au;
Hipsey, M. R., Centre for Water Research, University of Western Australia, Perth, Australia, hipsey@Cwr.uwa.edu.au;
Oldham , C. E., School of Environmental Systems Engineering, University of Western Australia, Perth, Australia, carolyn.oldham@uwa.edu.au

QUANTIFYING FEEDBACKS: WATER QUALITY AND SEDIMENT DIAGENESIS

Water quality in surface waters is the integrated result of physical, biological, and geochemical processes in the water column and sediments. In order to investigate the coupling and feedbacks between these components, here we document the development of a coupled model able to simulate the hydrodynamic, biogeochemical and ecological dynamics at high spatial and temporal resolution in both the water column and sediment. Test case studies for the model to date include 1) quantifying the potential for amelioration of acidity by organic carbon - driven alkalinity generation in sediments in a lake impacted by acid mine drainage, and 2) investigating the coupling between Zn toxicity and authochthonous carbon loading on Zn-bearing sediments in a pH-neutral system. Comparison of simulation results and field data are presented, and strategies required for reducing prediction uncertainty, including the potential for assimilation of real-time data streams, are discussed.

Sancho , G., College of Charleston, Charleston, USA, sanchog@cofc.edu;
Moreno, G., AZTI - Tecnalia, Sukarrieta, Spain, gmoreno@pas.azti.es;
Dagorn, L., Institut de Recherche pour le Développement, Sète, France, Laurent.Dagorn@ird.fr;
Garcia, D., AZTI - Tecnalia, Sukarrieta, Spain, dgarcia@pas.azti.es;
Itano, D., University of Hawaii, Pelagic Fisheries Research Program, Honolulu, USA, dgi@hawaii.edu

USE OF LOCAL ECOLOGICAL KNOWLEDGE (LEK) DATA TO EXAMINE TECHNOLOGICALLY ADVANCED FISHERIES: THE CASE OF TROPICAL TUNA PURSE SEINERS

Local ecological knowledge (LEK) held by people directly engaged in the exploitation of natural resources in remote ecosystems is a valuable tool for understanding environmental change, organism distributions and animal behaviors that is seldom utilized by science. We collected and analyzed LEK data from Spanish and French fishing masters of tuna purse seiner vessels in the tropical western Indian Ocean. This is one of the most technologically advanced fisheries in the world, mainly exploiting skipjack, yellowfin and bigeye tuna often through the use of drifting fish aggregating devices (DFADs). While the fleets displayed multiple technological and fishing strategy disparities, few differences were found in the knowledge of tuna behavior accumulated by the fishing masters. LEK data were collected on maximum attraction distances, temporal evolution and composition characteristics of tuna schools associated with DFADs. This information is very useful for designing and planning future projects to study aggregation behaviors of tuna.

Sanders, R. W., Temple University, Philadelphia, USA, robert.sanders@temple.edu;
Sahu, N. N., Temple University, Philadelphia, USA, n.sahu@temple.edu

INTERACTIVE EFFECTS OF UV-B EXPOSURE AND SALINITY STRESS ON POPULATION GROWTH OF A MARINE CILIATE

Heterotrophic protists are critical links in aquatic food webs, grazing algae and bacteria, while being preyed upon by zooplankton and larval fish. Population growth in many protists, including ciliates, is negatively affected by UV-B radiation. Climate change can alter exposure to UV-B and simultaneously modify other environmental factors. For example, variation in rainfall can affect both salinity and the depth that UV penetrates into the water column (via input of UV-absorbing dissolved organic carbon). The effect of additional environmental stressors on protistan populations exposed to UV is not well known. The ciliate *Parauronema* sp., isolated from tropical marine waters, was used as a model organism to elucidate the impact of multiple stressors on a protistan population. Ciliates were adapted stepwise to a range of salinities and then challenged with exposure to UV-B. While both high and low salinity had only a small inhibitory effect on *Parauronema* population dynamics, exposure to UV-B suppressed growth to a greater degree in those treatments relative to treatments at an intermediate salinity.

Santos, L. L., Universidade Estadual de Santa Cruz - Programa de Pós graduação em Sistemas Aquáticos Tropicais, Ilhéus, Brazil, lorena.lacerda@gmail.com;
Martins, P. A., Universidade Federal de Sergipe - Núcleo de Pós-Graduação em Geografia, Aracaju, Brazil, patrick_thomaz@yahoo.com.br;
Couto, E. G., Universidade Estadual de Santa Cruz - Programa de Pós graduação em Sistemas Aquáticos Tropicais, Ilhéus, Brazil, minda@uol.com.br

STRUCTURE OF MANGROVES VEGETATION AND HUMAN IMPACTS ALONG CACHOEIRA RIVER, NORTHERN BRAZIL

The estuary of Cachoeira River is covered by about 1,272 ha of mangroves. The rate of conversion/reclamation of mangrove land to other purposes is very high. These mangroves are also subject to garbage, dumping and receives domestic wastewater. The structural properties of mangrove vegetation were investigated on 13 transects distributed along the16 km long estuarine main channel, using Point-centered-quarter method. Three species were recorded, *Rhizophora mangle*, *Avicennia schaueriana* and *Laguncularia racemosa*. Different vegetation structures were observed along the estuary. In the areas of lower salinities (0 - 6 S) and under greater anthropic influence *L. racemosa* was more abundant, while *R. mangle* assumed greater importance in the mangroves more subject to marine

influence. The mean density (121 ha^{-1}), basal area (between 5 - 30m^2 ha^{-1}) and height (between 8 - 25m) suggest that these mangroves are well developed, although actually areas with mature and juvenile forests were intercalated. The salinity, tidal amplitude and human exploitation seem to be the main responsible for the observed structure in mangrove vegetation.

Sathyendranath, S., Dalhousie University, Halifax, NS, Canada, shubha@dal.ca;
Platt, T., Bedford Institute of Oceanography, Dartmouth, NS, Canada, tplatt@dal.ca

OCEAN COLOUR AS A TOOL FOR DIAGNOSING PHYTOPLANKTON COMMUNITY STRUCTURE FROM SPACE

The dynamics of the marine food web depend on the taxonomic status and the body sizes of the constituent organisms. In the particular case of phytoplankton, cell size varies over more than three decades in linear dimension. The selective contribution to sinking flux varies according to cell size. Moreover, we can recognise several functional types of phytoplankton whose contribution to tropho-dynamics (as well as to ocean bio-geochmestry) is distinctive. Food-web analysis would be well served by taking these differences into account. At large spatial scales, the phytoplankton community can be portrayed as the distribution of chlorophyll concentration using ocean-colour imagery. In this talk we explore how remote sensing can be extended beyond chlorophyll concentration to yield information of broader interest to analysis of the pelagic food web.

Sauchyn, L. K., Dalhousie University, Halifax, Canada, leah.sauchyn@dal.ca;
Scheibling, R. E., Dalhousie University, Halifax, Canada, rescheib@dal.ca

MICROBIAL DECOMPOSITION OF SEA URCHIN FECES: IMPLICATIONS FOR NUTRIENT CYCLING AND ENERGY FLOW IN A ROCKY SUBTIDAL ECOSYSTEM

During destructive grazing events, migrating aggregations (or fronts) of sea urchins (*Strongylocentrotus droebachiensis*) consume large amounts of kelp biomass (1 kg kelp m^{-1} front d^{-1}), converting luxuriant kelp beds into coralline-algae dominated barrens. Most of the ingested kelp is defecated, but the role of urchin fecal production in nutrient cycling and energy flow during the transition between these community states remains unexplored. We monitored microbial decomposition of urchin feces for 19 days at a wave-exposed site on the Atlantic coast of Nova Scotia by quantifying changes in fecal biochemical composition, particle size, and particle settling rate. We observed an initial rapid loss of organic carbon, organic nitrogen, protein, and lipid from feces, followed by a gradual enrichment of nitrogen, protein, and lipid. The average settling rate of all size fractions of feces decreased 57% over 19 days. Measuring rates and patterns of decay is essential in understanding the role of sea urchin feces in local nutrient cycling and as a food source for microbes and metazoans.

Saunders, M. I., Department of Oceanography, Dalhousie University, Halifax, Canada, msaunders@dal.ca;
Metaxas, A., Department of Oceanography, Dalhousie University, Halifax, Canada, metaxas@dal.ca

DISPERSAL OF AN INTRODUCED BRYOZOAN IN ST MARGARETS BAY, NOVA SCOTIA

For non-native species, determining patterns of larval dispersal can provide insights towards population dynamics, connectivity and expansion rates. In Nova Scotia, the recently introduced epiphytic bryozoan *Membranipora membranacea* causes defoliation of kelp beds and facilitates invasion of other benthic species. In this study, we combine a hydrodynamic model with observed larval distributions to recreate probable larval dispersal pathways of *M. membranacea*. We quantitatively sampled larvae at each of 2 depths (4, 12 m), at 8 stations within and outside St Margarets Bay, Nova Scotia. Physical properties of the water column were measured using CTD casts and a moored ADCP. We sampled from August to November 2007, when water temperature ranged from 6 to 17°C, and density structure in the water column alternated between well-mixed and stratified. Size distributions and abundance of larvae were compared among locations (stations, depths) and dates (with varying oceanographic conditions). Passive particles representing sampled *M. membranacea* larvae will be seeded into a 3D physical circulation model of the bay (and surrounding open coast) during the estimated larval period, to hindcast probable larval trajectories.

Saunders, P. A., Ashland University, Ashland, USA, psaunder@ashland.edu;
Yost, J., Ashland University, Ashland, USA;
Frank, A., Ashland University, Ashland, USA

SEASONAL DIFFERENCES IN DIEL HORIZONTAL MIGRATION BEHAVIOR OF ZOOPLANKTON IN A EUTROPHIC KETTLE LAKE (SITES LAKE, OH)

Sites Lake, OH (40oN, 82oW) is a small, deep kettle lake (2.6 ha, Zmax > 11 m) with littoral areas ~20-30% of the open water area. The lake is eutrophic, and the hypolimnion grows anoxic relatively early in the growing season. We have been investigating the possibility that pelagic zooplankton use littoral areas as predation refugia. This hypothesis has been suggested by other researchers who found evidence for diel horizontal migration (DHM) by zooplankton of shallow, unstratified lakes with relatively abundant aquatic macrophytes. Those studies observed DHM instead of the more typical predator-avoidance behavior of diel vertical migration (DVM). Previous studies in Sites Lake found strong support for DHM during fall (Sep-Oct) by Daphnia parvula; but no evidence for DVM by crustacean zooplankton. Larger Daphnia (0.5-1.1 mm) accounted for a majority of the nighttime increase in population size. This study focused on the spring Daphnia population. We used net-tow samples to compare mid-day and mid-night abundances. Data so far suggest that, unlike fall populations, spring Daphnia are not migrating horizontally in spring. Overall, work to date on Sites Lake shows differences in migration behavior among species and within species that are consistent with the predation refugia hypothesis. These results also support the hypothesis that seasonal onset of DHM behavior is related to the development of anoxic depths, which could explain why DHM is observed in a lake that stratifies.

Saville, A. G., Kutztown University, Kutztown, USA, asavi393@kutztown.edu;
Goodman, E. M., Kutztown University, Kutztown, USA, egood804@kutztown.edu;
Shappell, K. P., Kutztown University, Kutztown, USA, kshap860@kutztown.edu;
Thomas, D. R., Kutztown University, Kutztown, USA, dthom587@kutztown.edu;
Butler, N. M., Kutztown University, Kutztown, USA, butler@kutztown.edu;
Ambler, J. W., Millersville University, Millersville, USA, julie.ambler@millersville.edu

INTRA- AND INTERANNUAL VARIATION IN COMPOSITION OF COASTAL ZOOPLANKTON OF CHINCOTEAGUE, VA.

Temporal and spatial variations in physical and chemical parameters such as ocean circulation patterns, water temperature, and nutrient levels have a strong influence on zooplankton community composition, distribution, and abundance. This study investigated seasonal and spatial variation in the zooplankton communities along the coast of eastern Virginia. Zooplankton were sampled during the period of December 2005 through July 2007 at five stations along a transect that extended from nearshore to approximately 16 nm offshore. At each station, samples were collected either by integrated vertical plankton tows or, when possible, at discrete depth intervals to determine vertical distribution patterns. Analysis of the samples revealed a distinct pattern of variation between seasons (winter vs. summer) and between years (winter 2005-2006 vs. winter 2006-2007) in terms of horizontal (among stations) and vertical (among depths) distribution. There was also a relationship between these patterns and water temperature, salinity, and chlorophyll. The implications of these findings with respect to anthropogenic influences on coastal water bodies will also be discussed.

Scarratt, M. G., Fisheries and Oceans Canada, Mont-Joli, Canada, Michael.Scarratt@dfo-mpo.gc.ca;
Michaud, S., Fisheries and Oceans Canada, Mont-Joli, Canada, Sonia.Michaud@dfo-mpo.gc.ca;
Luce, M., Université Laval, Quebec, Canada, myriam.luce.1@ulaval.ca;
Royer, S. J., Université Laval, Quebec, Canada, sarah-jeanne.royer.1@ulaval.ca;
Levasseur, M., Université Laval, Quebec, Canada, maurice.levasseur@bio.ulaval.ca

MARINE BIOGENIC NITROUS OXIDE IN THE CANADIAN ARCTIC ARCHIPELAGO

The Arctic environment is currently undergoing significant long-term changes including an increase in average temperatures and a progressive loss of sea-ice cover, especially in the summer. The Arctic SOLAS (Surface Ocean Lower Atmosphere Study) project, a component of the International

Polar Year, is currently investigating biogenic trace gas dynamics and sea-air fluxes in Arctic waters in order to elucidate the effects of changing oceanographic conditions on regional and global climate. Nitrous oxide (N2O) is a biogenic greenhouse gas produced by microbial action in the water column. Its production is intimately linked to nitrogen cycling, where it is an intermediate in both nitrification and denitrification processes. Few data presently exist for N2O in polar waters. We measured the vertical distribution of N2O in water column profiles at 26 stations extending from northern Baffin Bay to the Beaufort Sea. The relationship of N2O to nutrient and oxygen distributions, bacterioplankton abundance, primary production and other oceanographic variables will be explored, and the relevance of Arctic waters as a source of N2O to the atmosphere will be evaluated.

Scavia, D., University of Michigan, Ann Arbor, USA, scavia@umich.edu;
Donnelly, K. A., University of Michigan, Ann Arbor, USA, tinadon@umich.edu

REASSESSING HYPOXIA IN THE NORTHERN GULF OF MEXICO

Gulf of Mexico hypoxia has received considerable scientific and policy attention because of its potential ecological and economic impacts and implications for agriculture within its massive watershed. A 2000 assessment concluded that increased nitrate load to the Gulf was the primary cause of increased hypoxia since the 1950s. More recently, models have suggested that large-scale hypoxia did not start until the mid-1970s, and that a 40-45% nitrogen load reduction may be needed to reach the hypoxia area goal of the Hypoxia Action Plan. Recently, USGS revised nutrient load estimates to the Gulf, and the Action Plan reassessment has questioned the role of phosphorus versus nitrogen in controlling hypoxia. In this paper, we re-evaluate model simulations, hindcasts, and forecasts using revised nitrogen loads, and test the ability of a phosphorus-driven version of the model to reproduce hypoxia trends. Our analysis suggests that, if phosphorus is limiting now, it became so because of relative increases in nitrogen loads during the 1970s and 1980s. While our model suggests nitrogen load reductions of 37-45% or phosphorus load reductions of 40-50% below the 1980-1996 average are needed, we caution that a phosphorus-only strategy is potentially dangerous, and suggest it would be prudent to reduce both.

Schattenhofer, M., Max Planck Institute for Marine Microbiology, Bremen, Germany, mschatte@mpi-bremen.de;
Fuchs, B. M., Max Planck Institute for Marine Microbiology, Bremen, Germany, bfuchs@mpi-bremen.de;
Amann, M., Max Planck Institute for Marine Microbiology, Bremen, Germany, ramann@mpi-bremen.de;
Zubkov, M. V., National Oceanography Centre, Southampton, United Kingdom, mvz@noc.soton.ac.uk;
Tarran, G., Plymouth Marine Laboratory, Plymouth, United Kingdom, g.tarran@pml.ac.uk;
Pernthaler, J., Limnologisches Institut, Universität Zürich, Kilchberg, Switzerland, pernthaler@limnol.unizh.ch

QUANTIFICATION OF MAJOR BACTERIOPLANKTON GROUPS ALONG A TRANSECT IN THE ATLANTIC OCEAN

Numerous studies have shown that the marine bacterioplankton consists of 10 major phylogenetic groups. These findings are based mainly on clone libraries or on fingerprinting methods and are therefore largely based on the estimation of band intensities or clone frequencies. An accurate quantification of these 10 major phyla *in situ* was until recently not possible due to methodological limitations of the fluorescence in situ hybridization techniques (FISH). With the improvement of FISH with enzyme labelled oligonucleotide probes and catalyzed reporter deposition (CARD-FISH) and the development of an automated counting system, large scale studies with several thousand samples become feasible. Here we present data obtained during the Atlantic Meridional Transect cruise 16 (AMT 16) spanning 14700 kilometers from Cape Town, South Africa to Falmouth, UK. More than 60 stations were examined with oligonucleotide probes specific for 13 different marine bacterial and archaeal groups resulting in more than 3600 individual samples. The high resolution analysis clearly showed a high horizontal and vertical variability of individual marine bacterioplankton groups across the entire Atlantic Ocean and a preference of major phylogenetic groups for certain oceanic provinces.

Scheibling, R. E., , Halifax, Canada, rescheib@dal.ca;
Gagnon, P., Dalhousie University, Halifax, Canada, pgagnon@mun.ca

FLUCTUATIONS IN ABUNDANCE OF AN INVASIVE BRYOZOAN (MEMBRANIPORA MEMBRANACEA) IN KELP BEDS: ENVIRONMENTAL MEDIATION AND CONSEQUENCES FOR ECOSYSTEM DYNAMICS

The encrusting bryozoan *Membranipora membranacea* has become the dominant epibiont on laminarian kelps following its introduction to the NW Atlantic in the late 1980s. In Nova Scotia, the bryozoan has spread along the entire Atlantic coast since it was first reported near Halifax in 1992. Rapid growth of *M. membranacea* in summer can have devastating effects on kelp canopies, rendering fronds more susceptible to breakage and erosion as wave action increases in fall and winter. Recurrent defoliation of kelp canopies has facilitated the establishment of an invasive green alga *Codium fragile* ssp. *tomentosoides*, which can inhibit recolonization by kelp and other native seaweeds. We document large, seasonal and interannual fluctuations in the cover of *M. membranacea* and kelps (*Saccharina longicruris, Laminaria digitata*) at a site where *C. fragile* progressively displaced kelp between 1992 and 2002. We relate reciprocal patterns in the abundance of *M. membranacea* and kelp to variations in inshore seawater temperature and wave height, which interact to determine rates of colony growth and kelp frond loss, and hence the transition from native to invasive algal communities.

Schiaffino, M. R., EGE-FCEN-UBA (Universidad de Buenos Aires), Buenos Aires, Argentina, rominaschiaffino@ege.fcen.uba.ar;
Unrein, F., IIB-INTECH (Instituto de Investigaciones Biotecnológicas - Instituto Tec. de Chascomùs) & CONICET , Buenos Aires, Argentina;
Massana, R., Departament de Biologia Marina i Oceanografia, Institut de Ciències del Mar-CMIMA, CSIC, Barcelona, Spain;
Gasol, J. M., Departament de Biologia Marina i Oceanografia, Institut de Ciències del Mar-CMIMA, CSIC, Barcelona, Spain;
Farias, M. E., PROIMI (Planta Piloto de Procesos Industriales Microbiológicos) & CONICET, Tucumán, Argentina;
Estevez, C., PROIMI (Planta Piloto de Procesos Industriales Microbiológicos) , Tucumán, Argentina;
Balagué, V., Departament de Biologia Marina i Oceanografia, Institut de Ciències del Mar-CMIMA, CSIC, Barcelona, Spain;
Izaguirre, I., EGE-FCEN-UBA & CONICET (Consejo Nacional de Investigación Científica y Técnica) , Buenos Aires, Argentina, iri@ege.fcen.uba.ar

BACTERIOPLANKTON ASSEMBLAGES IN MARITIME ANTARCTIC FRESHWATER LAKES, AS DETERMINED BY DENATURING GRADIENT GEL ELECTROPHORESIS (DGGE)

Bacterioplankton assemblages of freshwater lakes with contrasting trophic status located in two regions of Maritime Antarctica (Hope Bay -Antarctic Peninsula- and King George Island) were analysed by means of the fingerprinting technique DGGE. The lakes were sampled during two austral summers (2003-2004). At least four bands that were shared among lakes from Hope Bay were also found in lakes from Potter Peninsula. However, six bands appeared exclusively in specific lakes, which seems to be related to the local conditions and to the lake trophic status. Four bands were found only in three connected oligotrophic lakes from Hope Bay. Among the bands successfully sequenced (45 out of 36 positions), the best represented bacterial group in all lakes was Cytophaga-Flavobacterium-Bacteroidetes (48 %), followed by Actinobacteria (30 %), beta-Proteobacteria (15 %) and Cyanobacteria (7 %). Interestingly, many of the sequences showed high similarity with psychrophilic and psychrotolerant bacteria collected in GenBank, which suggests bacterial assemblages well adapted to low-temperature aquatic systems and glaciers, not only from different areas of Antarctica but also from elsewhere in the world.

Schmidt, A. L., Dalhousie University, Department of Biology, Halifax, Canada, aschmidt@dal.ca;
Lotze, H. K., Dalhousie University, Department of Biology, Halifax, Canada, hlotze@dal.ca

COMPARING ECOSYSTEM STRUCTURE AND SERVICES BETWEEN TWO COASTAL VEGETATED HABITATS IN NOVA SCOTIA

Coastal ecosystems are among those providing the most goods and services that satisfy human needs. However, the relative importance of

different coastal habitats in providing regulating and supporting services remains unclear. Here, we examine spatial patterns in structure (species composition, abundance and diversity) and regulating (carbon and nitrogen storage) and supporting (habitat/nursery provision) services within and among beds of two common canopy forming species, rockweed (*Ascophyllum nodosum*) and eelgrass (*Zostera marina*). In September 2006, we investigated four rockweed and three eelgrass beds along the Eastern Shore of Nova Scotia. Data were collected using visual dive surveys for large mobile macrofauna and quadrate-sampling for small, slow moving and sessile species and canopy characteristics (cover, density and height) along 3 transects located inside, along the edge and outside the vegetated areas. Carbon and nitrogen storage capacity was determined using algal and plant tissue. So far, our analyses revealed higher species abundance and richness within canopies, with total richness being higher in rockweed than seagrass, and nitrogen storage being higher in seagrass tissue.

Schubert, C. J., Eawag, Kastanienbaum, Switzerland, carsten.schubert@eawag.ch;
Lucas, F., Eawag, Kastanienbaum, Switzerland;
Durisch-Kaiser, E., ETH, Zuerich, Switzerland, edith.durisch-kaiser@env.ethz.ch;
Diem, T., Eawag, Kastanienbaum, Switzerland, Torsten.diem@eawag.ch;
Mueller, B., Eawag, Kastanienbaum, Switzerland, beat.mueller@eawag.ch

METHANE PRODUCTION, OXIDATION, AND EMISSION FROM THE WATER COLUMN OF LAKE ROTSEE, SWITZERLAND

Lake Rotsee is a eutrophic lake with high methane concentration below the oxycline due to methanogenesis in the sediments. We have monitored the lake over a one year period in which we could follow the methane cycle from turn-over to strongly stratified conditions. High methane concentrations (up to 1mM) were detected in fall and early winter. Beside the production of methane we have also studied the aerobic and anaerobic methane over several years in the anoxic water layer. Methane oxidation rates were highest in the interface between oxic and anoxic water layers around 8-10 m depth. The profile of carbon isotopic composition of methane showed strong indications for methane oxidation at the same depth. Anaerobic methane oxidizers ANME-1 and ANME-2 and aerobic methane oxidizing bacteria (MOB) were detected at the interface and are responsible for the loss of methane. An estimation of methane emissions to the atmosphere showed an average flux of 6.7 mg/m2/d.

Schultes, S. G., University of Sao Paulo, Sao Paulo, Brazil, sabine@io.usp.br;
Lopes, R. M., University of Sao Paulo, Sao Paulo, Brazil, rubens@usp.br

ZOOPLANKTON DISTRIBUTION AND COMMUNITY COMPOSITION IN TROPICAL AND SUBTROPICAL BRAZIL DETERMINED BY THE LASER OPTICAL PLANKTON COUNTER (LOPC) AND THE ZOOSCAN

The LOPC and the Zooscan system provide new tools to study zooplankton distribution and community structure with high temporal and spatial resolution. Highly diverse zooplankton assemblages sampled at 56 stations in coastal and offshore waters between 15 and 22 degrees South in austral winter 2007, and in monthly intervals on a coastal monitoring station, allow a calibration of results from both instruments. Mounted inside a 200 µm ring net, the LOPC was towed vertically through the upper 20 to 200 m of the water column. Limitations of the LOPC due to coincidence counting were only encountered at 4 of the 56 stations, all situated in highly turbid onshore waters. Integrated zooplankton biomass estimated with the LOPC ranged from 2.4 to 85.2 g WW m-2 and correlated significantly with plankton biovolume caught in the net for particles > 500 µm ESD. High biomass estimates for small particles (100 to 350 µm ESD) over Abrolhos Bank indicate the presence of suspended particulate matter of non-zooplankton origin and requires correction of LOPC biomass estimates based on biomass size spectra acquired with the Zooscan.

