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Estuarine Science: A Synthetic Approach to Research and Practice

(*Hobbie, J.E. (ed) 2000. Estuarine Science: A Synthetic Approach to Research and Practice. Island Press, Washington, D.C.*)

"Estuarine Science" arrives at a time of changing perceptions about estuaries and coastal marine systems. Until recently, attention to coastal issues by government and the general public has focussed mainly on assessing hazards and minimizing exposure to them through regulation. Recent events illustrate the fallacy of continuing to rely solely on this reactive approach, especially given the growing density of human population along the coast. For example, in September of 1999 two and half million residents of Florida evacuated their homes to avoid the threat of Hurricane Floyd, a dangerous category 4 storm that dawdled northward just off the Atlantic coast. Evacuation plans proved inadequate, and tens of thousands were stranded along highways in their cars, where they would have been at greater risk had Floyd come ashore in Florida. This response will not be repeated soon in face of a similarly assessed risk. Other examples of purely reactive management include banning the consumption of seafood from areas affected by red tides or chronic pollution and restricting certain activities to prevent the loss of critical habitat.

Estuarine science in the U.S. is a relatively young discipline. One measure of this is the fact that many of its pioneers are still active and contributed to writing this book. Over the last few decades, research in estuarine science has developed an understanding of the linked hydrological, geological, hydrodynamical and ecological processes active in maintaining coastal and estuarine systems. This research has also documented the pervasive influence of human activities on these processes. Much of the early progress in estuarine research was documented in a series of collected volumes published by Academic Press beginning in the mid-1970s until the mid-1980s. Although not part of this series, "Estuarine Science" is a very useful contribution in this tradition.

Growing scientific knowledge about estuaries and adjacent coastal system supports and feeds recent movement toward a proactive approach to estuarine management; one that also takes account of the influence of human activities and the connection between estuaries and their watersheds. This in turn has spawned a number of monitoring and management programs focussed on different coastal regions. The Estuaries and Clean Waters Act of 2000, signed into law on 7 November, authorizes $225 Million over five years just to coordinate the numerous federal and nonfederal estuarine restoration programs now underway in the U.S. The stakes are high. For example, failure to reverse decades of wetland loss in coastal Louisiana promises eventual disaster for the one million residents of New Orleans. At an average elevation of eight feet below sea level, New Orleans relies on the ~50 km expanse of wetlands that lie between it and the Gulf of Mexico to absorb the storm surge from hurricanes that frequent that part of the coast.

The puzzle nagging estuarine scientists is how to overcome numerous barriers that divide the science and attain a general, holistic knowledge of estuaries. Proactive management depends on predictive tools that can only come from integrating scientific knowledge across disciplines and geographic locations. The barriers arise

from both the multi disciplinary nature of the science and from administrative constraints on resource management. Jurisdiction over the marine coastal area of the United States is divided among the agencies of 23 states and at least a dozen separate, and sometimes competing, federal programs. Interagency cooperation can be effective lowering jurisdictional boundaries within a region. The result is that much specific knowledge exists on a few well-studied estuaries, but there is little or no understanding of how this knowledge applies to other coastal areas.

The solution, according to the contributors to "Estuarine Science," is to take a synthetic approach to research and practice. This book is a how-to guide for integrating scientific information with an eye to application for resource management. The first chapter introduces to five "types" of synthesis. These range from empirical, based on direct description of observational data, through to detailed predictive models that incorporate mechanistic understanding of linked physical, biogeochemical and ecological phenomena. In fact, the synthesis types describe a progression of understanding obtained from research that begins with basic characterization of whole-system behavior and leads to deeper understanding of the underlying mechanisms of cause and effect. One of the barriers to integration arises from apparent epistemological differences between different disciplines. For example, our understanding of estuarine circulation derives from fundamental knowledge contained in the Navier-Stokes equations; whereas understanding of estuarine ecology relies on observation and experiment. The five types of synthesis provide a single framework that encompasses both of these.

The synthesis theme carries through the remaining 16 chapters, which are organized into five parts. Part one covers the measurement and prediction of water and biogeochemical fluxes to estuaries from their watersheds. Part two discusses the coupling of ecological process with physical processes within estuaries. Part three links biogeochemical processes to the food web. Part 4 describes factors that influence the distribution and abundance of organisms in estuaries, i.e. habitat. And the concluding Part 5 examines synthesis as part of making scientific information useful to resource managers. Within each part, one chapter provides an overview and recommendations while other chapters describe synthesis case studies. I found this organization to be logical and effective.

"Estuarine Science" presents information on the role of hydrologic processes in estuaries that should be of interest to many readers of Eos. Estuarine and coastal hydrology is not generally included in the mainstream of hydrological science. For example, the 1991 report of the National Research Council, "Opportunities in the Hydrological Sciences," limits the domain of hydrological science to be the global water balance and continental water processes – that is fresh water. Estuarine scientists long ago recognized that hydrologic variability and associated variability in geochemical and sediment fluxes are major factors determining the structure and functioning of coastal ecosystems. "Estuarine Science" provides a good, but not exhaustive, introduction to the topic of estuarine and coastal hydrology. Topics covered include application of distributed watershed hydrology models to estimate fluxes to the coast, aspects of physical hydrology of the coast, and three different effects that freshwater discharge has on ecological processes in the estuarine water column.

Readers of "Estuarine Science" will not learn how to save New Orleans from inundation, prevent the plankton blooms associated with red tides or solve any of the other challenging problems we now face. Rather, this book's modest ambition simply is to begin deliberate progress toward synthesizing the scientific information we will need to succeed in solving these problems. Although the text is compiled from contributed chapters, this book is well organized, coherent, and quite readable. This accomplishment argues convincingly that the editor and his collaborators know what they are talking about on the topic of synthesis. I recommend "Estuarine Science" to my colleagues in coastal science and hydrology. However, its lessons on synthesis of scientific information also merit attention by the broader community of earth systems scientists.

This accomplishment argues persuasively that the ideas on synthesis, the guidance, offered inside (that are the topic) merit the attention by the diverse community concerned with coastal issues.

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