DYNAMICS OF MARINE ECOSYSTEMS: BIOLOGICAL–PHYSICAL INTERACTIONS IN THE OCEANS

Mann, K.H. & Lazier, J.R.N. 2006. 3rd ed. Malden, MA & Oxford, UK: Blackwell Publishing. xii + 496 pp. with 158 figures, 1 table, 8 boxes, 2 appendixes, bibliographic references and index. Soft cover. ISBN 13-978-1-4051-1118-8. US$80, UK£55.

If you want to bone up on the basics of biologic oceanography, are contemplating teaching a course in that subject or want to better understand talks given by oceanographic modelers, *Dynamics of Marine Ecosystems* is the book for you! The perspective comes entirely from the resource-driven angle—that is, not much about effects of predation on trophic structure, and the "biology" does not venture much beyond phytoplankton ... well, occasionally the text gets to zooplankton and omnivorous fishes such as anchovies in upwelling systems. There is no mention, for instance, that ocean food webs now are a pale shadow of what they were as recently as a few decades ago. Basically, the physics still explains the biology! That characterization of the "flavor" of this book is, however, the norm in what most people define as "biologic oceanography."

Dynamics of Marine Ecosystems is a very well-written book and clarifies many otherwise complex phenomena that make the ocean the ocean. I learned a good deal from reading through it.

It begins with the prefaces to the three editions and then an introduction (Chapter 1), titled "Marine ecology comes of age," which highlights some of the more recently appreciated phenomena—for example, oscillations (regime shifts) at various temporal scales and the consequences of elevated CO_2 in atmosphere and ocean. The book is then divided into three sections (A, B and C) based on spatial scale: processes that operate within one kilometer, at between one and one thousand kilometers, and at thousands of kilometers. To seabird enthusiasts, the latter two sections are more directly relevant to their usual interests, but the first section does review most of basic ocean processes.

In Part A, the three chapters cover biology and boundary layers, vertical structure of the open ocean (biology of the mixed layer), and vertical structure in coastal waters (freshwater runoff and tidal mixing). Considering boundary layers, water flow, drag, turbulence and mixing are the important factors. They affect processes such as nutrient uptake by phytoplankton and feeding efficiency of zooplankton. In the open ocean, the mixed layer is deep and the boundary strong, thus restricting nutrient flow upward; that chapter delves greatly into phytoplankton production in such circumstances and the characteristics of seasonal blooms. A strong mixed-layer boundary also affects the dynamics of CO_2. Finally, with the investigation of coastal waters, the book enters into a subject that is a hot issue today, as society confronts the effects of runoff, increased sedimentation and pollution. In that chapter, the subject of freshwater plumes and tidal mixing are covered.

In Part B, the three chapters deal with vertical structure in coastal waters (coastal upwelling regions), fronts in coastal waters, and tides, tidal mixing and internal waves. Thus, as should now be clear from the layout, the authors are looking at a number of the same processes at their three chosen scales and not just at separating processes that work only at one scale or another.

In Chapter 5, the mysteries of Ekman transport are initially revealed, and primary and secondary production in each of the five major upwelling systems—Canary, Humboldt, California, Benguela and Somali—are reviewed. Smaller-scale systems, such as that off Nova Scotia, are also covered. The chapter finishes by attempting to relate primary production to fish production in such systems. Chapter 6 on fronts in coastal waters would be of special interest to seabird biologists, explaining why predators might be concentrated in certain areas as compared with others—that is, the subject of "hotspots" that has been prominent recently. Chapter 7 delves into why plankton may also concentrate where they do.

The final major division of the book, Part C, is again composed of three chapters: ocean basin circulation (the biology of major currents, gyres, rings and eddies), variability in ocean circulation (the biologic consequences), and oceans and global climate change (physical and biologic aspects). Chapter 8 is thus a look at ocean turbulence in the large scale and the scale at which seabirds exhibit changes in community composition. Basically, wind circulation patterns and their consequences are considered here, including the now famous "thermohaline circulation." The chapter includes three examples of possible seabird prey or competitors as they might be affected by large-scale circulation: squid in western boundary currents, eels and oceanic gyres, and salmon as affected by the Alaskan Gyre. Finally, the production of rings and eddies are discussed, as are the major gyres of the world ocean. Chapter 9 is more about temporal variation to the physical structure and covers the El Niño–Southern Oscillation in all its complexities, decadal regime shifts, and very briefly, longer-term oscillations. The chapter ends with examples of how some fish stocks appear to have responded to this variability. Finally, Chapter 10 covers the subject for which many potential readers might well want to acquire this book: the complexities of what happens when the atmosphere holds too much CO_2 and how the ocean is affected. These days, lots of folks are putting a lot of stock in the ocean bailing us out of the climate crisis, particularly the polar oceans, which, because of their low temperature, should be able to absorb more CO_2 than the warmer parts of the seas. Thus, any marine scientist would want to be informed on this subject, and *Dynamics of Marine Ecosystems* is a good place to start.

Chapter 11 is titled "Questions for the future," where the authors consider important topics for future research: What makes hotspots, hotspots? To what extent are the outcomes of physical processes modified by biologic interactions? How does humanity effectively develop an understanding—that is, come up with a concept—that merges the tremendous range of scales under which ocean processes operate?

Obviously, the age of synthesis and modeling is rightfully upon us.

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