Schulz, K. L., SUNY College of Environmental Science and Forestry, Syracuse, USA, kschulz@syr.edu;
Teece, M. A., SUNY College of Environmental Science and Forestry, Syracuse, USA, mteece@esf.edu

CAN FATTY ACID COMPOSITION BE USED TO DETERMINE DIET? RECOMMENDATIONS IN LIGHT OF PHYLOGENETIC CONSTRAINTS

Fatty acids have long been considered promising trophic markers in aquatic systems, and there are a number of examples of successful uses of fatty acid markers to distinguish between bacterial and algal food sources, or between aquatic and terrestrial-derived carbon. Many researchers have expressed hope that fatty acid composition can be used in a more quantitative fashion to estimate long-term diet, similar to stable isotope composition. Here we review the qualitative and quantitative potentials and limitations of using fatty acid composition for diet analysis. First, we summarize known qualitative markers. Second, we evaluate and compare statistical techniques from various disciplines in terms of their ability to make fatty acid diet composition more quantitative. Finally, we will discuss limitations, corrections and methodological advances needed when using fatty acids in diet analysis, in light of a number of recent studies suggesting that many zooplankton are phylogenetically constrained in the degree to which their fatty acid composition changes, even with strong shifts in diet.

Seebens, H., University of Konstanz, Konstanz, Germany, hanno.seebens@uni-konstanz.de;
Einsle, U., Institute for Lake Research, Langenargen, Germany;
Straile, D., University of Konstanz, Konstanz, Germany

GHOST OF LIFE CYCLE DIFFERENTIATION PAST' DETERMINED THE RESPONSE TO OLIGOTROPHICATION IN FRESHWATER COPEPODS

In former studies, it was assumed that copepods responded species-specific to oligotrophication due to interspecific interactions and their ecological requirements. Copepods have a complex life cycle with species-specific periods of diapause which was usually not considered in former studies. We investigated a long-term data set (1970-1995) of copepods in Lake Constance with a high ontogenetic and temporal resolution in order to analyze the role of seasonality and life cycle in the copepod's response to oligotrophication. The four dominating species mainly differed in the presence and timing of diapause which resulted in a seasonally varying assemblage of active copepods in the water column. Nevertheless, we found a consistent pattern of season-specific long-term changes in abundances among species, i.e. abundances increased during summer and decreased in spring. This pattern was due to oligotrophication-related and season-specific changes of invertebrate predation affecting all species similarly. Since the seasonality of the copepods varies among species, the consequence of oligotrophication for the maintenance of their population depended on the season when species were non-diapausing, i.e. on the 'ghost of life cycle differentiation past'.

Seiden, J. M., Memorial University, St. John's, Canada, jennicas@hotmail.com;
Way, C., Memorial University, St. John's, Canada, cjway@mun.ca;
Rivkin, R., Memorial University, St. John's, Canada, rrivkin@mun.ca

BACTERIA AS AN INVASIVE SPECIES: BACTERIAL DYNAMICS IN BALLAST WATER DURING TRANS-PACIFIC VOYAGES OF BULK CARRIERS

Bacterial abundance and growth rates were determined in ballast water during trans-Pacific voyages from Japan to the west coast of Canada. Samples were collected from four ballast tanks, two of which underwent mid-ocean exchange (MOE). Bacterial abundances in the unexchanged tanks increased from ~4.6 Ãƒâ€" 108 cells/L to 1.8 Ãƒâ€" 109 cells/L (day 9), while in MOE tanks, abundances increased from ~8.6 Ãƒâ€" 108 cells/L to 2.2 Ãƒâ€" 109 cells/L (day 9) before MOE (day 12); all were followed by a decline. The average net growth rates for unexchanged and MOE tanks were 0.22 d-1 (0.02 to 0.92 d-1) and 0.10 d-1 (0.02 to 0.21 d-1), respectively. Despite different patterns of bacterial growth in the tanks, final abundances were not significantly different. Environmental factors affecting abundances were temperature and dissolved oxygen; the relationship between abundance and temperature was direct ($P < 0.001$) and with dissolved oxygen concentrations it was inverse ($P < 0.001$). Maintaining ballast tanks at lower temperatures and higher dissolved oxygen concentrations could be a strategy for controlling the introduction of invasive heterotrophic microbes.

Semyalo, R. P., University of Bergen, Bergen, Norway, ronald.semyalo@bio.uib.no

EFFECTS OF CELL BOUND MICROCYSTINS ON THE GROWTH AND SURVIVAL OF DAPHNIA LUMHOLTZI

This study investigated the effects of cell bound microcystins on the life history characteristics of *Daphnia lumholtzi*. To achieve this we conducted a series of experiments in a flow through system with the microcystins Ã¢â‚¬Å“producing *Microcystis aeruginosa* strain PCC7806 and its microcystins deficient mutant. A high quality green alga *Scenedesmus acutus* was used in mixtures with the *Microcystis* to overcome nutritional deficiency. Our results indicate that both variants of the *Microcystis* strain have a growth inhibiting and toxic effect on *D. lumholtzi* and that these toxic effects may be explained by other factors other than microcystins.

Sereda, J. M., University of Saskatchewan, Saskatoon, Canada, jeff.sereda@usask.ca;
Hudson, J. J., University of Saskatchewan, Saskatoon, Canada, jeff.hudson@usask.ca;
Taylor, W. D., University of Waterloo, Waterloo, Canada, wdtaylor@sciborg.uwaterloo.ca

EFFECTS OF ULTRAVIOLET RADIATION ON PHOSPHORUS KINETICS IN LAKES

Our study aimed to assess the impacts of ultraviolet radiation (UVR) exposure on phosphate availability and kinetics within lake planktonic communities. Studies were conducted on three thermally stratified Canadian shield lakes: Muskoka, Brandy, and Plastic. Study lakes were selected to encompass a range of chemical parameters (DOC, TP, pH, Fe) that have been shown to influence aquatic photochemistry. Photochemical changes of UVR exposed lake filtrate (<0.2 Ãƒ Æ'Ã¢â‚¬Å¡Ã¡Ãƒâ€šÂµm) resulted in increased 33P043- turnover times when added back to whole water (Lake Muskoka) relative to controls. However, UV exposed lake filtrate from Brandy and Plastic L. did not have a similar effect. UVR exposed whole water samples from Lake Muskoka and Brandy L. displayed reduced 33P043- turnover times relative to controls. Although photochemical changes were observed in the dissolved organic carbon (DOC) in UVR exposed treatments, these changes did not appear to correspond to increased P bioavailability in these lakes. Our results show that P kinetics in lakes may be influenced through photochemical changes in water chemistry, as well as through direct impacts on planktonic organisms.

Sherk, T. E., University of Washington alumnus, Branford, USA, tsherk@gmail.com

EMERGENCE OF *CHAOBORUS* (DIPTERA: CHAOBORIDAE) FROM SUBALPINE FINDLEY LAKE DURING WARM AND COLD YEARS

Chaoborus were collected in floating emergence traps at Findley Lake in the coniferous forest of the Cascade Mountains from 1972 to 1975. There was considerable yearly variation in the date of the thaw and of the maximum surface temperature. There was a large emergence of *Chaoborus trivittatus* each year which peaked only nine to thirteen days after the entire lake had thawed when the surface temperature was only 10 to 12.5 degrees C. In the cold year of 1974 when there was a maximum surface temperature of only 12.5 degrees C, the early-emerging *C. trivittatus* were the only *Chaoborus* that emerged. They had their maximum emergence from the 1.8 to 4.5 m deep sites that thawed first. In other years the maximum emergence was from the deeper sites and the minimum emergence was from the shallow sites that had the longest horizontal distance from the deeper water. In the warm years when there was a maximum surface temperature of 17.4 to 21.0 degrees C, there was also a small emergence of other *Chaoborus* during August.

Sherwood, G. D., Gulf of Maine Research Institute, Portland, USA, gsherwood@gmri.org;
Rose, G. A., Memorial University, St. John's, Canada, george.rose@mi.mun.ca;
Rasmussen, J. B., University of Lethbridge, Lethbridge, Canada, joseph.rasmussen@uleth.ca

SIZE-SCALING ANOMALIES IN PREDATORY FISH AS INDICATORS OF UNEVEN PREY-SIZE SPECTRA IN AQUATIC FOOD WEBS

Scaling coefficients (b-values) from length-weight relationships (LWR) in fish are normally considered to be species- and population-specific, and rarely are there attempts to explain residual variations in this power function. Here, we provide examples from marine and freshwater systems of variable b-values (among populations and size classes) and residuals (from the LWR) in two species of predatory fish (yellow perch and Atlantic cod) that correspond to the presence/absence of important feeding stages (determined by diet and stable isotope analyses). These fish, that normally undergo ontogenetic diet shifts towards larger prey, can maintain high b-values over their entire growth by having access to a diverse prey base. Conversely, 'holes' in the prey-size spectrum can lead to significant dips (localized negative residuals) in the LWR visualized clearly when condition factor (W/L^b) is plotted against length. Our results suggest that ontogenetic variations in condition factor of fish that normally undergo frequent diet shifts (to larger prey) may be a convenient and powerful way to track changes in prey communities that can be followed up with more detailed studies of prey availability and utilization.

Sherwood, O. A., Biology Dept., Memorial University of Newfoundland, St. John's, Canada, osherwood@gmail.com;
Edinger, E. N., Biology and Geography Depts., Memorial University of Newfoundland, St. John's, Canada, eedinger@mun.ca

AGES AND GROWTH RATES OF SOME DEEP-SEA CORALS OF NEWFOUNDLAND AND LABRADOR

Deep-sea gorgonian and antipatharian corals derive their organic endoskeletons from recently fixed and exported particulate organic matter, allowing them to be dated using the bomb-radiocarbon method. Radiocarbon measurements were used to calculate lifespans and growth rates of 6 species of deep-sea corals collected from the continental slope of Newfoundland and Labrador, between 400 and 900 m in depth. Bamboo corals (*Acanella arbuscula, Keratoisis ornata*) and antipatharians (*Bathypathes arctica*) secrete concentric growth rings in their axial skeletons, which proved to form annually. These species had the lowest radial growth rates of 0.04 to 0.07 mm/yr. *Primnoa resedaeformis*, *Paramuricea* spp. and *Paragorgia arborea* had higher radial growth rates of 0.09 to 0.2 mm/yr. Vertical growth rates ranged from 0.9 to 2.6 cm/yr. Lifespans ranged from 40 years for live-collected *P. resedaeformis* and *A. arbuscula* up to 270 years for a subfossil specimen of *K. ornat*a. Since all of the corals were from heavily fished areas, it is likely that age distributions are biased towards smaller and younger colonies. Recovery of deep-sea corals from fishing-induced damage will take decades to centuries.

Shimizu, K., Centre for Water Research, University of Western Australia, Perth, Australia, shimizu@cwr.uwa.edu.au;
Imberger, J., Centre for Water Research, University of Western Australia, Perth, Australia

ESTIMATING NEAR-BOTTOM CURRENT VELOCITY AND MASS TRANSFER COEFFICIENTS FROM THERMISTOR CHAIN DATA

In stratified lakes, near-bottom currents are primarily induced by internal waves. In this study, we estimated near-bottom current velocity by fitting numerically calculated internal wave modes to temperature data collected with thermistor chains distributed throughout Lake Kinneret. The results not only gave the damping rates and amplitudes, but also provided estimates of the velocity field over the lake, because each internal wave had a distinct modal structure. The estimated near-bottom velocity field was used to estimate the variability of the bottom stress, entrainment rate at the top of the boundary layer, and mass transfer coefficient at the sediment-water interface. Sensitivity of the estimates to number of thermistor chains and their locations was also assessed.

Short, C. M., University of Toronto Mississauga, Oakville, Canada, cindy.short@utoronto.ca;
Short, S. M., University of Toronto Mississauga, Mississauga, Canada, steven.short@utoronto.ca

MONITORING THE SEASONAL DYNAMICS OF INDIVIDUAL PHYCODNAVIRUSES USING QUANTITATIVE PCR

To determine if freshwater algal viruses differ with respect to their seasonal dynamics, the weekly abundances of three phycodnaviruses from Lake Ontario, Canada were monitored for several months. Initially, individual phycodnavirus DNA polymerase gene sequences from Lake Ontario clone

libraries were selected as targets for quantitative PCR assays. Before the sequence abundances of natural samples were estimated, primer and probe efficacy was validated. The amplification efficiency of each primer set was determined using a dilution series of cloned target genes, and primer and probe specificity was examined using the most closely related sequence found in the Lake Ontario clone libraries. Following these validation studies, quantitative PCR revealed that the temporal dynamics of the targeted phycodnavirus phylotypes differed. For example, the abundance of two phylotypes remained fairly stable over several months, while a third phylotype was more ephemeral. Our results show that closely related freshwater algal viruses can differ markedly in their seasonal dynamics, and suggest that the viruses that were the source of the target sequences infect organisms that also vary with respect to their seasonal dynamics.

Short, S. M., University of Toronto Mississauga, Mississauga, Canada, steven.short@utoronto.ca;
Short, C. M., University of Toronto Mississauga, Mississauga, Canada, cindy.short@utoronto.ca

THE SPECIES RICHNESS AND DYNAMICS OF FRESHWATER ALGAL VIRUSES

The genetic diversity of freshwater algal viruses (phycodnaviruses) was studied using a PCR method that targets a diverse subset of phycodnavirus DNA polymerase genes. Numerous gene sequences were obtained from a river and mesotrophic reservoir in Colorado, USA, and from a small meromictic lake and Lake Ontario in Ontario, Canada. Rarefaction analysis of the clone libraries demonstrated that sequence richness varied between different locations, and between samples from the same location collected on different dates. Phylogenetic analysis of unique sequences revealed that, for the most part, sequences originating from the same geographic region clustered together, and the freshwater sequences obtained during this study were more closely related to sequences from cultivated marine phycodnaviruses compared to those from cultivated freshwater phycodnaviruses. Thus, the freshwater phycodnavirus sequences obtained during this study are not genetically distinct from sequences originating from marine viruses. To utilize the clone library further and initiate studies of algal virus dynamics and autecology, sequences obtained during this study were used to develop quantitative PCR methods for monitoring the abundance of individual phycodnavirus phylotypes.

SIGEE, D. C., MANCHESTER UNIVERSITY, MANCHESTER, United Kingdom, david.sigee@manchester.ac.uk;
DEAN, A. P., MANCHESTER UNIVERSITY, MANCHESTER, United Kingdom, andrew.dean@manchester.ac.uk

MOLECULAR CHARACTERISATION OF FRESHWATER PHYTOPLANKTON USING FOURIER-TRANSFORM INFRARED (FTIR) MICROSPECTROSCOPY

Synchrotron-based FTIR microscpectroscopy has been used to characterise the molecular composition of freshwater phytoplankton sampled from a stratified eutrophic lake. Data from environmental samples have been used to study: (1) Intra-specific variation: looking at molecular variation within micropopulations of individual algal species. FTIR spectra from Pediastrum duplex (air-dried phytoplankton samples) had 12 distinct absorption bands, derived from a range vibrationally-active groups. The frequency distribution for individual bands demonstrated considerable molecular heterogeneity within the algal micro-population. Principal component analysis (PCA) indicated two major groupings of FTIR bands, indicating multi-factor control of molecular composition. (2) Inter-specific variation: FTIR analysis has since been used for molecular differentiation of co-dominant algae (Anabaena/Aphanizomenon; Microcystis/Ceratium) in two separate mixed phytoplankton samples Ã¢â‚â€œ using PCA followed by scores and loading plots. (3) Effect of changes in environmental parameters such as light intensity (depth within water column) and phosphorus availability (seasonal depletion) on molecular composition. Preliminary FTIR/X-ray microanalysis combined studies on laboratory-cultured cells showed that a decrease in internal P concentration (P quota) below 0.1% dry weight triggered a switch in carbon allocation from proteins to carbohydrates and lipids.

Siitonen, S., University of Helsinki, Helsinki, Finland, susanna.siitonen@helsinki.fi;
Korhola, A., University of Helsinki, Helsinki, Finland, atte.korhola@helsinki.fi

CLADOCERAN REMAINS AS INDICATORS OF RECENT CHANGES IN NW FINNISH LAPLAND

Cladoceran remains from sediment cores of two subarctic lakes, VallijÃ¤rvi and Somas, situated in NW Finnish Lapland, were studied in order to find out whether cladoceran populations have responded to known climatic fluctuations in the last c. 400 years. In turn of the 20th century both of the lakes show a distinct interface were the composition of species change; accumulation of cladoceran remains increased as a whole and planktonic species outrun the littoral ones indicating an increase in the production of these lakes during the 20th century. The share of Eubosmina ephippial carapaces drops in both lakes in the 20th century from an average 15% in Somas and from an average 12% in VallijÃ¤rvi to current 5% in both lakes showing dependency to temperatures. Differences in the location, morphology and history of the lakes appear to have affected to the intensity of occurred biological and sedimentological changes.

Simcic, T., National Institute of Biology, Ljubljana, Slovenia, tatjana.simcic@nib.si;
Brancelj, A., National Institute of Biology, Ljubljana, Slovenia, anton.brancelj@nib.si

ECOSYSTEM HEALTH INDEX (EHI) AND POTENTIAL ORGANIC MATTER DEGRADATION IN PLANKTON AND SEDIMENT AS AN ESTIMATOR OF LAKE TROPHIC STATE

Respiratory electron transport system (ETS) activity in plankton and sediment communities and ecosystem health index (EHI) were determined in two Slovenian lakes of different trophic levels. EHI calculated for Lake Bled and Lake Bohinj corresponded to health state “Middle” and “Good”, respectively. The negative correlations that were found between EHI and ETS activity of zooplankton, sediment and total ETS activity indicated increasing ETS activity of zooplankton, sediment and total ETS activity with increasing trophic level of a lake. A positive correlation between EHI and the ratio of ETS activity between plankton and sediment showed greater increase of ETS activity of sediment compared to plankton with eutrophication. ETS activity of different communities in a lake could be used as an estimator for trophic state in a lake ecosystem. The low seasonal variation of metabolic potential in sediment and its importance in organic matter degradation and recycling of nutrients in the lakes gives an advantage to measurement of biological oxidation capacity of sediments when monitoring of the changes in an ecosystem is performed.

Skoog, A., University of Connecticut, Groton, USA, annelie.skoog@uconn.edu;
Arias-Esquivel, V. A., University of Connecticut, Groton, USA, victor.arias@uconn.edu

THE EFFECT OF INDUCED SEDIMENT-SURFACE REDOX CONDITIONS ON FLUXES OF ORGANIC MATTER AND NUTRIENTS OVER THE SEDIMENT-WATER INTERFACE OF COASTAL SEDIMENTS.

As the first study, we determined the effect of inducing anoxia and restoring oxic conditions on fluxes of DOC, inorganic, and organic N-containing compounds in a laboratory incubation of Long Island Sound surface sediment. DOC, DON, NH4+, and urea fluxes increased at onset of anoxia in oxygen-depleted treatments. Restoring oxic conditions decreased DOC and POC concentrations, but had no effect on DON, urea, or NH4+ concentrations. The DOM C:N ratio decreased with time in both treatments, but decreased the most in the oxygen-depleted treatments The TN-flux was larger in the oxygen-depleted treatment than in the control. DON was a larger fraction of the benthic TN flux in the control than in the oxygen-depleted treatment. Anoxic conditions increased N and DOM concentrations in the overlying water. Hence, seasonal anoxia may cause a positive feedback loop in coastal areas.

Sliko, C. A., Rider University, Lawrenceville, USA, sliko@rider.edu;
Zabrocky, S. F., Rider University, Lawrenceville, USA, zabrocky@rider.edu;
Smalley, G. W., Rider University, Lawrenceville, USA, gsmalley@rider.edu

TWO STRAINS OF THE MIXOTROPHIC DINOFLAGELLATE *PROROCENTRUM MINIMUM* DIFFER IN THEIR ABILITY TO UTILIZE ORGANIC PHOSPHORUS FOR GROWTH

Many mixotrophic dinoflagellates employ alternative nutritional strategies when inorganic nutrients become limiting. We investigated the relationship between nutrient stress, organic phosphorus (P) uptake as evidenced by alkaline phosphatase (AP) activity, and growth rate in two strains of the mixotrophic dinoflagellate *Prorocentrum minimum*. *P. minimum* was grown under various nutrient conditions. Cell numbers, AP activity, and cellular P content were determined. Both strains exhibited a similar level of P stress when grown under P-limiting conditions, as evidenced by their similar internal P contents. However, while one strain showed high AP activity in response to P-limitation, AP activity in the other strain remained low throughout the experiment. When organic P was provided, only the strain showing high AP activity increased its growth rate. On the other hand, the growth rate of the strain showing low AP activity was not significantly higher than those of treatments that had not received any P. It thus seems that this second strain was unable to take advantage of organic phosphorus even under circumstances when inorganic P is limiting due to its inability to produce/activate AP.

Slough, S. W., Texas A&M University, College Station, TX, USA, sslough@tamu.edu;
Milam, J. O., Texas A&M University, College Station, TX, USA, jmilam@science.tamu.edu

USING VIDEO-EDITING SOFTWARE TO ASSESS [CONCEPTUAL] CHANGE IN PRE-SERVICE SCIENCE TEACHERS' IDENTITIES

Video-editing technology has become accessible, affordable, and easy to use. This presentation examines the use of video-editing software by pre-service teachers in a secondary science course. After a relatively short amount of instruction, students are able to produce personally relevant video documentaries. Students produced two video documentaries, one at the beginning of the semester and the other as a final project, which answered the questions: 1) for whom do I teach? and 2) how will I meet the needs of my students? Due to the open-ended nature of the assignment, these pre-service teachers were required to substantively reflect upon and demonstrate changes in their personal identity before and after instruction. Two examples of students' pre- and post-videos will be shared to demonstrate this conceptual change. Pre-service teachers reported that the projects took more time than a traditional paper, but the nature of the video production, selecting media which best represents their thoughts, made the assignment more personal. Those who struggled with the assignment reported they did so because they struggled with their teacher identity rather than with the technology.

Smiley Jr., P. C., USDA-ARS, Soil Drainage Research Unit, Columbus, USA, rocky.smiley@ars.usda.gov;
Gillespie, R. B., Department of Biology, Indiana University-Purdue University Fort Wayne, Fort Wayne, USA, gillespi@ipfw.edu;
King, K. W., USDA-ARS, Soil Drainage Research Unit, Columbus, USA, kevin.king@ars.usda.gov;
Huang, C., USDA-ARS, National Soil Erosion Research Laboratory, West Lafayette, USA, chi-hua.huang@ars.usda.gov

RELATIONSHIPS BETWEEN WATER CHEMISTRY AND FISH COMMUNITIES WITHIN CHANNELIZED HEADWATER STREAMS IN INDIANA AND OHIO

Many headwater streams in the midwestern United States were channelized for draining agricultural fields. Agricultural conservation practices are implemented to reduce nutrient and pesticide loadings within these altered streams. The impact of these practices is uncertain because the influence of water chemistry on stream communities is not well understood. We evaluated the relationships between water chemistry and fish communities within channelized headwater streams in Cedar Creek, Indiana and Upper Big Walnut Creek, Ohio. Measurements of water chemistry and fishes have been collected from 20 sites beginning in 2005. Backward selection multiple regression analyses indicated that fish communities were most often correlated with pH and dissolved oxygen and least frequently correlated with alachlor, metolachlor, and nitrate-nitrite. Observed relationships between water chemistry and fish communities were weak, but significant ($P < 0.05$). The strongest relationship ($r^2 = 0.44$) occurred between percent insectivores and ammonia, soluble reactive phosphorus, total phosphorus, atrazine, water temperature, conductivity, and pH. Our results suggest that fish communities are more strongly correlated with physicochemical characteristics than nutrients or pesticides within channelized headwater streams in Indiana and Ohio.

Smith, A. S., University of Louisville, Louisville, KY, USA, allisunsmith@gmail.com;
Alexander, J. E., University of Louisville, Louisville, KY, USA, jealex01@louisville.edu

POTENTIAL EFFECTS OF CRASPEDACUSTA SOWERBII MEDUSAE ON THE FRESHWATER ZOOPLANKTON COMMUNITY OF A SMALL LAKE

Of the few species of freshwater jellyfish known, Craspedacusta sowerbii has the most cosmopolitan distribution having been observed on every continent except Antarctica. However, little is known about the effects of medusa blooms on zooplankton communities. C. sowerbii was observed in a small lake in Louisville, Kentucky, in the fall of 2006. Collected individuals were subsequently introduced into microcosms with common zooplankton from that lake to study the effects of medusa predation on zooplankton abundance by species. Three experiments testing the feeding efficacy of C. sowerbii on different zooplankton species found significant impacts on the zooplankton communities present at the time of the medusa bloom. These quantitative studies contribute to our knowledge of the potential effects that this exotic freshwater jellyfish could have on zooplankton community dynamics.

