

## BOOK REVIEWS

*Limnol. Oceanogr.*, 46(3), 2001, 746  
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HOBBIE, JOHN E. [ED.]. 2000. **Estuarine science: A synthetic approach to research and practice**. Island Press. xi + 539 p. US\$30. ISBN 1-55963-700-5.

Estuaries, located at the boundary between land and ocean, have historically played important roles in the expansion of human civilization; consequently, anthropogenic effects on estuaries have been profound. Mitigation of these effects has been based primarily on tools provided by Wiley (1978) and Kennedy (1980) and recently refined by Van Westen (1996). Hobbie's new book significantly extends this field through the use of predictive modeling approaches; it substantially improves our ability to scientifically manage estuaries as sustainable systems for the future.

The book is divided into five sections: I, drainage basin synthetic studies; II, coupling of physics and ecology; III, linking biogeochemical processes and food webs; IV, controls of estuarine habitats; and V, synthesis for estuarine management. Each section begins with a useful summary and concludes with a synthesis chapter, which in some cases did not really complement the section.

Section I very effectively makes a case for understanding the importance of water flow, nutrients, and sediments from the drainage basin on the biogeochemistry of estuaries. It begins with one of the better empirical models (by Howarth et al.) available for linking land use with estuarine function and discusses some of the problems with application of such models in agricultural systems. In particular, "... the linkage between fertilizer use and nitrogen inputs to surface waters remains poorly documented . . ." because some of the nitrogen in a harvested crop is volatilized when it is fed to animals, and some leaches to surface waters. Another important conclusion is that only a small fraction (~20%) of the human-controlled nitrogen inputs to a watershed may reach the coastal boundary. The review of the current capacity to predict water transport and dissolved constituents through a drainage basin to the coastal zone by use of continental and global fluxes is excellent. It is clear that high spatial and temporal variability of physical and chemical properties of estuaries makes it difficult to generalize and make predictions in these systems; future success will require more detailed understanding of how estuaries are linked with drainage basins and riverine transport.

Section II deals with the physical processes that control the fate and transport of dissolved and particulate constituents in estuarine systems. It begins with a description of the relationships between sea-level anomalies and biological productivity. The empirical part of this treatment is very sound, if a bit narrow in its geographical perspective in comparison with the other examples in this section. One particularly interesting result is that salt marsh productivity decreased during a low sea level anomaly because of an increase in pore water salinity. The rest of this section focuses on the complex interactions between the physics and biology in estuaries. The characterization of estuaries on the basis of physical properties and how these classifications can include ecosystem processes is very clear, particularly the discussion of the need to go beyond the traditional hydrodynamic classification system and to include parameters that estimate particle-trapping efficiency and residence time. This theme is further developed (by Geyer et al.) with a comparison between physical processes and ecosystem structure that results in new and innovative recommendations on estuarine classifications and more effective use of numerical models.

Section III—a synthesis of how biogeochemical processes link with food webs—is less unified than the previous sections. It begins with a good overview (by Seitzinger) of site-specific denitrification studies, which are then linked with regional and global models. The overall conclusion is that, despite pitfalls inherent in attempting to make such a large-scale synthesis, these efforts are critical if we are to identify knowledge gaps that need future research. Boynton and Kemp emphasize the value of long-term data sets when examining the importance of river flow on nutrient and productivity dynamics in estuaries. Another important conclusion of this section is that case studies provide unique large data sets from which empirical syntheses can be made.

Section IV addresses the distribution and abundance of organisms in estuarine systems. Once again, I did not find the chapters in this section to be as coherently linked as the first two sections (drainage basins and physical forcing in estuaries). It begins with an overview of issues in wetland management and introduces the importance of a biogeomorphologic approach; given that coastal erosion is unquestionably important globally, I would have expected a more comprehensive and synthetic review than that presented here. The ensuing material jumps to the application of modeling physical and biological processes in well-studied estuaries. The interesting results presented here are based on model simulations of ecological processes and should prove useful in making predictions for management purposes. It is stressed (by Demers et al.) that modeling large fish populations in estuaries cannot be done reliably, because there simply are not enough detailed measurements to make meaningful predictions. It is further emphasized that the application of continuous measurement technology at anchored buoys is critical for future modeling efforts in estuaries.

Section V draws the preceding materials together to develop management strategies in estuaries. One of the key points (by Costanza and Voinov) is the need to combine good scientific knowledge with known human activities to derive viable predictive models. The specific steps that have been critical in the success "stories" of estuarine management are listed. Unfortunately, the specific details of how to make some of these key steps come to fruition are not explained. Nevertheless, this is the most comprehensive review to date on coupling scientific data with management planning.

It is unfortunate that it took 5 years after the workshop that produced most of this material for this book to appear; many of the case studies and models presented here have already appeared in the literature. I would also have liked to have seen a more a global approach, including comparisons with other well-studied systems, such as the Baltic Sea and the Peel-Harvey estuary in Australia. But these are minor quibbles—this is an excellent book that provides a badly needed synthetic approach to estuarine science and management. Furthermore, its remarkably low cost makes it an unusual bargain.

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