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RABALAIS, NANCY N., AND R. EUGENE TURNER [EDS.]. 2001. **Coastal hypoxia: Consequences for living resources and ecosystems.** Coastal and Estuarine Studies, 58. American Geophysical Union, Washington, D.C. vii + 463 p. US$68. ISBN 0-87590-272-3.

This book began as a workshop on coastal hypoxia held in Louisiana in 1998. Although that workshop focused on the Mississippi River/Gulf of Mexico (GOM), the book that grew from it is international in scope and offers readers a broad overview of the past, present, and future of hypoxia generally. Furthermore, although the workshop was held four years ago, the 41 authors of the 23 chapters have upgraded and updated their work with a great deal of fresh information. They all are to be commended for squarely hitting a rapidly moving target.

The book begins with a ''must read'' summary of the Mississippi River/GOM hypoxia issue, covering the causes and dimensions of GOM eutrophication and hypoxia, comparisons to other world hypoxic zones, and a brief view of the practical importance to resource organisms. The remainder of the book consists of sections describing effects on plankton, benthos, fish, food webs, and ecosystems and a final section dealing with social, international, and global-change perspectives.

The first section analyzes hypoxia's effects on plankton. Dortch et al. study the stoichiometric effects of biogeochemical change and discuss the implications of recent declines in the Si : N ratio in the Mississippi River. Marcus explores the response of zooplankton to hypoxia, noting physiological and behavioral adaptations that allow them to avoid hypoxia. Qureshi and Rabalais infer effects of hypoxia on zooplankton from spatial distributions and community structure, indicating that zooplankton's rarity under hypoxia may result more from avoidance than mortality. Purcell et al. investigate the idea that jellyfish are becoming more abundant because of coastal eutrophication and support this idea with a narrative review of trends seen in Chesapeake, the GOM, the Black Sea, fjords, and saline lakes.

The next section examines hypoxia effects on physiology and behavior. Burnett and Stickle, reasoning that exposure to hypoxia may be inevitable, review ways in which physiology is affected by acute and chronic low oxygen, highlighting reduced disease resistance under hypoxia. Rabalais et al. summarize an archive of video observations of fish and benthos from diver-filming and ROV observations and include a tabular summary of responses and considerable color imagery of photogenically dead organisms from the GOM.

The section on benthos treats the broad implications of hypoxia for critical fish food and resource organisms. Diaz and Rosenberg give a very usable summary table of responses of 57 systems, indicating major effects on benthos and subsequent fisheries. Platon and Sen Gupta analyze changes in foraminiferal community composition over a period of changing hypoxia, indicating indices of use for inferring trends in hypoxia. Wetzel et al. review the microcosm and field literature on meiofaunal effects, indicating that some organisms can be quite tolerant of hypoxia. The recovery of benthic communities following hypoxic events depends on a supply of colonists; therefore, Powers et al.'s analysis of posthypoxia larval settlement gives insight into the long-term dynamics of hypoxic regions. Rabalais et al. use rigorous statistical and numerical methods to contrast benthos responses to hypoxia at sites in the GOM representing differing sediment composition and duration of hypoxia. These examples illustrate dramatic decreases in benthos biodiversity and abundance following hypoxia, with little recovery.

A section of four chapters presents much-needed summaries of fisheries effects. Breitburg et al. compare effects in Chesapeake and Kattegat fisheries predicting that effects on GOM fisheries will become very serious. In fact, Craig et al.'s chapter shows that GOM hypoxia results in reduced yields of resource organisms as well as changes in their spatial behaviors. Zimmerman and Nance brave the complexities of organismal and fishing community behavior to present a detailed analysis of GOM shrimp fisheries statistics in the hypoxia context. Smith performs a spatially explicit analysis of fishing reports, suggesting that patterns in catch are consistent with distributions of hypoxia. Finally, Chesney and Baltz note strong fisheries yields in the face of hypoxia but contrast this with an intriguing table showing declining catch per unit effort in 18 out of 23 Gulf fisheries since 1933.

Food webs and ecosystem effects are discussed next. Caddy's chapter synthesizes Eurasian information on watershed effects on fisheries that unifies marine (effort driven) and freshwater (catchment driven) management concepts. Turner's chapter on the influence of eutrophication on food webs is a fundamentally ecological analysis of this complex subject. His refreshing and realistically skeptical approach is spiced with empirical analyses of many of the central questions and concludes with a great summary table of conclusions and predictions.

The final section yields perspectives on hypoxia. The first chapter treats the subject generating the most controversy in my part of the GOM watershed: economic impact. Keithley and Ward's treatment of this is largely hypothetical and philosophical, reiterating much economic theory in the context of hypoxia; I would have preferred a much more quantitative analysis. This is critical because the solutions of environmental problems often reside at the interface of ecology and economics. Conley and Josefson's short perspective on severe hypoxia in Denmark and its remediation adumbrates the next steps for coping with hypoxia in North America. Justic et al. place GOM hypoxia into a long-term context by using a chain of empirical relationships to predict that global change will likely increase hypoxia as much as the effect of altered nutrient loading did over the last century.

The final chapter by Turner and Rabalais offers a summary table which I would suggest as the starting point for a read of the book. It shows what the editors perceive as the nine major points of the book and indicates the chapters in which they are treated. The final paragraph emphasized an important conclusion for aquatic scientists to embrace—that the solution of environmental problems requires scientists to work within the social perspective of the problem. The authors wisely state that ''The success and struggles of the farmers of the sea and land are linked through the medium of water quality.''

Everyone interested in hypoxia should read this book. It offers an important snapshot of this growing worldwide problem and represents some of the best minds in the field focusing on one of the principal environmental issues of this decade.

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