Smith, D. R., USDA-ARS, West Lafayette, USA, Douglas.R.Smith@ars.usda.gov

SHORT-TERM AND LONG-TERM IMPACTS OF DREDGING ON NUTRIENT TRANSPORT IN AGRICULTURAL DITCHES OF THE LAKE ERIE BASIN, USA

Compared to natural streams in more pristine environments, little is known about nutrient fate and transport in agricultural drainage ditches, especially following human induced manipulations, such as dredging. We conducted studies to evaluate the immediate (days) and long-term (months and years) impacts of dredging on nutrient fate and transport from these systems. Using a flume, sediments collected from ditches after dredging removed less P from the water column than sediments collected before dredging. Similar results were observed for nitrification and denitrification. For long-term information, two monitoring stations were established upstream and downstream from a dredged section of ditch. Nitrogen transport appeared to be relatively unaltered while there was a loss of P mass (-12 kg soluble P and -5 kg total P) during the monitored period the year after dredging. Results from this research show that human manipulations of drainage ditches may result in greater nutrient transport to receiving waters over the short term; however, this may be offset as the systems recover over longer periods of time, at least with respect to P.

Smith, E. M., University of South Carolina, Georgetown, USA, erik@belle.baruch.sc.edu;
Buck, T., University of South Carolina, Georgetown, USA, tracy@belle.baruch.sc.edu;
Lakish, B., University of South Carolina, Georgetown, USA, ben@belle.baruch.sc.edu;
Willman, A., University of South Carolina, Georgetown, USA, willman@belle.baruch.sc.edu

EFFECTS OF TIDAL PULSING ON BACTERIOPLANKTON METABOLISM IN A TEMPERATE SALT MARSH ESTUARY

Tidal creeks represent conduits for organic matter exchange between salt marshes and the coastal ocean. This study, conducted in the salt marsh dominated North Inlet estuary (South Carolina, USA), investigated the response of bacterial metabolism (production, respiration and growth efficiency) in tidal creeks to temporal variations in the magnitude and form of salt marsh exports on tidal and seasonal scales. Tidal variation in

organic matter and inorganic nutrient concentrations were often greater than observed seasonal variation. Although seasonal patterns in rates tended to be highly correlated with temperature, rates measured on ebbing tides were, on average, greater than 2-fold higher than those measured on flooding tides. Variations in ebb Ã¢â‚â€œ flood differences in metabolic rates were significantly related to ebb Ã¢â‚â€œ flood differences in organic matter concentrations. These differences could, in part, be attributed to the timing of the tidal cycle with respect to the solar cycle. Results indicate that bacterioplankton could rapidly respond to tidally driven pulses of organic matter originating from the salt marsh and this, in turn, had important consequences for diurnal patterns in dissolved oxygen concentrations.

Smith, L. M., URI Graduate School of Oceanography, Narragansett, USA, leslie.smith@gso.uri.edu;
Schult, M., URI Graduate School of Oceanography, Narragansett, USA;
Coupland, C., URI Graduate School of Oceanography, Narragansett, USA;
Crockford, E. T., URI Graduate School of Oceanography, Narragansett, USA;
Olmeta, F., URI Graduate School of Oceanography, Narragansett, USA;
Requintina, E., URI Graduate School of Oceanography, Narragansett, USA;
Stoffel, H., URI Graduate School of Oceanography, Narragansett, USA;
Williams, H., URI Graduate School of Oceanography, Narragansett, USA;
Oviatt, C. A., URI Graduate School of Oceanography, Narragansettt, USA

SUMMER BLOOM CYCLES AND HYPOXIA IN NARRAGANSETT BAY

Blooms cycles in upper Narragansett Bay were examined over two summers, 2006 and 2007, for differences in bloom occurrence, stratification, and bottom oxygen concentration. A high volume of freshwater input in 2006 led to a greater stratification of the water column. Bloom occurrence was correlated to stratification in both summers wherein summer 2006 had larger, more frequent blooms than summer 2007. Total summer production during 2006 was 321gCm^{-2} and 166gCm^{-2} for each station whereas in 2007 it was much less at 131gCm^{-2} and 98gCm^{-2} at the same stations. In 2006 bottom oxygen decreased sharply early in the summer to hypoxic levels, increasing after a sharp decrease in stratification in mid-July. In 2007 bottom oxygen decreased gradually throughout the summer with no significant hypoxic events. These results support the connection between blooms and stratification and highlight the importance of stratification as a factor in determining vulnerability to hypoxia. This is of particular importance as climate trends in Narragansett Bay indicate that summer stratification may be increasing due to increases in rainfall and surface temperature, and decreases in wind velocity.

Smol, J. P., Queen's University, Kingston, Canada, smolj@queensu.ca;
Douglas, M. S., University of Alberta, Edmonton, Canada, msdougla@ualberta.ca

FROM CRADLE TO THE GRAVE: TRACKING THE FORMATION, DEVELOPMENT AND RECENT EVAPORATION OF HIGH ARCTIC POND ECOSYSTEMS

Shallow high Arctic ponds, which characterize almost all Arctic regions, are hotspots of biodiversity and production in this otherwise extreme terrestrial environment. However, due to their shallow nature, these ponds are also especially susceptible to the effects of climatic changes. In this presentation, we dovetail paleolimnological data spanning several millennia with our 25 year window of on-site monitoring data to show how ponds on Cape Herschel (Ellesmere Island) have changed dramatically over the last century, and especially over the last few years. Some of these ponds, which paleolimnological data indicate have been permanent water bodies for millennia, have completely desiccated during the last three polar summers (the warmest on record). By comparing recent pond water specific conductivity values to similar measurements made in the 1980s, we link the disappearance of the ponds to increased evaporation/precipitation. In addition to the limnological repercussions, the adjacent terrestrial ecosystems are also markedly affected (e.g. desiccation of wetlands, floristic changes, etc.), as are other organisms, such as birds. The final ecological threshold for these aquatic ecosystems has now been crossed: complete desiccation.

Snelgrove, P. V., Memorial University of Newfoundland, St. John's, Canada, psnelgro@mun.ca;
Bentzen, P., Dalhousie University, Halifax, Canada;
deYoung, B., Memorial University of Newfoundland, St. John's, Canada;
Bradbury, I. R., Dalhousie University, Halifax, Canada;
DiBacco, C., Department of Fisheries and Oceans, Halifax, Canada;
Gregory, R., Department of Fisheries and Oceans, St. John's, Canada;
Morris, C., Department of Fisheries and Oceans, St. John's, Canada;
Oake, B., Memorial University of Newfoundland, St. John's;
Pike, D. A., Memorial University of Newfoundland, St. John's, Canada;
Ryan, M., Memorial University of Newfoundland, St. John's, Canada;
Stanley, R., Memorial University of Newfoundland, St. John's, Canada;
Zou, Y., University of South Carolina, Columbia, USA

CONNECTIVITY OF MARINE FISHES IN COASTAL NEWFOUNDLAND

How populations of fishes in bays are connected is critical for informed conservation decisions, however, connectivity may be achieved to different degrees by egg and larval, juvenile, and adult movement. Our landscape models will quantify connectivity at multiple scales and life history stages for species with contrasting life history strategies. We are incorporating empirical field data (physical, distributional, behavioural), genetic assignment, otolith microchemistry, habitat distribution, and graph theory to evaluate metapopulation structure. Data suggest that smelt eggs, larvae, and adults provide very limited connectivity. Preliminary sculpin data suggest that larvae only provide connectivity within and between bays. Cod eggs and larvae connect within and among adjacent bays, but juvenile tagging and laboratory studies suggest limited movement. Acoustic telemetry of adult cod suggests that movement during spawning provides reproductive connectivity between bays. Genetic assignment of cod juveniles to spawning aggregations, in conjunction with analysis of otolith elemental composition of juveniles and adults from known collection areas will add insight on connectivity. Our ongoing study suggests that contrasting life stages of different species play dramatically different roles in connectivity or lack thereof.

Snyder, R. J., SUNY College at Buffalo, Buffalo, USA, snyderrj@buffalostate.edu;
Schregel, W. D., SUNY College at Buffalo, Buffalo, USA, schrwd89@mail.buffalostate.edu

THERMAL ACCLIMATION AND TISSUE-SPECIFIC FATTY ACID CONTENT IN THE ALEWIFE (*ALOSA PSEUDOHARENGUS*)

Cell membrane fatty acids play a key role in thermal acclimation. At higher environmental temperatures, the proportion of saturated fatty acids should increase and the proportion of unsaturated fatty acids should decrease; at lower temperatures, the opposite changes would be expected. We tested these expectations by feeding alewives a diet of frozen *Mysis* for nine weeks in the laboratory and then exposing the fish to either a warm or cold temperature challenge. Fatty acids in gill, liver, and muscle were analyzed by gas chromatography. The percentage of palmitic acid (C16:0) was significantly higher in the membranes of liver and muscle from the warm-challenged alewives and was significantly lower in gills of cold-challenged alewives. Vaccenic acid (C18:1) was significantly lower in liver and muscle cell membranes of warm-challenged fish. Changes in fatty acids were largely consistent with expectations regarding the role of membrane fatty acids in thermal acclimation, suggesting that diets high in unsaturated and low in saturated fatty acids would increase cold tolerance in alewives.

So, J. J., Ocean Sciences Centre (OSC), Memorial University, St. John's, Canada, jjso@mun.ca;
Hamel, J. F., Society for the Exploration and Valuing of the Environment (SEVE), , Portugal Cove-St. Philips, Canada;
Mercier, A., Ocean Sciences Centre (OSC), Memorial University, St. John's, Canada, amercier@mun.ca

GROWTH RATE AND PREDATION PRESSURE AS KEY FACTORS IN THE MANAGEMENT OF CUCUMARIA FRONDOSA (HOLOTHUROIDEA) IN THE NORTH ATLANTIC

Cucumaria frondosa is the most abundant holothurian in the North Atlantic and is currently being assessed as an emerging fishery in Atlantic Canada. In this study growth rates and predation pressure were investigated. Six size classes of sea cucumbers were kept in tanks provided with running unfiltered seawater under natural conditions of photoperiod for 16 months. All size classes exhibited seasonal growth with increases in immersed weight after spring peaks of phytoplankton abundance in

Newfoundland waters. Overall growth rates were low compared to previous data obtained in the St. Lawrence Estuary, and negative trends were observed in some classes. The main predator of C. frondosa, the asteroid Solaster endeca showed preference for small specimens (6.7 ± 2.0 cm contracted length compared to larger specimens (14.2 ± 1.8 cm contracted length). Sea cucumbers are fished by trawl which has the potential to damage them. In pair-wise feeding experiments, 100% of predatory asteroids targeted damaged over undamaged sea cucumbers. Slow growth rates combined with potential trawl-related increases in predation pressure emphasizes the need for a cautionary approach to managing the fishery.

Sobek, S., Swiss Federal Institute of Technology Zurich (ETH), Zurich, Switzerland, sebastian.sobek@env.ethz.ch;
Durisch-Kaiser, E., Swiss Federal Institute of Technology Zurich (ETH), Zurich, Switzerland, edith.durisch-kaiser@env.ethz.ch;
Zurbrügg, R., Swiss Federal Institute of Technology Zurich (ETH), Zurich, Switzerland, roland.zurbrugg@env.ethz.ch;
Kägi, R., Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland, ralf.kaegi@eawag.ch;
Wessels, M., Institut für Seenforschung, Langenargen, Germany, martin.wessels@lubw.bwl.de;
Wehrli, B., Swiss Federal Institute of Aquatic Science and Technology (Eawag), Kastanienbaum, Switzerland, bernhard.wehrli@eawag.ch

HIGH ORGANIC CARBON BURIAL EFFICIENCIES IN LAKE SEDIMENTS: RELATIONSHIPS WITH OXYGEN EXPOSURE TIME AND MINERAL PHASE PROPERTIES

Lake sediments bury about half as much organic carbon (OC) as marine sediments, in spite of the small areal extent of lakes. Nevertheless, the factors triggering the effective carbon sink in lake sediments are unclear. We compared the burial efficiency of organic carbon in a diverse set of lake sediments, focusing on the potential effects of oxygen exposure and protective sorption by minerals on the preservation and burial of OC. We found that in most lake sediments, OC burial efficiencies were considerably greater than in marine sediments. Further, OC burial efficiency was more strongly related to oxygen exposure time in lake than in marine sediments. On the other hand, OC burial efficiency was not related to the mineral surface area, a proxy of the sorption capacity of the mineral phase for OC. We conclude that the high OC burial efficiency in many lake sediments can primarily be attributed to a strong effect of oxygen exposure time, while protective sorption on mineral surfaces probably plays a subordinate role.

Sommer, U., Leibniz-Institute of Marine Sciences (IFM-GEOMAR), Kiel, Germany, usommer@ifm-geomar.de

STUDYING PLANKTON SEASONAL SUCCESSION - A SUCCESSION OF PARADIGMS

The last ASLO meeting in St. John's, in 1983, occurred during a period of rapid intellectual development in the field of plankton ecology. It was the "Golden Age" of plankton community ecology. Biotic interactions such as competition, grazing, predator-prey interactions became dominant topics of research. During the following 25 years, major shifts of focus have taken place. I will use the seasonal succession of plankton as an example to explore those shifts. Before the "Golden Age", plankton succession was thought to be driven by the physical environment. During the 1980'ies, the seasonal replacements of plankton populations were explained by biotic interactions, while physics was seen to determine the start and the end of the growth season and to cause disturbances in between (summarised in the PEG-model of 1986). Around 2000, interest in plankton seasonal succession became revitalized by the growing concerns about climate change. The first generation of studies marked a return to the concept of exclusive physical control while a new generation of studies begins to appreciate the role of biotic interactions once more.

SPATHARIS, S. D., UNIVERSITY OF THE AEGEAN, MYTILINI, Greece, spathari@marine.aegean.gr;
TSIRTSIS, G. E., UNIVERSITY OF THE AEGEAN, MYTILINI, Greece, gtsir@aegean.gr

DEVELOPMENT OF MODEL PHYTOPLANKTON COMMUNITIES AND ASSESSMENT OF THEIR APPLICABILITY IN COASTAL EUTROPHICATION STUDIES

Phytoplankton is always used as a key state variable in ecological models describing the functioning of marine or freshwater ecosystems. It is often included in the form of a single box representing the whole biomass, or more than one representing the major groups or the main size-classes. In this sense, biodiversity aspects and changes in community structure due to environmental stresses or pressures are not described in detail in ecological models. In the current study, two models simulating the distribution of phytoplankton individuals to species are proposed and their efficiency to model the changes that phytoplankton communities undergo is assessed. The two models are based on the logseries and lognormal distributions and their applicability is evaluated by fitting them to coastal phytoplankton communities, characteristic of oligotrophy to eutrophication. Furthermore an algorithm is proposed for the development of standard model communities using the two distributions. The efficiency of these standard communities to describe in detail changes in biodiversity due to eutrophication, is assessed through the application of a number of ecological indices, expressing diversity, evenness and dominance.

Speirs, D. C., University of Strathclyde, Glasgow, United Kingdom, dougie@stams.strath.ac.uk

BEYOND THE DRIFT PARADOX: PASSIVE DISPERSAL IN MARINE AND FRESHWATER ENVIRONMENTS AND HOW IT SHAPES POPULATION INTERACTIONS

The last few years have witnessed an increased appreciation of how physical processes in aquatic environments affect population dynamics. In advective environments, that is ones governed by unidirectional flow such as those in rivers and ocean currents, organisms that spend at least part of their time in the water but are unable to swim against the currents will inevitably be swept to regions that are inimical to population growth. Continued population persistence despite this setback is the so-called drift paradox. Initial theoretical work focussed on resolving the paradox by identifying the conditions for population invasion, the speed at which populations can invade, and how this is affected by the details of how dispersal occurs. Most recently, the complex effects of advection on inter-specific interactions such as competition and consumer-resource dynamics has begun to be explored. This talk will review some of these developments, linking the theory with examples from oceanic plankton, marine fish, and freshwater invertebrates. The talk will conclude with some novel results that illustrate the role of stochastic variations in flow in mediating the stability of consumer-resource interactions.

Sprules, W. G., University of Toronto Mississauga, Mississauga, Canada, gary.sprules@utoronto.ca

THAT'S ABOUT THE SIZE OF IT - HISTORY AND FUTURE OF BODY SIZE-BASED STUDIES IN ZOOPLANKTON ECOLOGY

While researchers were historically aware of body-size patterns in zooplankton communities, the ideas were arguably most thoughtfully presented in Brooks and Dodson's seminal 1965 paper. During the subsequent decades zooplankton ecology experienced an explosion of advances related to food-web interactions driven by size-based competitive and predatory interactions. At the same time, marine researchers began developing more integrative models of energy flow through size-structured communities while terrestrial ecologists established the early basis for what has fully flourished into a size-based Metabolic Theory of Ecology. Because of the strong dependency of many physiological and ecological processes on body size, it is no surprise that early concepts of 'big things eat little things' have blossomed into sophisticated and predictive theories. In this presentation I will summarize the early empirical basis from which these ideas developed, attempt a rationalization of the varied size-based approaches taken in disparate ecological fields, and offer comments on future initiatives deserving our attention.

Stanley, E. H., University of Wisconsin, Madison, USA, ehstanley@wisc.edu

POTENTIAL SOURCES OF NITRITE IN SOUTHERN WISCONSIN AGRICULTURAL STREAMS

Human activities routinely increase nitrogen (N) concentrations in aquatic environments, and agricultural streams in particular are often extremely N-rich. The total N pool of streams draining agricultural landscapes in southern Wisconsin is dominated by NO3-N. NO2-N is also present in most of these streams, in some cases reaching concentrations >0.1 mg NO2-N/L. NO2-

N formation is a transitional step for both oxidative reactions of NH4-N (such as nitrification) and reductive processes beginning with NO3-N (e.g., denitrification), so its presence could reflect very different processes and occurring in distinct stream habitats. Monitoring of several groundwater wells at one agricultural stream site has revealed very low (often undetectable) NO2-N concentrations, suggesting that NO2-N is generated in the channel environment. Addition of either NH4-N or NO3-N to stream sediments from this site both resulted in NO2-N accumulation; however, NO2-N production was greatest for NO3-N enriched fine anoxic sediments. Thus, the generation of this more toxic form of N may result from reductive processes occurring within benthic or hyporheic zones in many agricultural streams.

Stanley, R. R., Ocean Sciences Centre/Biology Deptartment, Memorial University, St. John's, Canada, rstanley@mun.ca;
Snelgrove, P. V., Ocean Sciences Centre/Biology Deptartment, Memorial University, St. John's, Canada;
deYoung, B., Deptartment of Physics and Physical Oceanography, Memorial University, St. John's, Canada;
Gregory, R., Deptartment of Fisheries and Oceans, Science Branch, St. John's, Canada;
Morris, C., Deptartment of Fisheries and Oceans, Science Branch, St. John's, Canada

EVALUATING CONNECTIVITY IN EARLY LIFE HISTORY STAGES OF ATLANTIC COD IN TRINITY BAY, NEWFOUNDLAND

The role of connectivity in evaluating structure in marine populations is often heavily influenced by physical processes during early life history stages. Our study evaluates connectivity within Trinity Bay, a large embayment in coastal Newfoundland. Smith Sound is an arm of the bay where one of the largest remaining cod aggregations represents a potential point source for pelagic egg production. This unique scenario creates an opportunity to evaluate drift of egg and larvae from a discrete source. Using high-frequency ring net tows to document the seasonal export of eggs from Smith Sound and multiple plankton surveys of the bay surrounding Smith Sound, we can match empirical data on egg and larval distributions to physical transport model predictions developed for Trinity Bay. Preliminary data suggest eggs drift from Smith Sound towards the northern mouth of the bay but then towards the east. These results mirror flow models which suggest a large gyre near Smith Sound may facilitate egg retention within the bay. Further evaluation of advection and diffusion will provide better understanding of connectivity at this life history stage.

Starr, M., Maurice Lamontagne Institute, Fisheries and Oceans Canada, Mont-Joli, Canada, StarrM@dfo-mpo.gc.ca;
Le Clainche , Y., Maurice Lamontagne Institute, Fisheries and Oceans Canada, Mont-Joli, Canada, yvonnick.leclainche@giroq.ulaval.ca;
Lavoie , D., Maurice Lamontagne Institute, Fisheries and Oceans Canada, Mont-Joli, Canada, LavoieD@dfo-mpo.gc.ca;
Chassé, . J., Gulf Fisheries Centre, Fisheries and Oceans Canada, Moncton, Canada, ChasseJ@mar.dfo-mpo.gc.ca;
Vézina, A. F., Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, Canada, VezinaA@mar.dfo-mpo.gc.ca

SIMULATION OF PLANKTONIC PRODUCTION IN THE GULF OF ST. LAWRENCE AND NORTHEAST SCOTIAN SHELF WITH A COUPLED 3D OCEAN-BIOGEOCHEMICAL MODEL

As part of the DFO-COMDA (Departement Fisheries and Ocean Canada - Centre for Ocean Model Development and Application) activities, we developped a coupled three-dimensionnal (3D) ocean-biogeochemical model of plankton dynamics in the Gulf of St. Lawrence and Northeast Scotian Shelf. A 8-compartments NPZD-type (Nitrogen-Phytoplankton-Zooplankton-Detritus) planktonic ecosystem model was embedded in the GSS4 physical model, that reproduces the essential physical oceanographic features such as tidal currents and mixing, temperature and salinity distributions, seasonal ice cover, seasonal current patterns. Primary production is carried out by small and large phytoplankton growing on nitrate (new production) and ammonia (regenerated production). Similarly, the secondary producers are divided into small and large grazers (micro-zooplankton and meso-zooplankton). Annual hindcast simulations of biological oceanographic conditions are compared to field observations from the Atlantic Zone Monitoring Program. The model performs reasonably well in general to reproduce the nitrate distributions and the seasonal evolution of primary production in the different subregions of the domain.

Stead, R. A., Universidad de Los Lagos, Puerto Montt, Chile, stead@ulagos.cl;
Schmidt, A. J., Universidad de Los Lagos, Puerto Montt, Chile, aschmidt@ulagos.cl;
Gomez, I. M., Universidad Austral de Chile, Valdivia, Chile, igomezo@uach.cl

BENTHIC PELAGIC COUPLING AND CONTRASTING PHYSIOLOGICAL PATTERNS OF SURFACE VERSUS SUBSURFACE DEPOSIT FEEDERS

Pseudechinus magellanicus>/em> is a surface deposit-feeding sea urchin found in soft bottoms of Chilean and Argentinian coastal areas. We evaluated its seasonal physiological response to settling POM at a deep depositional zone of a southern Chilean inlet and related results to experiments carried out on alternative diets. Results are contrasted with response of subsurface deposit-feeding sea urchins and a Maldanid polychaete. Settling POM from phytoplankton showed a peak of diatoms in spring and summer. A secondary autumn peak was dominated by diatoms and dinoflagellates. Sediment organic matter increase occurred only in early spring and autumn, although an increase of particulate protein and lipids was observed in summer and autumn. Pseudechinus magellanicus>/em> growth was in accordance to pattern of protein and oxygen uptake increase, spawning occurring in early spring until early summer. Subsurface organisms only showed interannual differences related to differential OM input whereas oxygen uptake showed no seasonality. Increase in dietary Lipids and Carbohydrates produced high respiration and excretion rates, but protein produced an inverse response. Highest ingestion rates were induced by high dietary lipid and carbohydrate characteristic of bloom deposition periods.(Fondecyt Grant Nº1050552 to RS)

Sterner, R. W., National Science Foundation, Arlington, VA, USA, stern007@umn.edu;
Bauer, M., University of Minnesota, St. Paul, MN, USA, mbauer@umn.edu;
Brovold, S., University of Minnesota, St. Paul, MN, USA, brovo001@umn.edu
Hood, J., University of Minnesota, St. Paul, MN, USA, hoodx008@umn.edu;
Peres-Neto, P., Université du Québec à Montréal, Quebec, Canada;
Yokota, K., University of Minnesota, St. Paul, MN, USA, yoko0026@umn.edu;
Yuan, F., Minnesota State University, Mankato, MN, USA, fei.yuan@mnsu.edu

LAKE WATERSHED URBANIZATION: LAND USE AND PLANKTON COMMUNITY STRUCTURE IN URBAN LAKES AND PONDS

We undertook a statistically based sampling of 100 lakes and permanent ponds located within the seven-county metropolitan area of the Twin Cities, Minnesota. We examined phytoplankton and zooplankton communities three times during one growing season along with several standard limnological parameters including total phosphorus; lake or pond area and depth and neighboring land use. Land use was determined at several levels of detail by GIS, examining buffer zones of different size (0.5 to 3 lake radii). Species richness of both phytoplankton and zooplankton was higher in non-urban habitats than urban habitats. Analysis by species indicated a strong signal of species preference for non-urban habitats as well as a higher co-occurrence (less fragmented) distribution in non-urban habitats. Variables significant in explaining phytoplankton distribution included: amount of impervious surface in the buffer, seston N and seston P. Variables significant in explaining zooplankton distribution included: seston P, presence of floating plants, average depth, and the percent of wetland in the buffer. Our results indicate strongly that more urbanized lakes and ponds have reduced biodiversity compared to non-urban (but still not pristine) land use types.

