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BIANCHI, T. S., J. R. PENNOCK, AND R. R. TWILLEY. 1999. **Biogeochemistry of Gulf of Mexico estuaries**. John Wiley & Sons. xix + 428 p. \$89.95. ISBN 0-471-16174-8.

Because most marine systems are open and difficult to define geographically, they are ill suited for the comparative approach that has been used so successfully in limnology. Estuaries, on the other hand, are semienclosed and consequently well suited for this approach. Earlier comparative studies of estuaries focused on the productivity of phytoplankton or fisheries and laid the groundwork for subsequent understanding of nutrient dynamics and problems like hypoxia (Boynton et al. 1982; Nixon et al. 1986; Pennock et al. 1994). This book uses the comparative approach and is ironically both narrow (only biogeochemistry; only Gulf of Mexico estuaries) and comprehensive (not much happens in an estuary that is not reflected in its biogeochemical cycles; the range of estuarine types in the Gulf is great). It succeeds in summarizing the current state of knowledge in this field, in providing a synthetic overview of the subject, and in making the somewhat arcane aspects of estuarine biogeochemistry accessible to the generalist.

Three introductory chapters on physics and sediments set the stage, cataloging things like residence times and tidal forcing. The nine following chapters deal exclusively with classical biogeochemical topics: nutrient dynamics, organic matter cycling, and trace element/organic interactions (there are no phytoplankton or zooplankton chapters masquerading as geochemistry). The material on nutrients includes reviews of loadings and water column processes and two chapters that present results of experiments on benthic fluxes and wetland/water column interactions. The latter chapters are handicapped by the fact that only a few estuaries were included in the experiments and that different investigators used somewhat different experimental protocols—problems that recur in most comparative analyses of ecosystems.

Two chapters deal directly with cycling of organic matter (one on particulate organic matter [POM], one on dissolved organic matter [DOM]), and three deal with trace element/organic interactions. These are mostly comprehensive reviews. Both traditional processes (particle reactivity, dissolved/particulate interconversions, metal speciation) and newer perspectives are treated in detail. Organic matter interactions comprise something of a theme for the book. New technologies that permit the mechanical separation of molecular weight fractions are rapidly changing our understanding of the nature and dynamics of DOM and forcing us to go beyond the traditional definitions of POM and DOM as dictated by retention on membrane filters of ill-defined porosity. I remain somewhat confused by the division of POM and DOM into a welter of new categories, from particulate to colloidal, to “sort of dissolved,” to “really, really dissolved,” probably because it is an attempt to make discrete something that is essentially a continuum (Azam 1998). The reconciliation of these various physical/mechanical categories of organic matter with what we are also learning about the chemical nature of the material will continue to be a daunting task into the future. Estuaries, with all of their heterogeneity and temporal vari-

ability, are possibly not the best places to look for order in this area, but this book does as well as could be expected in summarizing current thought.

The editors intend for the book to be used “. . . both as a reference source and as a supplementary textbook.” It probably will be more successful as a reference: the quality of the production is very high, the editors have been successful in standardizing notation and terminology beyond what one would expect in a multiauthored volume, and there are few typographic errors. One unfortunate editorial decision—omitting charge from the notation describing nutrient ions, e.g., ammonium is denoted NH_4 —will confuse some students and thus limit its utility as a textbook. The mathematical notation is also occasionally sloppy (e.g., in Chapter 8).

The final chapter provides a timely discussion of environmental problems and management issues. The Gulf of Mexico is to the Americas what the Mediterranean was to Rome—*mare nostrum*, an ocean we can claim as our natural birthright, a resource for commerce, recreation, and discovery. It has been sadly neglected under our stewardship, resulting in hypoxia, declining fisheries, and a lack of knowledge about the Gulf on the part of the general public. (When I moved to the Gulf Coast some years ago, a friend from New York who came to visit was astounded when she stood on its shores. “It’s like the ocean,” she said. “I didn’t know it was so big.” “It *is* the ocean,” I replied.) Fortunately, our neglect has been relatively benign for the Gulf estuaries; eutrophication and other anthropogenic plagues have not impacted them as much as estuaries on the Atlantic coast. Hopefully, with the aid of knowledge summarized in books such as this one we can save Gulf estuaries from these ills.

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