Stets, E. G., U.S. Geological Survey, Boulder, CO, USA, estets@usgs.gov;
Striegl, R. G., U.S. Geological Survey, Denver, CO, USA, rstriegl@usgs.gov;
Aiken, G. R., U.S Geological Survey, Boulder, CO, USA, graiken@usgs.gov;
Rosenberry, D. O., U.S. Geological Survey, Denver, CO, USA, rosenber@usgs.gov;
Winter, T. C., U.S. Geological Survey, Denver, CO, USA, tcwinter@usgs.gov

WHOLE-LAKE CARBON BUDGETS REVEAL NET AUTOTROPHY IN LAKES WITH HIGH DISSOLVED INORGANIC CARBON CONCENTRATION AND NET CARBON DIOXIDE EMISSION

Lakes are important to the transport, transformation, and retention of organic and inorganic carbon. Recent evidence suggests that in many lakes respiration (R) exceeds gross primary production (GPP) due to the input of organic material from the surrounding watershed, a condition known as net heterotrophy. We evaluated net production in several temperate

dimictic lakes using a carbon mass-balance approach for the calendar year 2004. Results indicated that the lakes were net autotrophic, being net sinks for inorganic carbon (IC) and net exporters of organic carbon (OC), despite being net emitters of carbon dioxide (CO_2). The mass balance was also consistent with a carbon stable isotope model that showed net photosynthetic removal of IC. A literature search of other published whole-lake carbon budgets indicates a tendency for net autotrophic lakes to reside in watersheds with high IC yield. These results emphasize the importance of considering geologic setting when evaluating lake net production and suggest that CO_2 emission from some lakes may be a result of IC inputs rather than net heterotrophy.

Stich, H. B., Institute for Lake Research, Langenargen, Germany, hb.stich@lubw.bwl.de;
Brinker, A., Fishery Research Station of Baden-Württemberg, Langenargen, Germany, Alexander.Brinker@lvvg.bwl.de

THE OLIGOTROPHICATION OF A LARGE, DEEP LAKE: A MODEL FOR THE DECLINE OF CHLOROPHYLL A CONCENTRATIONS IN LAKE CONSTANCE (1980 - 2004)

In Lake Constance, phosphorus concentrations after mixing declined from 85 µg/L in 1980 to 10 µg/L in 2004. Chlorophyll a concentrations in the surface layer (0-20 m) declined from more than 20 µg/L in 1980 to less than 5 µg/L in 2004. The coefficient of the annual chlorophyll a variation also decreased significantly. The recorded abundance of Daphnia declined by a factor of four from 16 to 4 x 105 Ind./m2 over the same period. Our model explains 76.4 % of the annual variation of chlorophyll a. Chlorophyll a development tracked seasonal trends in temperature and sunshine duration. The combination of percentage of phytoplankton biomass available for ingestion by Daphnia and the grazing rate achieved had a negative impact on chlorophyll a concentration. In contrast, the concentration of soluble reactive phosphorus (SRP) correlated positively with chlorophyll a. The model predicts an exponential negative response to any further depletion of SRP in Lake Constance, while the temperature trends predicted by current global warming scenarios are set to result in a moderate increase in productivity.

Stow, C. A., NOAA GLERL, Ann Arbor, USA, craig.stow@noaa.gov;
Lamon, E. C., Duke University NSEES, Durham, USA, conrad@duke.edu;
Qian, S. S., Duke University NSEES, Durham, USA, song@duke.edu;
Sellinger, C. E., NOAA GLERL, Ann Arbor, USA, cynthia.sellinger@noaa.gov

EXPLORING AND FORECASTING GREAT LAKES WATER LEVELS

A sustained decline in the levels of Lakes Michigan and Huron that began in 1997 is troubling because it is consistent with many climate change scenarios. We explored water level data (1860-2007) from these lakes with two quantitative techniques: Seasonal Trend Decomposition using Loess (STL) and Dynamic Linear Models (DLMs). In addition to the recent decline, STL results reveal a sustained decline around 1900, a long-term periodicity of ~30 years, and a correspondence with sunspot activity. DLM results indicate a relationship with precipitation over a three-year lagged period, which has been essentially unchanging from 1900-present. Additionally, the DLM highlights an underlying lake level decline beginning in 1973 that continues to the present. The underlying decline might be related to an evaporation increase, though we could not confirm this relationship. Because they are Bayesian-based, DLMs can be used to forecast future lake levels, based on precipitation forecasts, and propagate the full forecast uncertainty into a probabilistic expression that can be used for decision-making.

Stuart, A. T., Virginia Commonwealth University, Richmond, USA, stuartat@vcu.edu;
DeAlteris, J. A., Virginia Commonwealth University, Richmond, USA, jadealteris@vcu.edu;
McCallister, S. L., Virginia Commonwealth University, Richmond, USA, slmccalliste@vcu.edu

A MULTIDISCIPLINARY APPROACH ASSESSING THE BIOLOGICAL FATE AND TRANSPORT OF ALLOCHTHONOUS AND AUTOCHTHONOUS DOC ALONG A TRIBUTARY OF THE CHESAPEAKE BAY

Littoral and coastal zones receive and process organic carbon (OC) from a broad spectrum of allochthonous (e.g., leaf litter, soil-derived) and autochthonous (e.g., algal, submerged aquatic vegetation (SAV)) sources. This study employs a multidisciplinary approach (isotopic, optical, bioassay) to evaluate the biological impacts on, and fate of, allochthonous and autochthonous OC sources along a land to sea continuum. Microbial bioassays (nutrient amended) of algal, leaf litter and seagrass leachates resulted in ~ 95% of autochthonous OC metabolized with a significantly lower fraction of the leaf litter-derived OC utilized. The δ 13C of source leachates was compared to δ 13C signatures of in situ dissolved OC (DOC) values and bacterial biomass. These data suggested a spatial decoupling in the production and microbial metabolism of SAV-derived OC. Excitation emission matrix fluorescence spectra of chromophoric DOC was used to further elucidate the OC sources, transport and fate along the land to aquatic corridor. Understanding the biological processing and metabolic fate of specific OC sources in these regions connecting land and sea is critical for evaluating the impact of human activities on regional C budgets.

Sulzberger, B., Eawag: Swiss Federal Institute of Aquatic Science and Technology, CH-8600 Duebendorf, Switzerland, sulzberger@eawag.ch;
Durisch-Kaiser, E., Institute of Biogeochemistry and Pollution Dynamics, ETH Zurich, CH-8092 Zurich, Switzerland, edith.durisch-kaiser@env.ethz.ch

WHY DO WE NEED TO SPAN THE RANGE FROM MOLECULAR-LEVEL TO WHOLE ECOSYSTEM SCALE STUDIES IN AQUATIC PHOTOCHEMICAL RESEARCH?

This question will be addressed regarding the light-induced cycling of natural dissolved organic matter (DOM) in aquatic systems. The optical properties, bioavailability, and rates of microbial and abiotic mineralization of DOM depend on the origin and chemical composition of DOM and are strongly affected by solar radiation. For example, terrestrially derived DOM often exhibits a higher photoreactivity than autochthonous DOM, and light-induced transformations of terrigenous DOM tend to increase DOM bioavailability. Because of the strong link between the chemical composition and the photochemical and biological reactivity of DOM, the molecular-level characterization of DOM is a prerequisite for a better understanding of the effects of solar radiation, particularly UVR, on carbon cycling. Furthermore, mathematical kinetic modeling in conjunction with experimental studies greatly helps to assess individual (photo)chemical reactions occurring in complex heterogeneous aqueous systems. This paper will present study results from my research group at Eawag that combined photochemical laboratory experiments, kinetic modeling, and molecular-level characterization involving natural and synthetic DOM systems. It will be discussed how these studies help understand the fate of DOM in sunlit aquatic ecosystems.

Sun, B., Memorial University of Newfoundland, St. John's, Canada, beisun476@hotmail.com;
Way, C., Memorial University of Newfoundland, St. John's, Canada, cjway@mun.ca;
Rivkin, R. B., Memorial University of Newfoundland, St. John's, Canada, rrivkin@mun.ca

BACTERIA AS AN INVASIVE SPECIES: BACTERIAL ABUNDANCE AND COMPOSITION IN BALLAST WATER DISCHARGED INTO CANADIAN HARBORS

We assessed the potential introduction and risk to the Canadian coastal environment by ballast water-introduced bacteria. This study was carried out from March to November 2007 along the West and East coasts of Canada and on the Great Lakes. We measured bacterial abundances, and prokaryotic community structure of both ubiquitous phylogenetic groups (e.g. alpha-proteobacteria) and potential pathogens (e.g. Vibrio spp.) using Fluoresecence In Situ Hybridization (FISH). Our study showed that in each of the sampling locations bacterial abundances in harbor waters (3.4x108cells/L to 1.0x1010cells/L) were significantly greater than in ballast water (8.7x107cells/L to 2.1x109cells/L, alpha=0.05). FISH revealed that the average Eubacterial percentage of the prokaryotic community was higher in all port samples (65.5%) than in all ballast water samples (46.3%, P=0.006). However, there were no significant differences in the alpha-proteobacteria and Vibrio spp. composition between port and ballast water samples. The potential environmental risk from ballast water-distributed bacteria may be a factor in biodiversity changes.

SUN, Z., Ocean Sciences Centre (OSC), Memorial University, St. Johnâ€™s, Canada, zsun@mun.ca;
HAMEL, J. F., Society for the Exploration and Valuing of the Environment (SEVE), St. Johnâ€™s, Canada, jfhamel@mun.ca;
MERCIER, A., Ocean Sciences Centre (OSC), Memorial University, St. Johnâ€™s, Canada, amercier@mun.ca

SETTLEMENT PREFERENCES AND PLANULA BEHAVIOUR IN DEEP-SEA SOFT CORALS

The life history of deep-sea octocorals has rarely been studied, owing to the difficulty of collecting and keeping live specimens under laboratory conditions. Here we present data on settlement behaviour and substrate selection in bathyal nephteids *Drifa* spp. from the SW Grand Banks (eastern Canada). Between July 2007 and February 2008, planulae emitted by colonies of *Drifa* sp. obtained from 500 and 1200 m were collected and used to conduct experimental trials. Planulae of colonies from 1200 m typically settled faster than those from 500 m (on average 13 and 41 days, respectively). Planulae from both depths settled earlier on hard irregular substrata, i.e. shells and rough artificial surfaces, than on smooth artificial surfaces. Settlement occurred more rapidly on cleaned shells than fouled ones in planulae from 500 m but not in those from 1200 m. Larval behaviour differed markedly in two nephteids studied: planulae of *Drifa* sp. (500-1200 m) did not actively swim, but exhibited cycles of contraction and expansion, whereas planulae of *Drifa glomerata* (~350 m) displayed complex swimming and crawling behaviours.

Sunohara, M. D., South Nation Conservation, Berwick, Canada, sunoharam@agr.gc.ca;
Craiovan, E., Department of Earth Sciences, University of Ottawa, Ottawa, Canada;
Topp, E., Agriculture and Agri-Food Canada, London, Canada;
Gannon, V., Health Canada, Lethbridge, Canada;
Edge, T., National Water Research Institute, Environment Canada, Burlington, Canada;
Neumann, N., Alberta Provincial Laboratory for Public Health, Calgary, Canada;
Ruecker, N., Alberta Provincial Laboratory for Public Health, Calgary, Canada;
Robin, M., Department of Earth Sciences, University of Ottawa, Ottawa, Canada;
Lyautey, E., Agriculture and Agri-Food Canada, London, Canada;
Lapen, D. R., Agriculture and Agri-Food Canada, Ottawa, Canada

WATERSHED EVALUATION OF BENEFICIAL MANAGEMENT PRACTICES: QUANTIFYING THE ENVIRONMENTAL EFFECTS OF RESTRICTED CATTLE ACCESS TO SURFACE WATERS WITHIN A WATERSHED

Fecal matter derived from livestock can negatively impact surface water quality. Beneficial management practices that keep livestock directly out of surface waters can potentially improve water quality. This three year study compared stream water quality among an unrestricted livestock pasture system (livestock allowed to interact with stream directly) and a restricted pasture system (livestock excluded from interacting with stream via fencing and off-stream watering systems). Water quality endpoints included: indicator bacteria, pathogens, parasites, nutrients, and sediment. Microbial source tracking methods were employed to identify dominant fecal source and changes in source as linked to changes in pasturing activities. Microbial source tracking information indicated that livestock was the main source of fecal contamination in the stream. There were greater bacteria and nutrient loads in the unrestricted pasture stream system than there was for the restricted pasture system. Moreover, parasite and indicator bacteria concentrations increased after seasonal cattle introduction for both systems. Generally, water quality was improved modestly by livestock exclusion practices.

Sushchik, N. N., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences, Krasnoyarsk, Russian Federation, labehe@ibp.ru;
Gladyshev, M. I., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences, Krasnoyarsk, Russian Federation, glad@ibp.ru;
Kalachova, G. S., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences, Krasnoyarsk, Russian Federation, kalach@ibp.ru;
Makhutova, O. N., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences, Krasnoyarsk, Russian Federation, makhutova@ibp.krasn.ru;
Kravchuk, E. S., Institute of Biophysics of Siberian Branch of Russian Academy of Sciences, Krasnoyarsk, Russian Federation, kravchuk@ibp.krasn.ru

ESSENTIAL PUFA VS. ELEMENTAL COMPOSITION OF SESTON IN PERIODS OF DOMINATION OF FIVE PHYTOPLANKTON SPECIES IN A SIBERIAN RESERVOIR

We studied the elemental and fatty acid composition of seston for three vegetation seasons in a small Reservoir. Under comparatively low C:P ratio, multivariate analysis revealed no simple correlations between phosphorus and single n-3 PUFA species, but complex significant interaction between stoichiometry of seston and total sestonic n-3 PUFA as a whole. Sestonic C, P and N were found to originate mostly from phytoplankton. Phytoplankton species of genera of Stephanodiscus, Peridinium, Gomphosphaeria, Planktothrix and Anabaena in periods of their pronounced dominance had relatively constant species-specific elemental and PUFA composition. Due to differences founded in their elemental and PUFA composition, as well as in stoichiometry, there were no phytoplankton species of clearly high or low nutritional value. All of phytoplankters, or at least detritus, that originated from them, may meet specific elemental and biochemical requirements of specific groups of zooplankton. Dividing phytoplankton on basis of their elemental and biochemical composition, i.e., nutrition quality, into large taxa (cyanobacteria, diatoms, etc.) appeared to be too coarse for assessing nutritional value for zooplankton.

Sylvester, F., Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Canada, fsf@uwindsor.ca;
van Overdijk, C., Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Canada, coverdijk@accent.krakow.pl;
MacIsaac, H., Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Canada, hughm@uwindsor.ca

HULL FOULING AS A VECTOR FOR INTRODUCTION OF NONINDIGENOUS SPECIES IN THE GREAT LAKES

Hull fouling is a well recognized vector for introduction of aquatic nonindigenous species (NIS) worldwide, although studies in Canada are rare. This mechanism has not yet been addressed for the Great Lakes, where ballast water is reported as the primary mechanism of NIS introduction. During 2007, we surveyed 13 vessels entering ports on Canada's east and west coasts, and the Great Lakes, to assess their comparative risk of invasion from hull fouling. We collected 0-19, 20x20cm scrapings from exterior vessels surfaces; underwater video-transects were also shot. An additional 15 ships were surveyed in Vancouver and Halifax. Preliminary analysis of Great Lakes' samples has yielded an average of 400 organisms per ship, including several marine and freshwater groups: barnacles, bivalves, gastropods, amphipods, polychaetes, hydroids, cladocerans, copepods, ostracodes, nematodes, oligochaetes, rotifers, tardigrades, mites and insects. We also detected presence of established invaders as *Cercopagis pengoi*, though it is not clear whether this species was present before the ship entered the lakes. Further analyses will allow us to determine the potential strength of hull fouling vs. ballast water vectors.

Takesue, R. K., USGS, Santa Cruz, USA, rtakesue@usgs.gov;
Lacy, J., USGS, Santa Cruz, USA, jlacy@usgs.gov;
Talbot, S. L., USGS, Anchorage, USA, stalbot@usgs.gov;
Wyllie-Echeverria, S., UW, Friday Harbor, USA, zmseed@u.washington.edu

EELGRASS *(ZOSTERA MARINA)* MORPHOLOGY ALONG A HIGH-BOAT TRAFFIC SHORELINE: LIGHT LIMITATION OR GENETICS?

Oscillatory motions associated with boat wakes exert drag on aquatic vegetation and may degrade water clarity by resuspending sediment. In urban areas with high boat traffic, such conditions may chronically stress intertidal eelgrass *(Zostera marina)*. Eelgrass plants near an urbanized bay (Liberty Bay (LB), Puget Sound, Washington) were less than half as long and wide as plants at a nearby non-urbanized shoreline (Sandy Hook, SH). Furthermore, the LB eelgrass bed may have been light-limited because its deep edge was 1 m shallower than at SH. In situ optical backscatter measurements from mid-April to mid-May 2007 showed that turbidity was indeed higher over the LB eelgrass bed, but high turbidity was also frequent at SH. Turbidity events were not solely associated with boat wakes at either site. Morphological differences in eelgrass could also reflect genotypic variation between LB and SH beds. Analyses of microsatellite loci showed

that the eelgrass bed at LB was genotypically richer than at SH. Due to the small number of genets at SH, however, it is unclear whether the two eelgrass populations are distinct.

Tall, L., Université de Montréal, Montreal, Canada, laure.tall@umontreal.ca;
Caraco, N., Cary Institute of Ecosystem Studies, Millbrook, USA, caracon@ecostudies.org;
Maranger, R., Université de Montréal, Montreal, Canada, r.maranger@umontreal.ca

IMPACT OF AN INVASIVE MACROPHYTE, *TRAPA NATANS* ON NITROGEN DYNAMICS IN THE HUDSON RIVER

Aquatic plants can play a significant role as ecosystem engineers by altering chemical dynamics in the surround waters. In the freshwater reach of the tidal Hudson River, *Trapa natans*, a floating leaved, invasive plant depletes its environment of oxygen by venting it to the atmosphere. This results in large zones of anoxia in the *Trapa* beds during ebb tide. We measured the impact of this invasive plant on N dynamics by measuring the change in dissolved N_2 concentrations in the beds during the tidal cycle. We found a strong predictive relationship between O_2 and N_2 concentrations, with N_2 accumulating as O_2 depletes. Nitrate loss observed within *Trapa* beds can be explained entirely by denitrification measured as rates of N_2 production. Based on our model, zones of *Trapa* are hotspots for N loss removing approximately 40% of the summertime N load to the river. They are a significant and permanent N sinks in the freshwater reach of tidal Hudson River despite the fact that they occupy only 6% of the surface area.

Tam, J. C., St. Francis Xavier University, Antigonish, Canada, jamiectam@gmail.com;
Scrosati, R. A., St. Francis Xavier University, Antigonish, Canada, rscrosat@stfx.ca

TESTING THE ABUNDANT CENTRE HYPOTHESIS AT LOCAL AND REGIONAL SCALES USING NW ATLANTIC INTERTIDAL MUSSELS

The Abundant Centre Hypothesis (ACH), which states that species are most abundant at the centre of their range and decline towards the edges, has driven fundamental and applied ecological research about the causes of species range limits and the implications of climate change on species distributions. Intertidal blue mussels (*Mytilus edulis* and *M. trossulus*) are useful model organisms with which to test the ACH because their distribution patterns are nearly unidimensional along coastlines. We quantified population traits (density, percent cover, age, and size) of mussels in 6 regions across a latitudinal gradient ranging from Newfoundland to New York (approximately 2000 km) and across a wave-exposure gradient in Nova Scotia and Maine. At the regional scale, mussel density and cover increased from Newfoundland to Maine and decreased from Maine to New York. Size and age showed no significant differences between regions. Along the exposure gradient, mussel density was higher at the exposed level than at the very sheltered, sheltered, and very exposed levels. Our study indicates that mussel density across regional and local scales provides weak support for the ACH.

Tank, J. L., University of Notre Dame, Notre Dame, USA, tank.1@nd.edu;
Royer, T. V., Indiana University, Bloomington, USA, troyer@indiana.edu;
Rosi-Marshall, E. J., Loyola University, Chicago, USA, erosi@wpo.it.luc.edu;
Frauendorf, T. C., University of Notre Dame, Notre Dame, USA, tfrauendorf@gmail.com;
Griffiths, N. A., University of Notre Dame, Notre Dame, USA, Natalie.Griffiths.5@nd.edu;
Stephen, M. L., University of Notre Dame, Notre Dame, USA, stephen.2@nd.edu;
Whiles, M. R., Southern Illinois University, Carbondale, USA, mwhiles@zoology.siu.edu

THE WIDESPREAD OCCURRENCE OF TOXIN FROM TRANSGENIC CORN IN A STREAM NETWORK OF AN AGRICULTURAL LANDSCAPE

In 2007, nearly 50% of corn planted in the U.S. was genetically engineered to express the insecticidal Cry1Ab toxin. Because corn detritus on fields can be transported to stream channels via wind and surface runoff, the potential exists for Cry1Ab to occur in streams both in detritus and dissolved in the water. However, the prevalence and fate of the Cry1Ab toxin in aquatic environments is largely unknown. In a synoptic survey of 215 stream sites within a 1053 km^2 intensively-farmed region of Indiana, we measured the concentration of Cry1Ab in submerged corn detritus and in the water column. Corn detritus was found in 65% of the 215 stream channels, and of those, 27% had corn detritus with measurable Cry1Ab concentrations (mean = 68 ng/g). Of the sites with Cry1Ab-positive detritus, ~90% also had detectable Cry1Ab in the stream water (mean concentration = 14 ng/L). This study suggests that Cry1Ab may be a ubiquitous component of stream ecosystems in the corn-belt of the U.S. and spatial analyses will further investigate the role of streams in accumulating and transporting this transgenic product.

Tank, S. E., Simon Fraser University, Burnaby, Canada, suzanne_tank@sfu.ca;
Lesack, L., Simon Fraser University, Burnaby, Canada, llesack@sfu.ca;
Osburn, C. L., US Naval Research Laboratory, Washington DC, USA, christopher.osburn@nrl.navy.mil

RESOLVING SOURCES OF DOM TO LAKES OF THE MACKENZIE DELTA, WESTERN CANADIAN ARCTIC: A MULTIPLE TRACER APPROACH

The Mackenzie Delta provides a unique site to study dissolved organic matter (DOM) in aquatic systems. Lakes occur across a gradient that should shape their DOM signature: some lakes remain connected to riverwater channels throughout the summer, while others have short connection times, receive only brief inputs of spring floodwater, but contain dense macrophyte stands that could generate considerable autochthonous DOM. Permafrost melting (thermokarst) is an additional potential source of lakewater DOM. We measured DOM absorptivity, fluorescence, and lignin signatures, and stable isotopes of DOM and precursor materials to elucidate DOM sources in this system. Dissolved organic carbon (DOC) concentrations were seasonally stable except in thermokarst lakes, which accumulated considerable DOC during the summer. DOM molecular weight (assessed as a_{250}: a_{365}) decreased in all lakes as the summer progressed, but leveled off or increased slightly in late-summer, macrophyte-rich lakes. Stable C isotopes suggest that as much as 15% of DOM may be autochthonous in late-summer, high elevation lakes, with bacteria preferentially consuming autochthonous DOM. 'Internal' generation of DOM by macrophytes and thermokarst could help structure bacterial dynamics in this system.

Tarangkoon, W., Marine Biological Laboratory, University of Copenhagen, Helsingør, Denmark, wtarangkoon@bio.ku.dk;
Hansen, G., Department of Biology, Section of Phycology, University of Copenhagen, Copenhagen, Denmark, gerth@bio.ku.dk;
Hansen, P. J., Marine Biological Laboratory, University of Copenhagen, Helsingør, Denmark, pjhansen@bio.ku.dk

SPATIAL DISTRIBUTION OF DINOFLAGELLATES WITH SYMBIONTS: IMPORTANCE OF LIGHT, TEMPERATURE AND INORGANIC NUTRIENTS

The spatial distribution of dinoflagellate with intact symbionts was investigated during a cruise from Cape Town, South of Africa to the Broome Sea, Australia. The Dinophysiales genera *Ornithocercus*, *Histioneis*, *Parahistioneis* and *Citharistes* all had cyanobacteria as ectosymbionts, while the genera *Amphisolenia* and *Triposolenia* contained both intact cyanobacterial and eukaryotic endosymbionts. The dinoflagellates were mainly found in upper 100 m of the water column. All dinoflagellates with symbionts in the photic zone, were found at water temperatures above 16.5 ^{0}C, and both species diversity and cell concentrations were highest at temperatures of 25-30 ^{0}C. The dinoflagellates were always associated with water masses with low nutrient (N-limited) and chl *a* concentrations. Transmission electron microscopy of *O. magnificus* and *O. quadratus* confirmed numerous of food vacuoles inside the cells, and showed that at least some of this ingested material did clearly derived from eukaryotic cells. This suggests that dinoflagellates with ectosymbionts not only ingest their ectosymbionts, but also ingest other prey organisms. Thus, it seems that dinoflagellates with ectosymbionts use a multi resource strategy (photosynthesis/phagotrophy) to cope with the low nutrient environment.

Tarrant, A. M., Woods Hole Oceanographic Institution, Woods Hole, USA, atarrant@whoi.edu;
Baumgartner, M. F., Woods Hole Oceanographic Institution, Woods Hole, USA, mbaumgartner@whoi.edu;
Verslycke, T., Woods Hole Oceanographic Institution, Woods Hole, USA, tverslycke@whoi.edu;
Johnson, C. L., Bedford Institute of Oceanography, Dartmouth, Canada, cathjohnson@gmail.com

MOLECULAR CHARACTERIZATION OF DIAPAUSE IN THE MARINE COPEPOD CALANUS FINMARCHICUS

During the last juvenile stage (C5), Calanus finmarchicus undergoes a facultative diapause consisting of delayed development, migration to depth, reduced metabolism, and utilization of stored lipids. To facilitate studies of diapause regulation, we characterized gene expression patterns in C. finmarchicus C5 copepodids collected from surface and deep waters of the Gulf of Maine. Morphological and biochemical measurements demonstrated that these copepodids were from active and diapausing populations. Quantitative RT-PCR indicated (1) upregulation of three genes associated with lipid synthesis, transport and storage in active copepods, (2) upregulation of ferritin in diapausing copepods, consistent with a role of ferritin in protecting lipids from oxidative damage, and (3) upregulation of ecdysteroid receptor in diapausing copepods. This study represents the first molecular characterization of gene expression associated with calanoid copepod diapause, and provides a suite of markers that could be used to indicate physiological changes associated with preparation for, progression through, and emergence from diapause.

Taub, F. B., University of Washington, Seattle, USA, taub@u.washington.edu

CELLULOSE CONTRIBUTIONS TO AN ALGAE-*DAPHNIA*-MICROBE FOOD CHAIN IN CLOSED ECOLOGICAL SYSTEMS

The addition of cellulose fibers, expected to be inert or harmful to *Daphnia*, resulted in delayed, but larger and more sustained *Daphnia* populations, compared to ecosystems that received sodium bicarbonate or no-added-carbon. Potential mechanisms: (1) microbial breakdown of cellulose with its carbon becoming available to algae for photosynthesisÃ¢â‚¬â€ thus increasing primary production and *Daphnia* food; (2) direct assimilation of cellulose, which has been shown with radioactively labeled cellulose and the demonstration of cellulase enzymes in *Daphnia*; (3) microbial production of growth factors such as vitamins or fatty acids required by *Daphnia*; and (4) protection of algal cells by interference or gut filling, thus delaying over-grazing. Cellulose was also associated with increased in vivo fluorescence (estimate of algal biomass) in systems as compared to those that received no-added-carbon; this was shown in both microcosms open to the atmosphere and closed. Oxygen and carbon dioxide were monitored for metabolic activity in some experiments. A year after the systems were established, cellulose fibers are still evident. Thus, particulate materials, even of presumably inert materials, should not be ignored in food chain considerations.

Thackeray, S. J., Centre for Ecology and Hydrology , Lancaster, United Kingdom, sjtr@ceh.ac.uk

SPATIAL HETEROGENEITY IN LAKE ZOOPLANKTON: EXPLORING THE TEMPORAL DIMENSION

Lake zooplankton populations and communities are known to show a high degree of spatial heterogeneity. Within a lake, this patchiness is apparent over a range of spatial scales, with different drivers affecting distribution patterns at each scale. A number of studies have shown that basin scale patterns can be generated by physical processes such as internal waves and wind induced circulation patterns, however few studies have attempted to quantify these effects. The results of repeated spatial surveys in a UK lake will be presented and the influence of circulation patterns on the distribution of a lake zooplankton population quantified. The results will demonstrate the dynamic nature of these spatial patterns. Future work should integrate analyses of both spatial and temporal variation in zooplankton abundance. The high degree of temporal variation in spatial heterogeneity necessitates more intensive studies to assess the time scales over which spatial patterns change, and the ecological implications of these changes. Furthermore, the possible implications of spatial heterogeneity for long term analyses of lake communities must be considered.

Therriault, T. W., Fisheries and Oceans Canada, Nanaimo, Canada, thomas.therriault@dfo-mpo.gc.ca;
Herborg, L. M., Fisheries and Oceans Canada, Nanaimo, Canada, herborgl@pac.dfo-mpo.gc.ca

PREDICTING THE POTENTIAL DISTRIBUTION OF TWO NON-INDIGENOUS BOTRYLLID TUNICATES IN CANADA

Determining whether or not a potential invader can establish in new environments and what its potential distribution could be is important when characterizing potential risk. In marine waters, tunicates have received much attention, largely due to their negative impacts on shellfish aquaculture. Two botryllid tunicates, the golden star tunicate (Botryllus schlosseri) and the violet tunicate (Botrylloides violaceus), are no exception. In order to characterize the potential distribution of these closely related colonial tunicate species, we evaluated different types of environmental models. Simple models based on reported temperature and salinity tolerances were relatively uninformative as almost all waters were deemed suitable. In contrast, more complex genetic algorithm for rule-set prediction (GARP) environmental niche models based on documented Canadian occurrence points provided informative projections of the potential distribution for Canadian waters. Further, we were able to use occurrence points on one coast to predict the potential distribution on the other. We also evaluated how using occurrence data for a closely related species (the other botryillid) to supplement limited data for the target species affected predictions. The potential benefits and limitations of using these additional approaches for predicting the potential distribution of a new invader will be discussed.

Thomas, D. R., Kutztown University, Kutztown, USA, dthom587@kutztown.edu;
Ryan, W. L., Kutztown University, Kutztown, USA, ryan@kutztown.edu;
Butler, N. M., Kutztown University, Kutztown, USA, butler@kutztown.edu

ZOOPLANKTON RESPONSES TO HYDROSTATIC PRESSURE CHANGES

Zooplankton typically experience changes in hydrostatic pressure during their daily vertical migrations. This experiment was designed to examine the metabolic response of various marine and freshwater zooplankton in response to rapid changes in hydrostatic pressure. It was hypothesized that the response of these organisms to this stress would be an increase in oxygen consumption during recovery. Zooplankton were exposed to various levels of hydrostatic pressure, and their subsequent oxygen consumption was recorded. Initial results suggest that freshwater cyclopoid copepods exhibit an increase in oxygen consumption after being subjected to increased hydrostatic pressure, with oxygen consumption rates increasing with increasingly higher pressures. These results will be compared to the responses of various marine and freshwater plankton subjected to similar ranges of hydrostatic pressure.

Thompson, B. P., Fluid Imaging Technologies, Yarmouth, USA, brian@fluidimaging.com;
Nelson, W. H., Fluid Imaging Technologies, Yarmouth, USA, harry@fluidimaging.com;
Poulton, N. J., Bigelow Labortory for Ocean Sciencies, Boothbay Harbor, USA, npoulton@bigelow.org;
Ellis, S., Fluid Imaging Technologies, Yarmouth, USA, scott@jumpnowtek.com

USING AN IMAGING-IN-FLOW PARTICLE ANALYZER (FLOWCAM) FOR PHYTOPLANKTON ANALYSIS AND AUTOMATED CLASSIFICATION

The ability to monitor plankton in either a marine or freshwater system is a requirement for understanding the role these primary producers play in a particular ecosystem. Automated detection and monitoring tools are helpful in order to reduce labor intensive manual methods (such as microscopy) or when information is needed quickly in monitoring programs and in remote locations. Determining plankton abundance, biovolume estimates and size classification or group classification is important when identifying plankton or potentially harmful species in an aquatic system. Here we present data from a continuous imaging particle analyzer (FlowCAM) that uses proprietary VisualSpreadsheet software to automatically detect, image, enumerate and now automatically classify plankton in real-time. Once the FlowCAM has analyzed a sample or batch of samples, the software has the ability to process digital images for

automatic classification using user generated libraries or image training sets. Libraries and training sets can also be employed real-time to detect and then capture only those organisms of interest. These libraries can identify and quantify specific groups (e.g., genus or species) or size classes of plankton automatically. An overview of the technology will be given, along with Classification results from numerous sample runs.

Tokle, N. E., Norwegian University of Science and Technology/ Trondhjem Biological Station, Trondheim, Norway, Nils.Tokle@bio.ntnu.no;
Gismervik, I., University of Oslo/ Department of Biology, Oslo, Norway, Ingrid.Gismervik@bio.uio.no;
Vadstein, O., Norwegian University of Science/ Department of Biotechnology, Trondheim, Norway, Olav.Vadstein@biotech.ntnu.no

FEEDING STRATEGIES OF FOUR CALANOID COPEPODS OFFERED MIXTURES OF A CILIATE AND A DINOFLAGELLATE AS PREY

The feeding strategy of four calanoid copepods was studied when offered a mixture of *Karlodinium micrum* and *Strobilidium spirali*s in different concentrations and ratios. Two different experiments were performed; one with constant surplus concentration of *K. micrum* and varying *S. spiralis* concentration, and one with constant limiting food concentration and varying proportions of both types of prey. Fed *K. micrum* in surplus, the copepods *Acartia clausi*, *Centropages hamatus* and *Calanus finmarchicus* exhibited high preference for *S. spiralis*, fulfilling our criteria for switching when ciliates contribute >3-5% of the food offered, whereas *Temora longicorni*s did not discriminate between the two types of prey. When food was limiting, *T. longicornis* completely changed its feeding strategy, grazing almost solely on *S. spiralis* given that *S. spiralis* contributed >10% of the offered food. In contrast, *A. clausi* behaved at limiting food concentration as a non-selective suspension feeder. Our results suggest that the feeding behaviour of the four copepods and, possibly, copepods in general, is more complex than proposed in the literature.

Tokunaga, T., Saga University, Saga City, Japan, Tokunaga@ilt.saga-u.ac.jp;
Matsunaga, N., Kyushu University, Kasuga City, Japan, matsunaga@esst.kyushu-u.ac.jp

EFFECT OF RESUSPENSION OF SEDIMENTS ON OXYGEN CONSUMPTION PROCESSES IN ARIAKE BAY

The oxygen consumption process through the bottom surface is considered to play a very important role in the development of hypoxia. Numerous studies have been conducted to quantify sediment oxygen demand. However, we can easily guess that the effect of resuspension of sediments may also play an important role on oxygen consumption process in a sea area with strong tidal currents like the Ariake Bay. In this study, laboratory experiments were carried out. Two ways of experiments were performed. One was an experiment including the microbe activity, and the other experiments were cases without microbe activity by a mercury chloride. The oxygen consumption after having resuspended sediments is considerably larger than sediment oxygen demand. The chemical oxygen consumptions increased with increasing the layer thicknesses of sediments. The sediments including organic matter and a reduction material being resuspended, the chemical oxygen consumption excels in the early period, and only biological oxygen consumption increses afterwards. The oxygen consumption in 5 meters layer was estimated. Resuspension of sediments plays an important role for the oxygen consumption of Ariake Bay.

Tollrian, R., Ruhr-University , Bochum, Germany, tollrian@rub.de

INDUCIBLE DEFENSES: FROM MOLECULES TO ECOSYSTEMS

The last decades have changed our view of plankton organisms in many ways. A good example is the role of phenotypic plasticity in defensive traits. The fascinating ability of organisms to chemically sense their predation risk and to form adequate defense structures has been reported from unicellular organisms to vertebrates. I will review progress and recent trends in the study of inducible defenses. Phenotypic plasticity in defensive traits has been shown to evolve as an adaptation to heterogeneity in predation risk. Inducibility of traits is favored if the predation risk is variable, if reliable cues indicate the danger, if effective defenses can be formed within relatively short time spans and if costs are associated with the defenses, which can be saved during times when the defenses are not needed. However, even within single species not all genotypes respond in the same direction. Local adaptations and even the existence of multiple optima have been shown illustrating the role of selection in the evolutionary process. Inducible defenses have been reported to bear the potential to dampen predator-prey oscillations leading to coexistence in bi- and tritrophic experimental systems, and thus to influence populations and communities.

TRABELSI, A., LOV-UMR 7093-CNRS-UPMC Paris 6, Villefranche-sur-mer, France, asma.trabelsi@obs-vlfr.fr;
Rassoulzadegan, F., LOV-UMR 7093-CNRS, Villefranche-sur-mer, France

ROLE OF MICROBIAL LOOP IN DISSOLVED ORGANIC CARBON CYCLING

In a coastal Mediterranean Seawater, we studied the effects of the microbial loop on DOC cycling. We followed the abundance of distinct component of the microbial loop: bacteria, viruses, heterotrophic nanoflagellates and ciliates in comparison to DOC rates over 16 months of weekly sampling at Villefranche Bay. We also compared the grazing and nutrient changes effects on bacterial abundance and activity in different systems of natural water and incubation experiment. We found that bacteriovory by protists and viral lysis, were responsible on bacterial abundance control in both environments. In the natural system viruses were responsible of the most important variability of bacterial abundance; they were also responsible on the negative controls on bacterial production and bacterial growth efficiency leading to a lower DOC cycling of bacteria in the presence of high viral abundance. A direct negative correlation between DOC and viruses confirms our earlier finding on the importance of the viral effects of DOC changing rates. In addition to viruses, DOC rates were negatively correlated to ciliates and positively to bacterial abundances. Our results on the incubation experiment, showed that notably predation on bacteria and nutrient addition played also an important role in DOC regulation.

Tremblay, A., Hydro-Québec, Montréal, Canada, tremblay.alain@hydro.qc.ca;
Varfalvy, L., Hydro-Québec, Montréal, Canada, varfalvy.louis@hydro.qc.ca

GREENHOUSE GASES FROM BOREAL HYDROELECTRIC RESERVOIRS: 15 YEARS OF DATA ?

Carbon dioxide (CO2) and methane (CH4) are the world's main greenhouse gases and are emitted from both natural aquatic ecosystems (lakes, rivers, estuaries, wetlands) and manmade reservoirs. The role of greenhouse gas emissions from freshwater reservoirs and their potential contribution in increasing atmospheric GHG concentrations is actually well discussed worldwide. To our knowledge, although they are at the heart of the debate concerning pros and cons of different sources of energy production, there are fairly few emission measurements available for fresh water reservoirs on a global basis. Increasing the number of measurements will significantly reduce uncertainties surrounding representative mean gross flux from natural systems as well as from reservoirs. This communication presents data of GHG flux measurements taken on reservoirs of various ages and sizes as well as on adjacent lakes and rivers from Canadian boreal ecosystems. GHG emissions were measured with a floating chamber connected to an automated NDIR instrument giving real-time values. Our results indicate an increase of GHG emissions rapidly after flooding and a return to values of natural systems within 10 years or less. The return to natural ecosystems values is faster for CH4 than for CO2. Based on 15 years of data, GHG emissions from boreal reservoirs would generally represent 1 to 5% of a thermal power plant of equivalent generation capacity, therefore, boreal reservoirs are very low GHG emitters.

Tremblay, J. E., Université Laval, Québec, Canada, jean-eric.tremblay@bio.ulaval.ca

ARE PRODUCTIVE, POLAR MARINE ECOSYSTEMS EFFICIENT VECTORS OF DOWNWARD CARBON FLUX?

A decade of research in polar oceans suggests that the efficiency of the biological pump is low and similar across highly productive systems despite large differences in physical forcing and taxonomic composition. Estimates of the proportion of the annual particulate primary production intercepted by traps at 200 m are under 3% in these systems. Even if the vertical export of carbon to depth is somewhat underestimated, it is clear that most of the

photosynthetically-fixed carbon is retained in the upper water column at the seasonal scale. This finding implies that the high, short-term export efficiency previously invoked for high-latitude systems is either not widespread or the artefact of a flawed comparison between point estimates of primary production and time-integrative estimates of export. When this comparison is made after a bloom it greatly increases the apparent efficiency of seasonally-pulsed systems relative to those where primary production is relatively steady. This presentation addresses different modes of production, respiration and export in productive polar waters and revisits the notion that cold, seasonally-pulsed ecosystems foster rapid and efficient downward fluxes of particulate organic carbon.

Tremblay, N., Centro Interdisciplinario de Ciencias Marinas, La Paz, Mexico, nellytremblay@gmail.com;
Gómez-Gutiérrez, J., Centro Interdisciplinario de Ciencias Marinas, La Paz, Mexico, jagomezg@ipn.mx;
Zenteno-Savín, T., Centro de Investigaciones Biológicas del Noroeste, La Paz, Mexico, tzenteno04@cibnor.mx;
Robinson, C. J., Instituto de Ciencias del Mar y Limnología, UNAM, D.F. Mexico, Mexico, robmen@servidor.unam.mx;
Maeda-Martínez, A. N., Centro de Investigaciones Biológicas del Noroeste, La Paz, Mexico, amaeda04@cibnor.mx

BIOCHEMICAL EXPLANATION OF DIEL VERTICAL MIGRATION OF ZOOPLANKTON: KRILL RESPONSE TO HYPOXIC CONDITIONS

Although diel vertical migration (DVM) of krill and other zooplanktonic organisms has been studied since mid-XVIII century, evidence to explain inter-specific and spatio-temporal variations in DVM extension remains elusive. We compared the antioxidant response and respiration rates of three krill species of the Gulf of California. In winter, *Nyctiphanes simplex* showed significantly higher free radical production but less antioxidant activity than *Nematoscelis difficilis*, indicating higher UV exposure due to daily surface swarming behavior. In summer, *N. simplex* remained in the warmer top 150 m layer showing higher oxidative damage than *N. difficilis*, which had deeper DVM (below thermocline). *Euphausia eximia* and *N. difficilis* had higher superoxide dismutase and glutathione s-transferase activities than *N. simplex*, particularly when they were below the oxygen minimum layer (OML), perhaps as a response to being exposed to changing oxygen concentrations during ascent. *N. simplex* had lower respiration rates than *N difficilis*. Physiological mechanisms may be extrapolated to other zooplankton species living at ecosystems where OML is relatively shallow, such as coastal upwelling regions or the Eastern Tropical Pacific estimated globally about one million km^2.

Trottet, A., UQAR/ISMER, Rimouski, Canada, auroretrottet@gmx.fr;
Roy, S., UQAR/ISMER, Rimouski, Canada, suzanne_roy@uqar.qc.ca;
Tamigneaux, E., Ecole des peches et de l'aquaculture du Quebec, Grande Riviere, Canada, etamigneaux@cgaspesie.qc.ca;
Lovejoy, C., Universite Laval, Quebec, Canada, Connie.Lovejoy@bio.ulaval.ca;
Tremblay, R., UQAR/ISMER, Rimouski, Canada, rejean_tremblay@uqar.qc.ca

IMPACT OF CULTURED MUSSELS ON PLANKTON COMMUNITIES IN GRANDE-ENTREE LAGOON (QUEBEC)

Mussel culture has been steadily growing since the 1970s in Canada. The sustainability of this industry depends on the ability to forecast the impact of mussel farms on the surrounding ecosystem based on knowledge of local conditions and ecosystem vulnerability. A research program was set up in 2003 to determine the carrying capacity of the Grande-EntrÃƒÆ'Ã†â€™Ãƒâ€šÃ©e Lagoon for suspended mussel culture. The present study examined specifically the influence of mussel filtration activity on plankton communities. Influence of the mussel longlines was estimated by comparing observations inside and outside of the mussel farm. Results showed no differences for nutrients, organic matter and microscopically-determined plankton communities but the mussel farm significantly increased phytoplankton daily productivity and the autotrophs:heterotrophs ratio was often higher at the farm. Present mussel production is probably not high enough to exert a significant control on plankton composition and biomass at the spatial and time scales studied here, although it can enhance the production rate of phytoplankton. The occasional decrease in ciliates observed at the mussel farm relative to the outside suggests that future increases in mussel production could affect these organisms.

Truhn, K. M., Fordham University- Louis Calder Biological Station, Armonk, USA, truhn@fordham.edu;
Perrone, A. A., Fordham University- Louis Calder Biological Station, Armonk, USA, aperrone@fordham.edu;
Wehr, J. D., Fordham University- Louis Calder Biological Station, Armonk, USA, wehr@fordham.edu;
Bell, M., Texas A and M, Galveston, USA;
Vaccarino, M., Baldwin Wallace College, Berea,

OBSERVATIONS AND EXPERIMENTS USED TO PREDICT THE SPREAD OF THE INVASIVE CYANOBACTERIA *LYNGBYA WOLLEI* IN A NORTHEASTERN LAKE

The invasive benthic cyanobacterium *Lyngbya wollei* has colonized a mesoeutrophic lake in southeastern New York. Lake Mahopac is 240 hectares, 20m deep, and hypoxic below 7-10 m for 6 months / year. The lake occupies a suburban landscape with heavy summertime recreation use. Grass carp introduced in 1994 reduced aquatic macrophytes, with *L. wollei* the new dominant benthic autotroph. Annual surveys and experiments have investigated its spatial distribution and links with nutrient inputs: benthic biomass increased more than 2-fold since 1993, and is now recorded in 14 of 30 littoral monitoring sites lake-wide, which correlate with 2 to 3x greater available sediment-N (as NH_4^+). Adjacent riparian soils contribute NO_3^-, which is reduced in hypoxic sediments to ammonium. Total sediment-P (not available-P) was 2x greater in *Lyngbya* sites. Experiments confirmed that elevated N + Ca stimulate *Lyngbya* growth. (1) We propose a series of in situ bioassays to assess combined effects of N, P, Ca and Fe as co-triggers. (2) Assays will also assess the influence of hypoxic conditions, which may enable localized N-fixation and release of iron from sediments.

Tse, P., The Chinese University of Hong Kong, Hong Kong, Hong Kong POC, tpema0@netvigator.com;
Lie, A., The Chinese University of Hong Kong, Hong Kong, Hong Kong POC, AlleAYLie@gmail.com;
Wong, C. K., The Chinese University of Hong Kong, Hong Kong, Hong Kong POC, chongkimwong@cuhk.edu.hk

DIETARY COMPOSITION AND PREDATION IMPACT OF FLACCISAGITTA ENFLATA (CHAETOGNATHA)

Dietary composition and predation impact of the chaetognath Flaccisagitta enflata were studied from samples collected monthly from over a 12-month period from two sheltered bays in the subtropical coastal waters of Hong Kong. Averaged zooplankton density was much higher in Tolo Harbour (TH) than in Mirs Bay (MB). Food containing ratio for F. enflata averaged 16.9% in juveniles and 2.8% in adults, and did not differ significantly between TH and MB. Calanoid copepods, the most important prey, constituted 46% of the gut contents in both TH and MB. Cladocerans constituted 26% of the gut contents in MB and 8% in TH even though their densities were higher in TH than in MB. Copepods and cladocerans were eaten by both adults and juveniles. In contrast, larvaceans, which constituted 33% of the gut contents in adults and only 9% in juveniles, were eaten mainly by adults in both TH and MB. Predation impact of F. enflata, expressed as percentage of prey population removed daily, was 0.28 - 0.42% for copepods, 0.3 - 1.3% for cladocreans and 1.3 - 2.2% for larvaceans.

Tucker, S., Fisheries and Oceans Canada, Nanaimo, Canada, Tuckers@pac.dfo-mpo.gc.ca;
Trudel, M., Fisheries and Oceans Canada, Nanaimo, Canada, TrudelM@pac.dfo-mpo.gc.ca;
Welch, D., Kintama Research Corporation, Nanaimo, Canada;
Beacham, T. D., Fisheries and Oceans Canada, Nanaimo, Canada;
Morris, J. F., Fisheries and Oceans Canada, Nanaimo, Canada;
Candy, J. R., Fisheries and Oceans Canada, Nanaimo, Canada

USING DNA-BASED STOCK IDENTIFICATION TO ELUCIDATE COASTAL MIGRATION OF JUVENILE SOCKEYE SALMON (ONCORHYNCHUS NERKA)

Marine survival of salmon varies with ocean conditions at multiple spatial scales. Therefore the fate of individual stocks may depend on where they migrate and time spent in different regions. This may be particularly pertinent for stocks of BC sockeye which have recently displayed differential survival. Juveniles (n=3551) were collected from the west coast of BC to the Aleutian Islands in coastal DFO trawl surveys from 1997 to 2007, May

to February allowing us to reconstruct changes in stock composition for different regions and seasons using DNA stock identification techniques. We allocated individuals to 13 regional populations. Fraser river stocks tended to dominate most catches reflecting large population sizes. However in spring, catches were dominated by salmon from nearby rivers. Proportional stock composition changed as season's progressed indicating northward migration along the coast. Most Fraser River sockeye migrated through Johnston Strait with the exception of Harrison Lake sockeye which migrated through Juan de Fuca Strait. Sockeye generally disappeared from the coast by winter with the exception of a proportion of Fraser fish found along the west coast of Vancouver Island.

Umorin, M. P., Texas Water Development Board, Austin, USA, Mikhail.Umorin@twdb.state.tx.us

HOW TO PUT PHYSICS, CHEMISTRY, AND BIOLOGY TOGETHER?

A framework for connecting separate models of interacting processes is introduced. The framework allows concurrent or sequential interaction of models with different grids and time steps. The interaction is achieved through a creation of a system state object and its communication with running processes via MPI. System state object periodically updates or saves its status to a storage. The framework is implemented in C++ and tested for a case of using netCDF output from a hydrodynamic model of an estuary to drive a biological model with a different grid structure.

Unal, E., University of Connecticut, Avery Point, USA, ebru.unal@uconn.edu;
Bucklin, A., University of Connecticut, Avery Point, USA, ann.bucklin@uconn.edu;
Wiebe, P. H., Woods Hole Oceanographic Institution, Woods Hole, USA, pwiebe@whoi.edu

MOLECULAR GENETIC EVIDENCE OF BASIN-SCALE POPULATION DYNAMICS OF THE COPEPOD CALANUS FINMARCHICUS IN THE NORTH ATLANTIC OCEAN

The copepod Calanus finmarchicus is a key component of the pelagic food web in the North Atlantic. The basin-scale population may be considered to be partitioned among three semi-distinct gyre systems: the Norwegian Sea, the northern North Atlantic, and the western North Atlantic. Even though its ecology and life history characteristics are well documented, the population genetics of C. finmarchicus have not been comprehensively characterized. In this study, basin-scale patterns of population genetic diversity and structure of C. finmarchicus were described using Single Nucleotide Polymorphism (SNPs) in three protein-coding nuclear genes detected using multiplexed ABI SNaPshot protocols. Samples were collected during 2005 from diverse locations across the geographic range of the species, with samples selected to resolve spatial scales from small-scale patches to ocean gyres. The results revealed significant geographic partitioning among the ocean gyre populations, as well as possible smaller-scale population genetic heterogeneity. The significant sub-division of the species population will impact its sensitivity to climate change, and determine consequences of large-scale forcing on the geographically and genetically distinct populations.

Valdes, A., SoMAS, Stony Brook University, Stony Brook, USA, alexandra.valdes@stonybrook.edu;
Aller, J. Y., SoMAS, Stony Brook University, Stony Brook, USA, jyaller@notes.cc.sunysb.edu;
Radway, J. C., SoMAS, Stony Brook University, Stony Brook, USA, jcradway@notes.cc.sunysb.edu;
Kemp, P. F., C-MORE, Honolulu, USA, paul.kemp@hawaii.edu;
Chistoserdov, A. Y., University of Louisiana at Lafayette, Lafayette, USA, ayc6160@louisiana.edu

DETECTION OF HUMAN VIRAL PATHOGENS IN COASTAL WATERS

Viral pollution in the marine environment is of great concern due to human viral infections and the discharge of human viral pathogens into coastal waters via wastewater discharges, aerosols, and land runoff. Bacterial indicators are typically used for water quality measurements, but these do not totally reflect fecal pollution. We have developed methods to concentrate, detect and quantify specific human viruses in coastal waters to contrast point (wastewater discharges) and non-point sources (rainfall events). One liter of water was collected monthly and concentrated initially using tangential flow filtration (TFF) and adsorption-elution (AE) methods followed by ultracentrifugation. Reverse transcriptase-PCR (RT-PCR) and Quantitative RT-PCR (QRT-PCR) were used for detection and quantification of Enteroviruses, Hepatitis A viruses and Noroviruses. Total viral abundances were tracked by epifluorescence microscopic counts of viral-like particles (VLPs). Concentrations methods collected VLPs with efficiencies ranging from 20-60% depending on water type. Human pathogenic viruses were detected in environmental samples, but low viral RNA yields hampered quantification. Efforts continue to optimize quantification and determine viability.

Valiela, I., The Ecosystems Center and Boston University Marine Program, Marine Biological Laboratory, Woods Hole, USA, ivaliela@mbl.edu;
Fox, S. E., The Ecosystems Center and Boston University Marine Program, Marine Biological Laboratory, Woods Hole, USA, sefox@mbl.edu;
Olsen, Y. S., The Ecosystems Center and Boston University Marine Program, Marine Biological Laboratory, Woods Hole, USA, yolsen@bu.edu;
Kinney, E., The Ecosystems Center and Boston University Marine Program, Marine Biological Laboratory, Woods Hole, USA, ekinney@bu.edu

COUPLING OF LAND AND SEA THROUGH THE LITTORAL ZONE AND ALTERATIONS OWING TO HUMAN LAND USE

There are powerful couplings between watersheds and coastal waters. The couplings of adjoined terrestrial and aquatic ecosystems are largely controlled by water transport down gradient from land to sea, often through littoral wetlands. Coastal wetlands provide key ecological services to adjoined ecosystems, including interception of land-derived nutrients, carbon burial, organic and sediment transport, stabilization of coastal land, and provision of food and nurseries for commercial fish and shellfish stocks. Human-driven changes in terrestrial land use alter the connectivity among adjoined receiving ecosystems, and the linkages are mediated by processes taking place at the interface of land and sea in the littoral zone. Since there is widespread human settlement and construction near shore (cities, roads, levees), the natural coastal landscape has been significantly altered and wetlands have been severely reduced worldwide. The loss of wetland area has been linked to increased nutrients and particulates in receiving waters, phytoplankton and macroalgal blooms, loss of seagrass meadows, and reduced fish and shellfish stocks.

Van de Bogert, M. C., University of Wisconsin, Madison, USA, mcvandeb@wisc.edu;
Langman, O. C., University of Wisconsin, Madison, USA, oclangman@wisc.edu;
Bade, D. L., Kent State University, Kent, USA, dbade@kent.edu;
Carpenter, S. R., University of Wisconsin, Madison, USA, srcarpen@wisc.edu;
Cole, J. J., Institute of Ecosystem Studies, Millbrook, USA, colej@ecostudies.org;
Pace, M. L., University of Virginia, Charlottesville, USA, pacem@ecostudies.org;
Kratz, T. K., University of Wisconsin, Madison, USA, tkkratz@wisc.edu;
Hanson, P. C., University of Wisconsin, Madison, USA, pchanson@wisc.edu

CONFRONTING WITHIN-LAKE HETEROGENEITY: HOW MANY SENSORS DOES IT TAKE TO MEASURE WHOLE-LAKE METABOLISM?

Automated, high-frequency, in-situ dissolved oxygen (DO) sensors are widely used to obtain estimates of gross primary production (GPP) and respiration (R) in aquatic ecosystems. While researchers often rely on a single, centrally-located, sensor for these estimates, recent work has shown considerable heterogeneity of these measurements within lakes. How can researchers best measure whole-lake metabolism when faced with that heterogeneity? We addressed this question by deploying 35 and 28 high-frequency temperature and DO sensors throughout the epilimnia of two lakes in Northern Wisconsin, USA, respectively. These sensors provided location-specific dissolved oxygen measurements as well as spatially-weighted lake-wide estimates. The average range of daily variation in dissolved oxygen was approximately 0.1 mgÃ¢â‚Â¢Lâ»Â¹dâ»Â¹ in pelagic sites, while much greater, 0.8 mgÃ¢â‚Â¢Lâ»Â¹dâ»Â¹, in littoral zones. Individual locations often did not follow the classic Odum model(1956) and prevented the estimation of GPP and R. When averaged lake-wide, however, dissolved oxygen did follow the Odum model and we were able to calculate

whole-lake GPP and R. The minimum number of sensors needed to obtain acceptable results was determined using rarefaction techniques.

Van de Waal, D. B., Aquatic Microbiology, Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Amsterdam, Netherlands, dwaal@science.uva.nl;
Verspagen, J. M., Aquatic Microbiology, Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Amsterdam, Netherlands, jvrspgn@science.uva.nl;
Van Donk, E., Aquatic Food Webs, Centre for Limnology, Netherlands Institute of Ecology, Nieuwersluis, Netherlands, e.vandonk@nioo.knaw.nl;
Matthijs, H. C., Aquatic Microbiology, Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Amsterdam, Netherlands, hansmatt@science.uva.nl;
Huisman, J., Aquatic Microbiology, Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Amsterdam, Netherlands, jefhuism@science.uva.nl;
Visser, P. M., Aquatic Microbiology, Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, Amsterdam, Netherlands, pvisser@science.uva.nl

RISING CO2 AND THE IMPACT OF C:N STOICHIOMETRY ON MICROCYSTIN PRODUCTION IN HARMFUL CYANOBACTERIA

Microcystis is a widespread and potentially harmful cyanobacterium, which can produce hepatotoxic microcystins. Microcystin variants, such as microcystin-LR, -RR and -YR, differ in the composition of amino acids and thereby in their nitrogen:carbon (N:C) ratio. We studied the impact of changes in the availability of dissolved inorganic carbon (DIC) and nitrogen (DIN) on microcystin production of Microcystis aeruginosa strain HUB5-2-4. Continuous cultures were grown under nitrogen-limited, carbon-limited, or light-limited conditions. The experiments showed that rising CO2 levels caused a shift from carbon to nitrogen limitation under nitrogen-poor conditions, but a shift from carbon to light limitation under nitrogen-rich conditions. The intracellular microcystin content decreased significantly with increasing cellular C:N ratios. Interestingly, the strongest effect was observed in microcystin-RR, which is the microcystin variant with the highest N content. Microcystin-RR increased 52-fold from nitrogen-limited to light-limited conditions. In total, our results indicate that rising CO2 concentrations will lead to reduced microcystin contents in relatively oligotrophic waters, whereas it will lead to increased microcystin contents in eutrophic waters.

van Oevelen, D., NIOO-KNAW, Yerseke, Netherlands, d.vanoevelen@nioo.knaw.nl;
Veuger, B., NIOO-KNAW, Yerseke, Netherlands, b.veuger@nioo.knaw.nl

QUANTIFYING THE STOICHIOMETRIC AND COMPOUND-SPECIFIC SIDE OF BACTERIVORY IN AN INTERTIDAL SOFT SEDIMENT USING ^{13}C AND ^{15}N AS TRACERS

Bacterivory is a potentially important interaction between bacteria and benthos in marine sediments. Experimental work has shown that the contribution of bacterial carbon in diets of most benthic species is limited to 10-15%. The limiting nutrient in marine benthic food webs is however nitrogen and the low C:N ratio of bacteria suggests that they may be more important as nitrogen source. Moreover, bacteria may be an invaluable source of essential or limiting fatty acids and/or amino acids. The stoichiometric and compound-specific sides of the bacteria Ãƒ Æ'¢Ã¢Ã¢â‚Å¡Ã¢Ã¢â€šÂÃ… â€œ benthos interaction were targeted specifically by injecting ^{13}C-glucose and ^{15}N-ammonium in the sediment surface of *in situ* experimental plots and retrieved cores. Enrichment in ^{13}C and ^{15}N was traced in bacteria (bacterial-specific fatty acids and amino acids), meiobenthos (taxa-level) and macrobenthos (species level) and allowed simultaneous quantification of the importance of bacterial C and N in the diets of intertidal fauna. Compound-specific ^{13}C and ^{15}N enrichment in fatty acids and amino acids of two dominant polychaetes (Heteromastus filiformis and Nereis spp.) and oligochaetes allowed identifying compounds that are specifically derived from bacteria.

Vercaemer, B., Fisheries and Oceans Canada, Dartmouth, Nova Scotia , Canada, vercaemerb@mar.dfo.mpo.gc.ca;
Nicolas, J. M., Fisheries and Oceans Canada, Dartmouth, Nova Scotia , Canada, nicolasjm@mar.dfo.mpo.gc.ca;
Sephton, D., Fisheries and Oceans Canada, Dartmouth, Nova Scotia , Canada, sephtond@mar.dfo.mpo.gc.ca

A CANADIAN AQUATIC INVASIVE SPECIES PROJECT: MONITORING FOR TUNICATES IN NOVA SCOTIA

In the past decade, the shellfish culture industry in Atlantic Canada has been severely impacted by invasions of fouling tunicates. A surveillance program was initiated by DFO in 2006 under the Aquatic Invasive Species program, with the involvement of community groups, to monitor five species of concern: Ciona intestinalis, Botrylloides violaceus, Botryllus schlosseri, Styela clava and Didemnum vexillum. Collection plates were deployed at geo-referenced sites along the coast of mainland Nova Scotia and Cape Breton and retrieved after 12 and 24 weeks. Monitoring sites were selected based on the presence of the following risk factors for tunicate introduction or establishment: shellfish processing/aquaculture in area, port with international traffic, marina with US traffic, fishing harbour, high risk ports with herring or US caught lobster processing. To complement this targeted surveillance, posters, brochures and ID Watch Cards were produced in an effort to promote community based monitoring (general surveillance) and circulated to members of the general public, lease holders and fishermen. Numerous presentations have been made to various stakeholders and a toll-free AIS tunicates reporting line and e-mail address were also established.

Vermaat, J. E., Institute for Environmental Studies, Vrije Universiteit, Amsterdam, The Netherlands, jan.vermaat@ivm.vu.nl;
Vigneau, N., Institute for Environmental Studies, Vrije Universiteit, Amsterdam, The Netherlands
Omtzigt, N., Institute for Environmental Studies, Vrije Universiteit, Amsterdam, The Netherlands

THE VARIABLE IMPORTANCE OF HABITAT PERIMETER FOR MARSH BIRDS IN COMPLEX DUTCH WETLAND LANDSCAPES: IS IT EDGE OR AREA?

Across the Netherlands, a range of wetland complexes forms a patchy network of variable extent, habitat quality and prevalence as well as mutual proximity. We assessed the effects of within-complex habitat prevalence and spatial arrangement, land use in the wetland complex and in the surrounding perimeter of 10 km radius, and water quality on abundance of 15 different wetland bird species, applying principal components analysis. Together these variables allowed us to assess the relative importance of the water, the littoral edge and the adjacent wetland at a landscape scale. The bird species differed in size (beak-to-tail: 13 – 80 cm), guild, overall abundance in Northwestern Europe and national red list status (Dutch populations range between 3 – 25000 pairs), and included the marsh harrier, bearded tit, bluethroat, several warblers, bitterns, common snipe, water rail and two ducks. Detailed, reliable census data exist for all since at least 1990. For most species, total area of the wetland complex was most important in explaining abundance. It covaried strongly with the first principal component, explaining 41% of total variance. Only for four species, water perimeter was more important (the great reed warbler, Savi's warbler, the little bittern and the night heron). Water perimeter covaried with the second principal component, and explained 18%. Water quality (as total nitrogen, total phosphorus, mean summer chlorophyll and Secchi depth) did not covary with bird abundance, but agricultural intensity in the perimeter (as fertilizer use) as well as visitor density in the complex both correlated positively with nutrient concentration and negatively with submerged aquatic vegetation. Together they covaried with a third component, explaining 17%. In the wetland complexes, area and perimeter of forest and marshland without trees (reed and sedgebeds, hay meadows) all covaried, suggesting that these complexes were quite similar in landscape pattern. This is confirmed by the joint covariance pattern in density of most bird species: 11 have parallel patterns of abundance among wetlands. Only three wetland complexes harbour source populations of more than two bird species, making them crucial for biodiversity conservation.

Vervynck, J., University of Victoria: the VENUS Project, Victoria, Canada, jverv@uvic.ca;
Dewey, R., University of Victoria: the VENUS Project, Victoria, Canada, rdewey@uvic.ca

MANAGING DATA ON THE VENUS CABLED OCEAN OBSERVATORY

The Victoria Experimental Network Under the Sea (VENUS) is a real-time, high power, interactive cabled ocean observatory available over the Internet. For over 2 years we've been collecting data from Saanich Inlet and most recently from Strait of Georgia. Our instrument packages include CTDs, acoustic devices, current meters, oxygen sensors plus interactive camera and hydrophone systems. VENUS continues to grow as the number of active science groups increases, introducing new instruments and science experiments. As a result, the Data Management and Archiving System (DMAS) team has faced many challenges transferring and storing data. A Sybase database stores scalar values retrievable using SQL queries. We developed processes using Java, web services, and MATLAB to manage the transfer of data and generate data products. Complex data (large files and high data rates) such as acoustic profiles and camera images are stored in the instrument manufacturer's native format using the Archive Directory (aD) System. VENUS data are freely available on the Project website: http://www.venus.uvic.ca. Users can view data products in galleries and make personal data requests of the Archive. A new Download Data page is in development and will provide access to VENUS data through various graphical user interfaces. The website is frequently updated with useful information available to the science community, students, teachers, and the general public.

Vincent, W. F., Université Laval, Québec City, Canada, warwick.vincent@bio.ulaval.ca;
Mueller, D. R., University of Alaska Fairbanks, Fairbanks, USA, dmueller@gi.alaska.edu;
Vincent, A. C., McGill University, Montréal, Canada, vincenta@physics.mcgill.ca

SOLAR-HEATED MEROMICTIC LAKES IN THE POLAR REGIONS AS INDICATORS OF CLIMATE CHANGE

The deep saline waters of ice-covered meromictic lakes in the Arctic and Antarctica show thermal maxima that are well above ambient air temperatures. We simulated the heat transfer in one of these lake types in High Arctic Canada (Lake A, lat 83 N) using a high spatial-resolution model based on a one dimensional heat diffusion and radiative transfer equation. Boundary conditions were forced using climate data from an automated weather station installed next to the lake. There was a good fit between simulated and observed water column temperatures, including the mid-water temperature maximum of 8.5C, after 63 years of heating (RMSE = 0.10C). This suggests that Lake A became ice-free in the 1940s, a known period of intense warming of the circumpolar Arctic. Simulation of prolonged loss of ice cover due to climate change predicted drastic cooling and loss of the thermal profile. Ironically, increased greenhouse warming on a planetary scale may bring about the collapse of the greenhouse effect in ice-covered polar lakes, thereby altering these ecosystems through cooling and complete disruption of their unique bio-physical structure.

Voelker, B. M., Colorado School of Mines, Golden, USA, voelker@mines.edu;
Hansard, S. P., Colorado School of Mines, Golden, USA, shansard@mines.edu;
Easter, H. D., Colorado School of Mines, Golden, USA, heaster@mines.edu;
Slatter, J., Colorado School of Mines, Golden, USA;
Vermilyea, A. W., Colorado School of Mines, Golden, USA

SUPEROXIDE DETECTION AND REACTIONS IN NATURAL WATERS

Superoxide radical is produced both biotically and photochemically in natural waters and can reduce and/or oxidize many metals of biogeochemical interest. We have recently applied the MCLA technique for chemiluminescent detection of superoxide in aqueous systems to (1) measure in situ concentrations and decay rates in natural waters, (2) observe superoxide formation and decay in laboratory irradiations of natural water samples, and (3) directly observe the reactions of superoxide with Mn and other trace metals of interest. Our results suggest that superoxide will be a significant oxidant of Mn(II) in some waters. However, the chemiluminescence technique must be applied with caution, as trace (<100 pM) detection of superoxide is susceptible to contamination issues and other artifacts.

Wacker, A., University Potsdam, Potsdam, Germany, alexander.wacker@uni-potsdam.de;
Weithoff, G., University Potsdam, Potsdam, Germany

ROTIFERS FEEDING ON MIXOTROPHS: THE ROLE OF FATTY ACIDS

We examined an important ecophysiological link between mixotrophic flagellates and their sympatric consumers by comparing variations in their fatty acid profiles. A mixotrophic flagellate was grown under either exclusively autotrophic conditions in the light with inorganic carbon, under exclusively heterotrophic conditions in the dark with an organic carbon source, or in the light with organic and inorganic carbon sources (=mixotrophic). Under heterotrophic growth conditions the flagellate reduced its content of the n-3 polyunsaturated fatty acid (PUFA) alpha-linolenic acid (C18:3n-3). Although PUFAs with more than 18 carbon atoms were not detected in the flagellate, significant amounts of long-chained PUFAs were found in its consumers, three rotifers species. Species-specific differences in the fatty acid profiles in rotifers with respect to long-chained PUFAs were found.

Waite, T. D., University of New South Wales, Sydney, Australia, d.waite@unsw.edu.au;
Rose, A. L., University of New South Wales, Sydney, Australia, andrew.rose@unsw.edu.au;
Garg, S., University of New South Wales, Sydney, Australia, s.garg@unsw.edu.au

KINETIC MODELLING OF THE LIGHT-INDUCED REDOX CYCLING OF IRON IN SEAWATER IN THE PRESENCE OF NATURAL ORGANIC MATTER

We have conducted a series of laboratory studies to investigate the generation of ferrous iron and reactive oxygen species when solutions of seawater containing natural organic matter and ferric iron are exposed to simulated sunlight. Total ferrous iron, superoxide and hydrogen peroxide were measured at nanomolar concentrations with high temporal resolution using chemiluminescence-based methods. In all cases, ferrous iron concentrations rapidly peaked at several nanomoles per litre after a few minutes, and then declined over time. Superoxide concentrations followed a similar profile, while hydrogen peroxide concentrations increased in a non-linear manner. A numerical kinetic model was developed based on fundamental chemical reactions, and provided an excellent fit to the data.

Watanabe, S. W., Dalhousie University, Halifax, Canada, sh848442@dal.ca;
Scheibling, R. E., Dalhousie University, Halifax, Canada, rescheib@dal.ca;
Metaxas, A., Dalhousie University, Halifax, Canada, metaxas@dal.ca

RANGE EXPANSION OF TWO MARINE INVASIVE SPECIES (*CODIUM FRAGILE* AND *MEMBRANIPORA MEMBRANACEA*) IN ATLANTIC CANADA

In the NW Atlantic, successful establishment of the invasive macroalga *Codium fragile* ssp *tomentosoides* is often dependent on prior defoliation of competitively dominant, native kelps. Overgrowth of kelp by an invasive bryozoan *Membranipora membranacea* increases frond erosion, and thus has facilitated the establishment and spread of *Codium* in this region. To document the range expansion of both invasive species along the Atlantic coast of Nova Scotia, from 2000 to date, we conducted video-surveys of shallow, rocky habitats from Liverpool to Halifax in 2000, and then along the entire coast in 2007. In 2000 and 2007, *Membranipora* was observed throughout the survey range, wherever kelps were present. The distribution of *Codium*, in 2000, ranged from Cape La Have Island to Pennant Island, and in 2007 had expanded to between Cape Sable Island and Canso, falling within the range of the bryozoan in both survey years. The spread of *Codium* appears continuous to the southwest, suggesting natural dispersal along the direction of mean current flow, and discontinuous to the northwest, suggesting one or more separate, independent introductions.

Wehr, J. D., Fordham University, Louis Calder Center- Biological Field Station, Armonk, USA, wehr@fordham.edu;
O'Brien, P., Fordham University, Louis Calder Center- Biological Field Station, Armonk, USA;
Truhn, K. M., Fordham University, Louis Calder Center- Biological Field Station, Armonk, USA, find_kam@yahoo.com;

Perrone, A. A., Fordham University, Louis Calder Center- Biological Field Station, Armonk, USA, aperrone@fordham.edu

NITROGEN AND PHOSPHORUS STOICHIOMETRY OF STREAM PERIPHYTON FROM URBAN AND RURAL WATERSHEDS: IMPLICATIONS FOR STREAM FOOD WEBS.

We are conducting a regional analysis of algal species composition, biomass, and nutritional composition of stream periphyton communities in NY State. 1st-to 4th-order streams were compared along an urban to rural landuse gradient, and using a regional analysis of drainage basins. Gradient and regional analyses each identified significant increases in temperature, turbidity, conductance, pH, dissolved P, Si, Ca, and Mg in urban streams. The gradient study revealed greater periphyton AFDM in urban streams, but not significantly greater chlorophyll-a, or % organic matter. Regional analysis yielded significant differences between urban and rural drainage basins in all measures of algal biomass, C:N and C:P. Both approaches documented significantly greater algal C, N and P (and C:N ratios) in urban streams, but algal C:P did not vary significantly along the landuse gradient. No single landuse or in-stream variable explained variation in algal C:P ratios; C:P and C:N ratios were best predicted by SRP, Mg, Si and conductance. Contrasting results suggest that models attempting to assess effects of "urbanization" on stream ecosystems must consider the nature of land-use types, not simply degree of urbanization.

WEISSE, T., Austrian Academy of Sciences, Institute for Limnology, Mondsee, Austria, thomas.weisse@oeaw.ac.at;
MOSER, M., Austrian Academy of Sciences, Institute for Limnology, Mondsee, Austria, michael.moser@assoc.oeaw.ac.at;
SCHEFFEL, U., Austrian Academy of Sciences, Institute for Limnology, Mondsee, Austria, ulrike.scheffel@assoc.oeaw.ac.at;
STADLER, P., Austrian Academy of Sciences, Institute for Limnology, Mondsee, Austria, peter.stadler@oeaw.ac.at

LIFE AT PH 2.6 - PROTISTS ARE ADAPTED TO EXTREME CONDITIONS

Acid mining lakes (AML) are extreme habitats with pH ranging from 2 to 5. Due to the oxidation of pyrite and related processes, AML often contain extremely high concentrations of sulfate, iron and heavy metals. Eukaryote biodiversity is reduced to a few protist and rotifer species. We present results from field and laboratory investigations on the most acidic Austrian lake, an AML located close to the Czech border. Seasonal variation of pH ranges from 2.5 to 3.7 near the surface. Higher values were recorded close to the lake bottom, at low oxygen levels. We investigate pH tolerance and pH adaptation of the major players to test two alternative hypotheses: (1) AML harbor primarily specialists adapted to the extreme habitat or (2) acidotolerant species (generalists) dominate that benefit from competitive release under acidic stress. Our field and experimental results with several flagellate and ciliate species demonstrate that these organisms are well adapted to low pH. Highest growth rates were achieved at the lowest pH investigated (2.5-3.5), whereas growth was reduced at circumneutral pH; ciliates responded with increased encystment at elevated pH.

Wells, R. D., Texas A&M University, Galveston, USA, wellsr@tamug.edu;
Rooker, J. R., Texas A&M University, Galveston, USA, rookerj@tamug.edu

EARLY LIFE FEEDING ECOLOGY OF PELAGIC FISHES IN SLOPE WATERS OF THE NORTHERN GULF OF MEXICO

Stable isotopes of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) were used to investigate feeding patterns of the early life stages of blue marlin, sailfish, swordfish, common dolphin, and pompano dolphin, and to estimate the percent organic matter derived from both particulate organic matter (POM) and pelagic *Sargassum*. Stable isotopes significantly varied among fishes as mean $\delta^{13}C$ values ranged by 2Ã¢â‚Â and mean $\delta^{15}N$ values ranged by 4Ã¢â‚Â . Ontogenetic changes in stable isotopes were found for each species. Significant increases in $\delta^{13}C$ with increasing size were found for sailfish, swordfish, and common dolphin. $\delta^{15}N$-length relationships were more variable with significant positive relationships for sailfish and pompano dolphin, while blue marlin showed a significant inverse relationship. Results of a 2-source mixing model suggest an equal contribution of organic matter by both organic sources (POM = 50.3 %; *Sargassum* = 49.7 %) to the early life stages of pelagic fishes examined (pooled across taxa); however, the contribution by each source was species-specific.

Whipple, S. J., Skidaway Institute of Oceanography, Savannah, USA, swhipple@uga.edu;
Patten, B. C., University of Georgia, Athens, USA, bmpatten@earthlink.net;
Verity, P. G., Skidaway Institute of Oceanography, Savannah, USA, peter.verity@skio.usg.edu;
Borrett, S. R., University of North Carolina Wilmington, Wilmington, USA, borretts@uncw.edu;
Nejstgaard, J. C., University of Bergen, Bergen, Norway, jens.nejstgaard@bio.uib.no;
Frischer, M. E., Skidaway Institute of Oceanography, Savannah, USA, marc.frischer@skio.usg.edu
Anderson, J. T., Morgan State University, St. Leonard, USA, janderson@moac.morgan.edu

ECOSYSTEM INDIRECT EFFECTS OF PHYTOPLANKTON BLOOMS: COMPARATIVE NETWORK ENVIRON ANALYSIS OF MESOCOSM MODELS OF A PHAOCYSTIS PLANKTONIC ECOSYSTEM IN NORWAY

An ongoing goal of aquatic ecology is to elucidate the direct and indirect effects of plankton blooms. The approach taken must be comparative and holistic. To effect these goals, two steady-state ecosystem models of a mesocosm bloom of Phaeocystis pouchetii were constructed from empirical data from 2003 experiments in a Norwegian fjord. The first of these models represents a pre-bloom ecosystem state with low density solitary P. pouchetii flagellates; the second represents a phytoplankton bloom dominated by P. pouchetii with a high density of large multi-celled colonies. An hypothesis is that the life cycle alterations of P. pouchetii, exemplified by the colony bloom, would produce substantial changes in the trophic energy transfer and biogeochemical flows in the bloom ecosystem. Comparative network environ analysis provides an holistic means to analytically compare the pre-bloom and bloom ecosystem models. These analyses allow for the quantification of the direct and indirect relationships between any pair of ecosystem compartments and trace the fate of ecosystem inputs or outputs. One can quantify how these relationships change in pre-bloom versus bloom ecosystem models.

White, M. S., Trent University, Peterborough, Canada, miwhite@trentu.ca;
Metcalfe, R. A., Ministry of Natural Resources, Peterborough, Canada;
Xenopoulos, M. A., Trent University, Peterborough, Canada

WATER LEVEL FLUCTUATION CHARACTERIZATION AND CONCORDANCE IN LARGE BOREAL SHIELD LAKES

Very few studies have statistically characterized water level fluctuations (WLF) in lakes. Here we present short-term WLF data (sampled at hourly intervals from Nov 1st, 2005 Ã¢â‚,â€œ Nov 1st, 2006) for sixteen large lakes (>1000ha) in Northern Ontario. The purpose of this study was to measure lake water level fluctuation at a sufficient temporal resolution to determine the hydrograph character (shape) of large Boreal lakes and concordances with both landscape and environmental variables. We show that yearly amplitude ranged between 27 and 138 cm ($\bar{x}$ = 59 ± 34 cm). Amplitude was significantly ($P < 0.05$) correlated with dissolved oxygen ($r = 0.71$), basin/lake ratio ($r = 0.71$), recharge rate ($r = 0.81$), deep water ($r = 0.77$) and dense coniferous forest ($r = 0.52$). Using wavelet analysis we detected a consistent and coherent pattern among hydrographs and regional groupings. Record low water levels are now being recorded in several lakes across the globe and a better understanding of WLF is critical to assess loss of ecosystem services.

Wickland, K. P., U.S. Geological Survey, Boulder, CO, USA, kpwick@usgs.gov;
O'Donnell, J. A., University of Alaska-Fairbanks, Fairbanks, AK, USA, ftjao1@uaf.edu;
Koch, J. C., U.S. Geological Survey, Boulder, CO, USA, jkoch@usgs.gov;
Jorgenson, M. T., ABR, Inc., Fairbanks, AK, USA, tjorgenson@abrinc.com;
Harden, J. W., U.S. Geological Survey, Menlo Park, CA, USA, jharden@usgs.gov;
Striegl, R. G., U.S. Geological Survey, Denver, CO, USA, rstriegl@usgs.gov;
Anderson, L., U.S. Geological Survey, Denver, CO, USA, land@usgs.gov

CHEMICAL CHARACTER AND LABILITY OF CARBON ACROSS A CHRONOSEQUENCE OF DRAINED SEDIMENTS OF A DRYING ARCTIC LAKE, INTERIOR ALASKA

Drying of lakes over large regions in the arctic and subarctic has been occurring during the past several decades, exposing lake sediments to

aerobic conditions. This drying likely leads to changes in sediment C chemistry and lability due to microbial degradation and encroachment of terrestrial vegetation. Characterization of C chemistry and lability in these drained sediments is critical to understanding its role as a biotic substrate and as a source of greenhouse gases. We collected sediments from a drying lake in interior Alaska, including flooded sediments (T0) and areas continuously or intermittently drained for approximately 5 yrs (T1), 15 yrs (T2), and 30 yrs (T3). We characterized sediment C chemistry (elemental and pyrolysis-gas chromatography/mass spectrometry analyses) and lability of solid and leachable C. Organic C content of surface sediments decreased from 16 to 10 g C/g sediment from T0 to T3, while DOC yield and aromaticity was greatest from T3 sediments. Incubation results (3.5 months, 10oC) indicate that C in T3 sediments is least labile. This suggests C is quickly oxidized from drained sediments, leaving recalcitrant C behind.

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

BASIN: BASIN-SCALE ANALYSIS, SYNTHESIS, AND INTEGRATION - RESOLVING THE IMPACT OF CLIMATIC PROCESSES ON ECOSYSTEMS OF THE NORTH ATLANTIC BASIN AND SHELF SEAS.

BASIN is an initiative to develop a joint EU/North American ocean ecosystem research program. The focus is the integration and synthesis of data sets for coupling with modeling studies at the basin-scale to elucidate the mechanisms underlying observed changes in physical and biological changes in the North Atlantic Ocean and to predict consequences of climate and environmental change. The first meeting in Iceland in March 2005 provided the basis upon which further program development has taken place. Two subsequent science workshops (Hamburg January 2007; Chapel Hill May 2007) have been held to identify key issues and strategies for the development the BASIN program. They identified and documented the state of the art of climate-related ecosystem research in the North Atlantic Basin and associated shelf seas, and produced broad based objectives that are designed to foster the development of an understanding of the links between climate and the marine ecosystems of the North Atlantic Basin. A third meeting (Amsterdam January 2008) produced a draft BASIN science/implementation plan that will be submitted to the funding agencies for action once completed and reviewed.

Wiedner, C., Leibniz-Institute of Freshwater Ecology and Inland Fisheries , Stechlin-Neuglobsow, Germany, c.wiedner@igb-berlin.de;
Rohrlack, T., Norweigian Institute of Water Research, Oslo, Norway, thomas.rohrlack@niva.no;
Ruecker, J., Brandenburg University of Technology, Bad Saarow, Germany, j.ruecker@limno-tu-cottbus.de;
Nixdorf, B., Brandenburg University of Technology, Bad Saarow, Germany, b.nixdorf@t-online.de

HOW MANY CHEMO AND ECOTYPES EXIST IN CYANOBACTERIA POPULATIONS AND DO THEY VARY OVER TIME? A CASE STUDY ON *PLANKTOTHRIX AGARDHII*.

Seasonal dynamics of cyanobacteria, microcystin (MC) and anabaenopeptin (AB) were studied in a eutrophic shallow German lake over a two-year period. 83 *Planktothrix agardhii* strains were isolated from the lake at different times. Their growth rates and oligopeptid content were determined. In the lake 3 MC and 4 AB variants were detected. *P. agardhii* biovolume correlated with the concentrations of total MC and AB but not with the concentrations of single MC and AB variants, which differed in their seasonal time course. Strains were grouped into 16 chemotypes based on their content of MC and AB variants. Growth rates of all strains ranged from 0.17-0.35 d^{-1}, indicating the existence of different ecotypes. Significant differences in growth occurred between strains of different chemotypes but also between strains of the same chemotype. Thus, the chemotype does not match with the ecotype. Seasonal changes in concentrations of MC and AB variants in the lake could not be explained by the variability of the cellular MC and AB content, which was determined for selected strains. Thus, chemo and ecotypes composition changes over time.

Wilhelm, S. W., The University of Tennessee, Knoxville, TN, USA, wilhelm@utk.edu;
Bourbonniere, R. A., Environment Canada, Burlington, ON, Canada, rick.bourbon@ec.gc.ca;
Bullerjahn, G. S., Bowling Green State University , Bowling Green, OH, USA, bullerj@bgnet.bgsu.edu;
Carrick, H. J., Penn State University, University Park, PA, USA, hjc11@psu.edu;
Ostrom, N. E., Michigan State University, East Lansing, MI, USA, ostromn@msu.edu;
Marvin, C. J., Environment Canada, Burlington, ON, Canada, chris.marvin@ec.gc.ca;
McKay, R. M., Bowling Green State University, Bowling Green, OH, USA, rmmckay@bgnet.bgsu.edu;
Twiss, M. R., Clarkson University, Potsdam, NY, USA, mtwiss@clarkson.edu;
Smith, R. E., The University of Waterloo, ON, Waterloo, Canada, rsmith@sciborg.uwaterloo.ca

WINTER ASSESSMENT OF MICROBIAL BIOMASS AND METABOLISM (WAMBAM): THE IMPLICATIONS FOR CLIMATE CHANGE ON WINTER BIOLOGICAL ACTIVITY IN A LAURENTIAN GREAT LAKE

Most of what we know about the biology of the Laurentian Great Lakes is based on studies in the early spring to late summer period. In contrast, few studies have been carried out in other seasons, particularly winter. In response to this need we carried out biological surveys on Lake Erie in February 2007 and 2008. One remarkable discovery was the documentation of high phytoplankton biomass dominated by the filamentous centric diatom, *Aulacoseira* spp. Phytoplankton biomass in the water column in ice-free regions persisted at levels far exceeding (up to 10-fold) chl-a levels normally found during spring and summer. Primary and secondary productivity and health estimates, morphological and molecular taxonomic examinations, sediment trap results and water column chemistry will be presented to demonstrate the importance of winter production in the overall scheme of total lake productivity. We will also present results in light of the effects of ice cover (and changing ice cover), and provide insight on how this biomass influences seasonal hypoxia (*"dead zone"* formation) late in the summer months.

Willey, J. D., U North Carolina Wilmington, Wilmington, NC, USA, willeyj@uncw.edu;
Kieber, R. J., U North Carolina Wilmington, Wilmington, NC, USA, kieberr@uncw.edu;
Seaton, P. J., U North Carolina Wilmington, Wilmington, NC, USA, seatonp@uncw.edu;
Miller, C., U North Carolina Wilmington, Wilmington, NC, USA, millerc@uncw.edu

RAINWATER: AN EPISODIC SOURCE OF PHOTOCHEMICALLY REACTIVE IRON TO SURFACE SEAWATER

Rainwater hydrophobic extractable dissolved organic matter (EDOM) contains ligand(s) that prevent Fe(II) oxidation for at least four hours after mixing with seawater. The EDOM Fe(II) complex is at least as strong as the Fe(II) ferrozine complex, making it the strongest Fe(II) ligand observed in natural waters. EDOM occurs even in very low organic content marine rain and does not have the same chemical composition or chromophoric properties as EDOM collected from the nearby Cape Fear River. Photochemical experiments demonstrate that iron complexed with EDOM accurately mimics the diurnal cycling of Fe in rainwater. During the day photoreduction of Fe(III)EDOM predominates, while at night a fraction of the photochemically produced Fe(II) oxidizes to Fe(III). EDOM complexed Fe(II) resists oxidation. Photochemical production of Fe(II) from EDOM can be predicted using the same model developed for this prediction in authentic rain. In addition to its central role in redox reactions occurring in the troposphere, the stability of EDOM complexed Fe(II) is important because it directly affects the bioavailability of rainwater-derived Fe in the surface ocean.

Williams, C. O., Purdue University, West Lafayette, USA, williaco@purdue.edu;
Smith, D. R., USDA-ARS, West Lafayette, USA, drsmith@purdue.edu;
Bowling, L., Purdue University, West Lafayette, USA, bowling@purdue.edu;
Lembi, C., Purdue University, West Lafayette, USA, lembi@purdue.edu;
Joern, B. C., Purdue University, West Lafayette, USA, bjoern@purdue.edu

FACTORS AFFECTING PHOSPHORUS (P) RELEASE AND RETENTION BETWEEN STREAM AND DITCH SEDIMENTS AND OVERLYING WATER

Internal phosphorus (P) loading from sediments to waterbodies may be a significant source of P and may prevent the attainment of surface water nutrient criteria developed by the USEPA. Our objectives were to determine the relationship between surface water P concentrations and underlying sediments and determine if differences in land management practices were related to ditch and stream water P concentrations. Thirty-two sampling sites were identified in the watershed and grouped into four general land management categories: Row Crop Agriculture, Livestock Agriculture, Low Density Residential, and High Density Residential. Findings showed that there was a general relationship between extractable P (20 mM $CaCl_2$) in sediment and water column P. Phosphorus concentrations were greater in areas with a greater percentage of urban and grass not used for agricultural production. While surface water P fluctuated above and below the proposed EPA nutrient criteria limit (76.3 ug P/L), sediment-extractable P was consistently above the proposed EPA nutrient criteria limit for all samples and sampling months.

Williams, P. J., University of Bangor, Menai Bridge, United Kingdom, pjlw@bangor.ac.uk

IT'S HIGH TIME TO LOOK AT THE ACCURACY OF *IN VITRO* METHODOLOGY

Estimates of oceanic productivity essentially derive from *in vitro* observations of $^{14}CO_2$ uptake. This method offers neither external nor internal checks. The light/dark O2 method does: net community production (NCP) can be measured *in vitro* and *in situ*; the observed 40% or so discrepancy between the two methods is beyond statistical error. A variety of explanation exist: time scale problems of sampling, import of organics; but none provide a wholly satisfactory explanation. The error is invariably one way ÃƒÆ'¢Ã¢Ã¢â‚¬Å¡Ã¢â€šÂÃ…â€œ lower values for NCP from *in vitro* methodology. IÃƒÆ'¢Ã¢Ã¢â‚¬Å¡Ãƒâ€¹Ã…â€œm inclined to regard the *in situ* methodology as the gold standard, so the finger points at the *in vitro* methodology. An underestimate of NCP can come from an underestimate of photosynthesis or an overestimate of respiration, or both. On the grounds that over the 12-24 hour timescales of the measurement there is a greater likelihood of inhibition than stimulation (the latter generally requires growth), the likely error lies with the measurement of photosynthesis: As the explanation is not technique-dependent (it would include 14C measurements), the implication for estimates of oceanic productivity are major.

Williamson, C. E., Miami University, Ohio, Oxford, USA, craig.williamson@muohio.edu;
Salm, C. R., University of Maine, Orono, USA, courtney.salm@umit.maine.edu;
Saros, J. E., University of Maine, Orono, USA, jasmine.saros@maine.edu;
Mitchell, D. L., University of Texas M. D. Anderson Cancer Center, Smithville, Texas, USA, dmitchel@mdanderson.org

CLIMATE IMPACTS ON ZOOPLANKTON GRAZING IN ALPINE LAKES: UV AND TEMPERATURE.

Previous research in both aquatic and terrestrial systems suggests that higher trophic levels may be more susceptible to climate change than primary producers. We examined the effects of two climate variables, temperature and UVR on zooplankton grazing rates in an alpine lake. We used a factorial-design and in situ microcosms that manipulated temperature (8C, 12C) and UVR (+/-) to examine the response of several phytoplankton species in the presence and absence of zooplankton. Response data (phytoplankton cell counts) were analyzed with a 3-way ANOVA (temperature, UV, and zooplankton (+/-) as factors). DNA dosimeters assessed the potential for UV damage. Significant interaction effects were observed for temperature, UV, and zooplankton grazing on one species (Dinobryon sp.) and an interactive effect of temperature and zooplankton grazers on two other species (Fragilaria crotonensis and Cyclotella sp.). The DNA dosimeters showed high DNA damage in the UV+ treatments (800 cyclobutane pyrimidine dimers per megabase DNA) compared to background levels in the UV-shielded treatments. Species-specific responses of phytoplankton to zooplankton grazing are likely to be altered by changes in temperature and UV in response to climate change in alpine lakes.

Wilson, H. F., Trent University, Peterborough, Canada, henrywilson@trentu.ca;
Xenopoulos, M. A., Trent University, Peterborough, Canada, mxenopoulos@trentu.ca

LANDSCAPE DETERMINANTS OF DOC CHARACTER ACROSS AN AGRICULTURAL LAND USE GRADIENT

We examined the influence of watershed land use and morphology on dissolved organic carbon (DOC) concentration and character in thirty-six south-central Ontario streams, over a two year time period. We classified DOC character using fluorescence ratio, biological index (BIX), specific absorbance at 280nm, and stream water C:N ratios. Stream DOC concentrations were not significantly correlated with agricultural land uses, but DOC character was, however; strongly related to land use. Our results indicate that DOC is more autochthonous-like and less recalcitrant in character when originating in watersheds with more intensive agricultural land use. The best predictor of DOC character was the proportion of monocultural land use within a 100m buffer of the streams. This land use metric was significantly correlated with all measured indicators of DOC character, particularly fluorescence ratios (r2 = 0.76). DOC character within the study streams was relatively consistent over time and showed much less seasonal variability than did DOC concentrations.

Wissel, B., University of Regina, Regina, Canada, bjoern.wissel@uregina.ca;
Leavitt, P. R., University of Regina, Regina, Canada, peter.leavitt@uregina.ca;
Cooper, R. N., University of Regina, Regina, Canada, cooper3r@uregina.ca;
Pham, S., University of Regina, Regina, Canada, dietrics@uregina.ca

ENVIRONMENTAL CONTROLS OF FOOD WEB STRUCTURE IN PRAIRIE LAKES

Salinity excerpts stronger effects on aquatic food webs than most other key environmental parameters (nutrients, DOC, morphometry). As the onset of osmotic stress differs greatly among taxonomic groups, food-web complexity in saline lakes is highly variable. To evaluate the effects of salinity on food-web composition, we analyzed lake morphometry, water chemistry, algae, and zooplankton of 70 prairie lakes, with salinity ranging from fresh to hypersaline. In regard to water chemistry, major ions, DOC, and N were highly correlated with salinity, while lake depth, TP, and Ca were controlled otherwise. Zooplankton species richness dramatically declined from fresh to hyposaline waters: freshwater lakes had "typical" zooplankton species compositions; but at intermediate salinities, salt-tolerant species were common, followed by large conspicuous invertebrates and finally artemiidae. Additionally to salinity, CCA identified lake depth, TP and Ca as variables that significantly influenced zooplankton species composition. Climate change scenarios predict more droughts across the prairies, and as saline lakes are very sensitive to hydrologic changes, these systems will be critically important to detect early signs of climate change and predict its consequences for lake food webs.

Withers, P. J., ADAS UK Limited, Salisbury, United Kingdom, paul.withers@adas.co.uk;
Jarvie, H. P., Centre for Ecology and Hydrology, Wallingford, United Kingdom, hpj@ceh.ac.uk;
Harper, D., University of Leicester, Leicester, United Kingdom, dmh@leicester.ac.uk;
Hodgkinson, R. A., ADAS UK Limited, Cambridge, United Kingdom, robin.hodgkinson@adas.co.uk;
Palmer-Felgate, E. J., Centre for Ecology and Hydrology, Wallingford, United Kingdom, ejsu@ceh.ac.uk;
Wasiak, P., University of Leicester, Leicester, United Kingdom, phw7@leicester.ac.uk;
Wasiak, K., University of Leicester, Leicester, United Kingdom, kk82@leicester.ac.uk;
Stoate, C., The Game and Wildlife Conservation Trust, Loddington, United Kingdom, cstoate@gct.gov.uk;
Foy, R. H., Queens University, Belfast, United Kingdom, bob.foy@talktalk.net;
Bowes, M. J., Centre for Ecology and Hydrology, Wallingford, United Kingdom, mibo@ceh.ac.uk

SOURCES OF NUTRIENTS IN AGRICULTURAL STREAMS AND THEIR ECOLOGICAL SIGNIFICANCE

Correct apportionment of phosphorus (P) sources in watersheds is critical for the development of cost-effective measures to combat eutrophication. Streams and various P sources in small (<10 sq. km) rural watersheds varying in agricultural intensity were monitored during 2004-07 to characterize their nutrient chemistry and ecological status. While stream P and bed sediment P concentrations were greater in the more agriculturally intensive watersheds, runoff from farmyards and roads, and/or influenced by septic tank discharges, were more concentrated and bioavailable than runoff from cultivated land and pasture land. Positive relationships between soluble reactive P (SRP) and boron (B) for some sites in all source groups suggested widespread contamination with domestic wastewater effluent/detergents. Ecological measurements suggested that stream ecology was limited by P at concentrations below 100 µg SRP/L and by other factors above 100 µg/L. The results suggest that the links between agricultural intensification and poor ecological status must not be automatically assumed just because it is a rural watershed. Collective social responsibility is needed to tackle the multiple and scattered P sources encountered in these watersheds.

Wohlers, J., Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, jwohlers@ifm-geomar.de;
Engel, A., Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, Anja.Engel@awi.de;
Zoellner, E., Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, ezoellner@ifm-geomar.de;
Sommer, U., Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, usommer@ifm-geomar.de;
Riebesell, U., Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany, uriebesell@ifm-geomar.de

THE EFFECT OF GLOBAL WARMING ON THE PARTITIONING AND FATE OF ORGANIC CARBON IN THE SURFACE OCEAN: A MESOCOSM STUDY

The cycling of organic matter in the surface ocean is determined by the complex interaction of production (source) and consumption (sink) processes. These can strongly differ regarding their sensitivity to increasing temperatures. Heterotrophic processes (e.g. bacterial degradation of organic matter), for instance, are expected to be more temperature-sensitive than autotrophic ones (e.g. photosynthesis), which are typically rate-limited by light or nutrient availability. By shifting the balance between the sources and sinks of organic matter, global warming may affect its partitioning and fate in the surface ocean. Here we report our findings from an indoor mesocosm study where we exposed a natural Baltic Sea plankton community to four different temperature regimes and followed the buildup and decline of a phytoplankton spring bloom. We observed significant temperature-related effects on the consumption of dissolved inorganic carbon as well as on the partitioning of carbon between dissolved and particulate organic matter. A sharp increase in transparent exopolymer particles was observed at elevated temperatures, potentially supporting the aggregation of organic matter. The implications of such changes for the future marine carbon cycle will be discussed.

Wong, J., University of Toronto at Scarborough, Toronto, Canada, jez.wong@utoronto.ca;
Williams, D. D., University of Toronto at Scarborough, Toronto, Canada, williamsdd@utsc.utoronto.ca;
Febria, C. M., University of Toronto at Scarborough, Toronto, Canada, catherine.febria@utoronto.ca

SPECTROSCOPIC CHARACTERIZATION OF DOM IN THE HYPORHEIC ZONE HELPS INTERPRETATION OF CARBON CYCLING IN STREAM SEDIMENTS

In temperate streams, dissolved organic matter (DOM) in surface waters is presumably altered by the annual input of leaf litter in the fall. However, consequences of this pulsed input for DOM in subsurface hyporheic waters remain unknown. Since DOM represents the largest carbon reservoir in aquatic ecosystems, its interactions with microbes are important in mediating carbon transfer into the food web. We characterized, using UV and fluorescence spectroscopy, DOM for the hyporheic zone of a second-order stream in southern Ontario. Spectroscopic characteristics such as molecular weight, colour, and fluorescence fingerprints indicate that DOM in surface and subsurface waters change over time; these differences are most pronounced 100cm below the streambed. This suggests DOM is dynamic, reflective of ecosystem metabolism, and intricately linked to biogeochemical mechanisms in the hyporheic zone.

Wotton, R. S., UCL, London, United Kingdom, r.wotton@ucl.ac.uk

TRANSPORT OF PARTICULATE ORGANIC MATTER ALONG RIVERS - THE IMPORTANT ROLE OF EXOPOLYMERS (EPS)

Exopolymers (EPS) assemble to form particles and they bind flocculated aggregates. EPS are also the characteristic binding agents of faecal pellets produced by animals living in rivers. The conversion of huge numbers of fine particles to larger faecal aggregates is a well-known feature of the biology of animals that feed from suspensions. Their faecal pellets are carried downstream or may sink to the substratum in suitable regions, providing an input of particulate organic matter that is potentially of good quality. Other types of animals transform seasonal inputs like leaves into faecal pellets that may be stored in sediments for months. Have we underestimated the role of faecal pellets because so many studies on animals have concentrated on their feeding?

Wysmyk, J. K., Dalhousie University, Halifax, Canada, jwysmyk@dal.ca;
Schmidt, A. L., Dalhousie University, Halifax, Canada, aschmidt@dal.ca;
Lotze, H. K., Dalhousie University, Halifax, Canada, hlotze@dal.ca

EFFECTS OF NUTRIENT LOADING ON THE STRUCTURE OF SEAGRASS BEDS (*ZOSTERA MARINA*) IN ATLANTIC CANADA.

Seagrass beds provide important habitat for juvenile fish, invertebrates, and macroalgae, stabilize the substrate, and take up nutrients from the water column. Increased nutrient inputs into coastal waters through human activities can have deleterious effects on seagrass beds through algal overgrowth, turbidity, and oxygen depletion. Here, we investigated how the structure and environmental quality of seagrass beds changed across a gradient of nutrient enrichment. Each of a high, medium, and low-impacted site was sampled in four geographic areas in New Brunswick and Prince Edward Island in August 2007. We used eleven quadrats and three cores along a 50 m transect to assess shoot density, canopy height, leaves per plant, and biomass as structural parameters, and measured six water column-properties as environmental-quality variables. Seagrass density decreased and plant height increased in medium- and high-impacted sites indicating significant changes in seagrass bed structure with increased nutrient loading. Changes in bed structure were related to increased light attenuation, chlorophyll-a concentration and total suspended particulate matter at high-impacted sites suggesting shading effects by higher phytoplankton productivity and water-column turbidity.

Xenopoulos, M. A., Trent University, Peterborough, Canada, mxenopoulos@trentu.ca

DECOMPOSITION OF WOOD IN STREAMS: EFFECTS OF AGRICULTURAL LAND USE

Decomposition is an important ecosystem function in streams. I studied woody decomposition in 17 streams in southern Ontario, whose catchments

vary in land use and cover (agriculture, forests, and wetlands). I quantified the decomposition rates over a 30 day incubation period using tongue depressors placed in two habitats (riffles and pools) in streams. I also measured stream nutrients and characterized the land cover of each stream's catchment. Sticks significantly decayed faster when placed in riffle habitat compared to pools. In addition, decomposition was higher in streams flowing through catchments rich in agriculture, than in streams with watersheds primarily composed of upland forest. These higher rates of decomposition were accompanied by lower C:N ratios in accumulating organic matter (r2 = 0.35), which reflected the greater total dissolved nitrogen (r2 = 0.20) in agriculturally influenced streams. Decomposition was also affected by the type of agricultural land cover, with higher rates found in streams having catchments containing a high proportion of mixed agriculture (compared to primarily cropland catchments). These results show that increasing agricultural land use can affect rates of stream decomposition by way of the greater nutrient subsidies to microbial decomposers.

Yamamuro, M., The University of Tokyo, Kashiwa, Japan, yamamuro@k.u-tokyo.ac.jp;
Hiratsuka, J., Shimane Research Group of Wildlife, Matsue, Japan, j.hiratsuka@topaz.plala.or.jp;
Ishitobi, Y., Shimane Prefectural Institute of Public Health and Environmental Science, Matsue, Japan, ishitobi-yu@pref.shimane.lg.jp

DIFFERENCE IN THE MUSCULISTA SENHOUSIA INVASION TO UPSTREAM REGION IN RELATION WITH ITS HOME GROUND HABITAT

M*usculista senhousia* is widely spread invasive bivalves. Although it is native in Japan, its invasion to the habitat of commercial filter-feeding bivalve destroys local fisheries, and thus it is regarded as biofouling species. Lake Shinji is an oligohaline lagoon, and it is the biggest fisheries field of Asiatic clam, *Corbicula japonic*a, in Japan. It is connected with a polyhaline lagoon, Lake Nakaumi, with River Ohashi. This river is the boundary habitat for *C. japonica* and *M. senhousi*a. Shallow coast of Lake Nakaumi is densely inhabited by *M. senhousia*. Expected sea level rise may shift the salinity of the region upwards, which may enhance invasion of *M. senhousia* to Lake Shinji and collapse brackish clam fisheries. Lake Shinji has direct connection with Japan Sea via River Sada. Although the salinity range is similar to River Ohashi, only a few *M. senhousia* inhabits in River Sada. We attributed this difference to the home ground habitat of *M. senhousia* as the stock of pelagic larva. When and why Lake Nakaumi became the home ground of *M. senhousia* will be also discussed.

Yan, N. D., York University, Toronto, Canada, nyan@yorku.ca;
Hamill, A. L., York University, Toronto, Canada, lily.hamill@gmail.com

25 YEARS OF RESEARCH ON INVADERS IN THE PLANKTON: LESSONS LEARNED, PARTICULARLY FROM THE SPINY WATER FLEA, BYTHOTREPHES

Since the last ASLO conference in St. Johns, research on more than 70 planktonic invading species has exploded. Zebra mussel research dominates the field, with research on the spiny water flea, Bythotrephes, a close second. We will summarize current knowledge of the identity and sources of the invading taxa, their routes of entry to, and locations of, their newly invaded habitats, and their ecological impacts. While the majority of earlier research simply tallied invaders, or provided single-site, impact studies, there is a growing body of work on invader vectors and pathways, and regulators of establishment success, both of which suggest avenues for preventing future introductions. Using Bythotrephes as an exemplar reveals that planktonic invaders can: 1) spread very rapidly and establish themselves in stable communities; 2) transform the diversity, size and species composition, diel migratory behaviour, abundance and productivity of its prey, and 3) effect shifts to hypolimnetic and jelly-clad taxa (Holopedium and Conochilus). The eventual impacts of planktonic invaders on native Canadian plankton biodiversity, may be as large as historical impacts of acid rain.

Yang, J., Department of Earth Sciences, Dalhousie University, Halifax, Canada, jun.yang@dal.ca;
Scott, D. B., Department of Earth Sciences, Dalhousie University, Halifax, Canada, david.scott@dal.ca

TESTATE AMOEBAE AS INDICATORS FOR YOUNGER DRYAS AND HOLOCENE CHANGES IN CLIMATE

As single-celled organisms with a short re-generation time, testate amoebae respond more rapidly in terms of community structure and density to environmental change than larger animals and plants. In this study, we tracked Younger Dryas (YD) and Holocene changes in climate based on testate amoebae from Cameron Lake, Nova Scotia. The results indicate the decreases in species richness and diversity were highly correlated to the YD, North Atlantic Preboreal Oscillation (PBO) and 8.2 cal kyr cooling events, while the three declines in species abundance roughly coincided with three recent ice-rafted debris (IRD) events in the middle and late Holocene climate of North Atlantic, thus supporting the view that Holocene climate exhibits variability on millennial scales. Further, the most dramatic changes in species composition occurred at the YD/Holocene transition when the dominant genus abruptly shifted from Centropyxis to Difflugia mainly due to both climatic amelioration and rapid lake acidification. The middle Holocene warming and eutrophication were characterized by an abrupt increase of species abundance as well as a meso-eutrophic species, D. limnetica (also known as Curcirbitella tricuspsis), being particularly prominent and a decline in relative abundance of an oligotrophic species, C. aerophila. Interestingly, the YD reversal and 8.2 cal kyr cooling events were clearly recorded by testate amoebae, although they did not cause marked changes in the terrestrial vegetation.

Yang, J., University of Maryland, College Park, USA, jeanne.yang@gmail.com;
Del Vecchio, R., University of Maryland, College Park, USA, rossdv@umd.edu;
Boyle, E., University of Maryland, College Park, USA, eboyle@umd.edu;
Kujawinski, E. B., Woods Hole Oceanographic Institution, Woods Hole, USA;
Blough, N. V., University of Maryland, College Park, USA, neilb@umd.edu

CHANGES IN MOLECULAR WEIGHT OF TERRESTRIAL CDOM IN RELATION TO LIGNIN PHENOL CONTENT

Previous work examined the spatial and seasonal variation across the Middle Atlantic Bight (MAB) of (a) CDOM optical properties (absorbance and fluorescence); (b) lignin phenol content; (c) ultra-high resolution mass spectrometry of C18 extracted organic matter (C18-OM). The results provided strong evidence that a component of CDOM in the open ocean is of terrestrial origin and arises from modified (partially oxidized) lignin. This work further suggested a change in molecular form (i.e. decrease in MW) but not in absolute content of the lignin phenol content. To further investigate structural changes of CDOM as it transits across estuarine, coastal and oligotrophic waters (i.e. across the MAB), we investigated the size distribution of C18-OM by GPC, as well as changes in molecular weight and lignin phenol content of HS, lignin and selected C18-OM upon laboratory photobleaching experiments were also investigated. The results of these experiments will be placed in the context of previous work and the charge-transfer model of CDOM optical properties.

Yao, D., University of Maryland, Solomons,MD, USA, yao@cbl.umces.edu;
Suzuki, M., University of Maryland, Solomons,MD, USA, suzuki@cbl.umces.edu;
Buchan, A., University of Tennessee Knoxville, Knoxville ,TN, USA, abuchan@utk.edu

IN SITU ACTIVITY OF NAC11-7 ROSEOBACTERS IN COASTAL WATERS OFF THE CHESAPEAKE BAY, BASED ON FTSZ GENE EXPRESSION

We are currently developing an approach to measure in situ growth rates of specific roseobacters independent of tracer additions and incubations. The rationale of this method is to correlate rates of in situ expression of the cell division gene ftsZ and growth rates of individual roseobacters. Phylogenetic analysis of Roseobacter clade ftsZ genes from a station at the mid-Atlantic coast off of Chesapeake Bay revealed a number of sequences from the putatively photoheterotrophic NAC11-7 subgroup, for which we developed a quantitative assay. In order to examine whether in situ growth may be synchronized within this subgroup, we quantified ftsZ genes and transcripts in a set of diel samples from the same station. Strong variations of ftsZ gene copies indicated that advection likely affected our sampling and expression was measured for different populations. Remarkably, we observed a strong correlation (R Square=0.93) between the NAC11-7 ftsZ expression and gene copies in the sampling site. Thus, in situ activity of the

NAC11-7 group appeared to reflect its abundance. This correlation also suggests that NAC11-7 growth is not synchronized at this sampling site.

Yokota, K., University of Minnesota, St. Paul, MN, USA, yoko0026@umn.edu;
Sterner, R. W., University of Minnesota, St. Paul, MN, USA, stern007@umn.edu

PHYSIOLOGICAL COST OF ALGAL INDUCIBLE DEFENSE REVEALED BY COMPETITIVE DYNAMICS

The green alga *Desmodesmus* forms colonies in response to chemical cues from invertebrate grazers. This chemically mediated increase in algal particle size is considered an inducible anti-grazer defense mechanism accompanied by the physical cost of increased sinking. Other, physiological costs have also been speculated upon but not demonstrated. To evaluate the existence of such physiological costs, we used the competitive displacement rate as a measure of species fitness and performed a series of competition experiments where *Desmodesmus* competed against a unicellular green alga, *Monoraphidium*, with or without a synthetic *Daphnia* kairomone substitute, octyl sodium sulfate (OSS). Presence of OSS substantially altered competitive dynamics between the two algae. Over the 27-d period *Desmodesmus* displaced *Monoraphidium* with or without OSS; however, the competitive advantage of *Desmodesmus* vs. *Monoraphidium* was greater in control than in the OSS treatment. The adverse effect of OSS stemmed from the initial depression of *Desmodesmus* by *Monoraphidium* during the log phase and became undetectable as the cultures entered the stationary phase. These results supported the suspected presence of physiological cost that trades off against the inducible anti-grazer defense.

Zepp, R. G., US EPA, Athens GA, USA, zepp.richard@epa.gov;
White, E. M., US EPA, Athens GA, USA, white.emily@epa.gov;
Molina, M., US EPA, Athens GA, USA, molina.marirosa@epa.gov

DIFFERENTIAL EFFECTS OF SOLAR ULTRAVIOLET RADIATION ON CULTURABLE ENTEROCOCCUS FAECALIS AND ENTEROCOCCUS DNA DETERMINED USING REAL-TIME QUANTITATIVE PCR

Biological contamination of aquatic environments by pathogenic microorganisms is often assessed using fecal indicator bacteria such as enterococci. The concentrations of enterococci are commonly determined by culturing techniques, but there has been recent interest in using molecular microbial analysis methods with shorter reporting times. The quantitative polymerase chain reaction (qPCR) applied to detect DNA concentrations of *Enterococcus* is one rapid technique that shows great promise for evaluating recreational water quality. Very little is known about factors that affect the fate and transport of enterococci culturable and qPCR indicators in freshwater environments. Studies conducted near UV-disinfected effluents of sewage treatment plants indicate that the sensitivity of these two indicators to solar ultraviolet (UV) radiation may be very different. In this paper we compare the effects of solar UV radiation on culturable *Enterococcus faecalis* with its effects on *Enterococcus* measured using real-time qPCR. As part of this study, we also report the effects of chromophoric dissolved organic matter (CDOM) and suspended sediments on the light-induced degradation of these indicators. (Although this work was reviewed and approved by EPA, it may not necessarily reflect Agency policy.)

Zhang, J., University of Saskatchewan, Saskatoon, Canada, jan.zhang@usask.ca;
Hudson, J., University of Saskatchewan, Saskatoon, Canada, jeff.hudson@usask.ca

LONG-TERM TRENDS IN DOC AND REGIONAL VARIABLES ACROSS EASTERN CANADA

The long-term trends in dissolved organic carbon (DOC), precipitation (PP), total solar radiation (TSR), temperature, and sulfate deposition (SO4) was examined at 56 lakes of four sites across eastern Canada: Dorset (1978-1998), Experimental Lakes Area (ELA, 1982-2002), Turkey Lakes Watershed (TLW, 1982-2002) and Kejimkujik and Yarmouth in Nova Scotia (NS, 1982-2002). An increase in DOC concentrations, as reported in the literature for other regions, was not present at our sites, except for ELA. This increase in DOC was concomitant with an increase in summer precipitation and a decrease in summer TSR. Although changes in temperature and SO4 have been cited elsewhere to explain changes in DOC, we did not find evidence to support this mechanism. That is, changes in DOC in our lakes did not correspond with changes in SO4 deposition and temperature. These observations combined with the results from multiple regression analyses, suggest that the long term pattern in DOC is more strongly influenced by TSR and PP, than by other regional variables over the temporal scale considered at our study sites.

Zhao, Y., University of Maryland Biotechnology Institute, Baltimore, USA
Wang, K., University of Maryland Biotechnology Institute, Baltimore, USA
Budinoff, C., University of Tennessee, Knoxville, USA, cbud@utk.edu;
Buchan, A., University of Tennessee, Knoxville, USA, abuchan@utk.edu;
Lang, A., Memorial University Of Newfoundland, St. John's, Canada, aslang@mun.ca;
Chen, F., University of Maryland Biotechnology Institute, Baltimore, USA, chenf@umbi.umd.edu

DIVERSITY OF ROSEOBACTER GENE TRANSFER AGENT (GTA) GENES IN THE CHESAPEAKE BAY

Roseobacters are abundant in marine environments and play important biogeochemical roles. Almost all (95%) of the 25 available Roseobacter genome sequences contain a conserved GTA gene cluster, suggesting that gene transfer mediated by GTAs could be important in this group of mixotrophic marine bacteria. In this study, we investigated the diversity of Roseobacter GTA genes in Chesapeake Bay using a specific PCR primer set targeting the GTA major capid protein (Mcp). The mcp gene was successfully amplified from many Roseobacter isolates and the Bay microbial communities. Four mcp clone libraries were constructed and diverse sequences were found for Chesapeake Bay microbial assemblages. This study suggests that the current Roseobacter genome database still lacks the Chesapeake Bay stereotype. A distinct seasonal pattern was observed for roseobacterial GTAs, further supporting previous observations of seasonal dynamics of roseobacters in the Bay based on 16S rRNA gene sequences. The congruence between the Mcp and 16S rRNA phylogenies indicates that mcp (a single copy gene) may be a useful genetic marker to investigate diversity and abundance of Roseobacters.

Ziegler, S. E., Memorial University of Newfoundland, St. John's, Canada, sziegler@esd.mun.ca;
Lyon, D. R., University of Arkansas, Fayetteville, USA, dlyon@uark.edu

CARBON FLOW WITHIN BIOFILM MICROBIAL COMMUNITIES AND ITS RELATIONSHIP TO DISSOLVED ORGANIC CARBON SOURCE AND CYCLING IN HEADWATER STREAMS

In situ enclosure experiments were conducted using 13C-labeling to investigate the variation in biofilm bacterial-algal C exchange and its relationship to DOC release in headwater streams. Experiments were conducted in six streams in the Arkansas Ozarks, U.S.A spanning a 100-fold range in dissolved inorganic N concentration. 13C-bicarbonate labeling of stream water was used to follow newly fixed C into DOC and epilithic biofilms during light and dark incubations. Net release of DOC occurred in the light, was positively correlated to net primary production (NPP), and ranged between 4 and 46% of NPP. Interestingly, the proportion of newly fixed C in DOC released during these incubations was significantly lower in the most nutrient-deplete streams. Further, the 13C-labeling of biofilm phospholipid fatty acids indicated that greater incorporation of newly fixed C into heterotrophic bacteria relative to NPP occurred in the most nutrient-deplete streams. The data suggest that algal-derived C supported the degradation and release of terrestrial-derived DOC from the nutrient-deplete forested streams while more direct mechanisms such as sloppy feeding and algal exudation were likely important mechanisms in the nutrient-replete streams.

Zimmermann-Timm, H., Potsdam Institute for Climate Impact Research, Potsdam, Germany, Heike.Zimmermann-Timm@pik-potsdam.de;
Langerwisch, F., Potsdam Institute for Cliamte Impact Research, Potsdam, Germany;
Poulter, B., Potsdam Institute for Climate Impact Research, Potsdam, Germany;
Rost, S., Potsdam Institute for Cliamte Imapct Research , Potsdam, Germany;
Cramer, W., Potsdam Institute for Climate Impact Research, Potsdam,

THE AMAZON - AN IMPORTANT TIPPING ELEMENT: INTERACTIONS BETWEEN LAND AND RIVER AND THE RIVER'S IMPACT ON THE ATLANTIC

The Amazon has one of the largest catchments in the world, and it plays a vital role for global water and carbon cycles. This tropical river has been identified as one of the globe's the most important tipping elements and changes in this system could have unpredictable impacts on global climate. During annual flooding the terrestrial and riverine components of the basin are closely connected and an intense replacement/exchange of organic material occurs. The quality and quantity of these fluxes can be altered by land-use change and climate change. To understand the fluxes and the modifications in the exchange we use an adapted version of the dynamic global vegetation model LPJmL. This terrestrial biosphere model represents key ecosystem processes in a realistic manner. For our purpose we adjusted the model and provided a framework for a new module that links terrestrial processes with riverine fluxes. We study the impact of land use change and climate variability on carbon dynamics and carbon dioxide emission in this area. To this end we attempted to reproduce the riverine carbon fluxes in a realistic manner. The carbon fluxes from the Amazon river and the dust transport from the Sahara seem to cause the biggest effects on the Atlantic.

Zoellner, E., IFM-GEOMAR, Leibniz Institute of Marine Sciences, Kiel, Germany, ezoellner@ifm-geomar.de;
Peeken, I., IFM-GEOMAR, Leibniz Institute of Marine Sciences, Kiel, Germany, ipeeken@ifm-geomar.de;
Yassaa, N., Max Planck Institute for Chemistry, Mainz, Germany, yassaa@mpch-mainz.mpg.de ;
Koertzinger, A., IFM-GEOMAR, Leibniz Institute of Marine Sciences, Kiel, Germany, akoertzinger@ifm-geomar.de

VIRAL AND BACTERIAL DYNAMICS IN THE MAURITANIAN UPWELLING AREA - INTERACTIONS WITH BIOGEOCHEMISTRY AND TRACE GAS EMISSIONS

The subtropical Northeast Atlantic is a hydrographically highly dynamic and important system, including the Mauritanian upwelling area as one of the biologically most productive regions. We will present comprehensive in situ data on viral and bacterial distribution patterns at different temporal and spatial scales. Various interrelations between viro- and bacterioplankton community parameters and several biological and biogeochemical variables (e.g. phytoplankton pigments, nutrients, oxygen) will be discussed for this heterogeneous marine environment. At selected stations during the cruise, supplementary bottle incubation experiments were performed on board RV Meteor to investigate viral and bacterial responses to experimental changes of biotic (competition/predation) and abiotic conditions (light). Thereby, one focus was to elucidate the potential effects of heterotrophic activity and changing microbial food web structure on VOC (volatile organic compound) emissions in the waters off the Mauritanian coast. By combining analyses of microbial assemblages (by flow cytometry as well as molecular tools such as DGGE and CARD-FISH) and headspace samples (GC-MS measurements) the experiments yielded evidence for distinct viral dynamics and diverse linkages between microbial food web structure and patterns of VOC release.

Zou, Y., University of South Carolina, Columbia, USA, zou@math.sc.edu;
Pike, D. A., Memorial University of Newfoundland, St. John's, Canada, dapike@math.mun.ca;
Bradbury, I. R., Dalhousie University, Halifax, Canada, IBRADBUR@DAL.CA;
Snelgrove, P. V., Memorial University, St. John's, Canada, psnelgro@mun.ca;
Bentzen, P., Dalhousie University, Halifax, Canada, pbentzen@DAL.CA

RAINBOW SMELT IN NEWFOUNDLAND - A GRAPH THEORETIC PERSPECTIVE ON GENETIC CONNECTIVITY

We compare various applications of graph theory to ecological research (such as landscape connectivity models, as well as population graph models). Further, we introduce two new models of connectivity measurement, one that entails an index of coincidence of genetic data collected from sample populations, and another that is based on pairwise comparisons of individuals. We focus our analysis on a case study of rainbow smelt from Newfoundland coastal locations and evaluate the relative effectiveness of the graph theoretic techniques at discerning metapopulations and the degree of connectivity between population sampling sites. We find that neither of the previous two models successfully distinguishes metapopulations within our dataset. However, each of the two models that we introduce do perform well at this task.

Author Index

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

2008 ASLO Summer Meeting

8-13 June 2008 · St. John's, Newfoundland & Labrador · Canada

Conference Management Office · The Schneider Group, Inc.
5400 Bosque Blvd., Suite 680 · Waco, TX 76710 USA
Telephone: +1 254-776-3550 · Telefax: +1 254-776-3767
E-mail: stjohns2008@sgmeet.com
Web: http://www.aslo.org/stjohns2008

ASLO
Advancing the science of limnology and oceanography

Society of Canadian Limnologists
SCL
Société Canadienne de Limnologie

North American Benthological Society
Founded 1965

ST. JOHN'S

HYDRO
THE POWER OF COMMITMENT