BOOK REVIEW

Marine Biology


Marine biology is a popular course at many colleges and is often taught at several levels, ranging from general education to a core course for biology and zoology majors. Textbooks for these courses necessarily are tailored to the appropriate student audience to convey both the novelty and excitement of studying marine organisms. In addition, they must summarize an ever-expanding body of facts on how marine organisms function, adapt, and interact with their physical and biological environment. This book is the second edition of a textbook targeted primarily for upper-level undergraduate students and is best suited for those with some introduction to basic biology.

Marine biology is a topic that encompasses a tremendous range of information including biology at all levels of organization from cellular to seascape and aspects of chemistry, physics, and geology. Additionally, like other scientific disciplines, progress relies on hypothesis testing, proper experimental design, and statistical analysis. Levinton begins the approach to this highly interdisciplinary topic by focusing first on the history of the science and the principles on which our understanding of the marine environment are based. A short history of marine biology in the first chapter covers some of the seminal contributions of early natural historians and the more recent explorations made possible through advances in technology that allow either a real or virtual presence in nearly every known marine habitat. This is followed with a very readable treatment of the application of the scientific method and the use of hypothesis testing and experimentation in marine biology. The first chapter concludes with the delineation of the major marine habitats based on depth and location.

The next 5 chapters focus on general information and principles that guide how the marine environment works and how marine organisms interact with the physical environment and each other. Chapter 2 covers basic descriptions of the ocean environment, physical properties of seawater, basic physical and geological oceanography, and introductions to waves and tides. A well-organized treatment of the ecological hierarchy, interactions between organisms, and an introduction to genetic variation and how it relates to speciation, evolution, and biogeography is presented in the third chapter. This chapter concludes with general descriptions of community and ecosystem level processes such as dispersal, competition, predation and herbivory, disease and parasitism, disturbance, and facilitation. While this may be review material for students already having taken an ecology course, this introduction lays the groundwork for more advanced discussions of the relative importance of these processes in specific marine communities.

The second section of the book examines how marine organisms function in their environment. It begins with Chapter 4, which presents how organisms function and how their physiology is affected by the physical environment, including temperature, salinity, oxygen concentration, and light. A thorough treatment of reproduction, dispersal, and larval ecology of marine organisms is presented in Chapter 5 and includes discussions of life cycles, modes of dispersal, factors affecting different types of larvae, and the larval settlement process. The last chapter in this section on principles (Chapter 6) is an excellent treatment of the fluid medium and how the physical properties of seawater (density, viscosity, velocity) have fundamental effects on marine organisms. This chapter provides students with a good introduction to basic hydrodynamics and biomechanical principles that are supported by several illustrative examples. The material presented in this chapter would have been absent in a marine biology textbook published 10 years ago. Its presence here reflects the increasing appreciation among marine biologists of the importance of hydrodynamics and how biomechanical constraints govern (in part) the shape and function of marine organisms.

Section III of the book includes chapters that review the organisms inhabiting the open ocean water column. Chapter 7 presents a description of the plankton with a brief introduction to different phytoplankton representatives and a more expanded section on zooplankton groups, including a discussion of patchiness and vertical migration. The nekton are the focus of Chapter 8, including the larger cephalopods, the fishes, marine mammals, birds, and reptiles. High-quality color photographs and line drawings of representatives of both the plankton and nekton will give students an appreciation for the diversity of form represented by open water organisms.

The following section (Chapters 9 and 10) presents the dominant processes determining the abundance and distribution of open water organisms. The roles of light and nutrients in controlling phytoplankton abundance are presented in Chapter 9 along with a discussion of phytoplankton succession and the microbial loop. Primary productivity, trophic transfer, and food chains and webs are the subject of Chapter 10. An up-to-date discussion of several methods employed to estimate primary production are presented,
including modern small-scale (pump-probe fluorometry) and large-scale (satellite color scanners) methods. The chapter concludes with a presentation of the distribution of primary production among the world’s oceans.

The next section (Chapters 11–13) is devoted to describing the diversity of benthic marine organisms and the general habitats in which they live. The diversity of benthic invertebrates from protists to urophorids is presented in Chapter 11 and is accompanied by line drawings and black and white photographs. General characteristics are given for each group, followed by a discussion of their biology. Benthic seaweeds, seagrasses, and benthic microorganisms are covered in Chapter 12. Phycologists may be disappointed at the brevity of the presentation of the macrophytes (6 pages versus 28 pages for benthic invertebrates), but this chapter does provide a basic introduction to the major benthic macrophyte groups. Color photographs of some benthic invertebrates and macrophytes are presented at the end of the chapter. The section concludes with Chapter 13, which presents an excellent discussion of the unique challenges organisms face living in soft sediment habitats and hard substratum environments.

Section VI (Chapters 14 and 15) covers the major benthic community types. Chapter 14 introduces intertidal rocky and sandy/muddy shores, salt marshes, mangroves, and estuaries. Unique aspects of each of these communities are presented with an extensive discussion of the role of physical and biological factors that result in zonation patterns in the abundance of benthic organisms. The overview of intertidal research, which has contributed disproportionately to our understanding of benthic ecology, is excellent and will give students an appreciation for the roles of competition, predation, disturbance, and larval supply in determining intertidal community structure. Perhaps more importantly, this part of the book accurately presents marine ecology as a dynamic science, whose practitioners continually challenge and test ideas about the relative roles of different ecological processes in structuring marine communities. This section concludes with discussions of seagrass beds, kelp forests, subtidal rocky reefs, and coral reefs in Chapter 15. The ecology of each community is presented along with examples of community shifts resulting from eutrophication, pollution, and overgrazing, all of which highlight the complex interactions between physical and biological factors that can radically change benthic community structure.

Section VII (Chapters 16 and 17) reviews shelf and deep sea subtidal environments, how they are sampled, gradients in the physical environment over these depths, and how biodiversity changes from the shelf to the deep sea. Chapter 16 includes a discussion of hydrothermal vent environments and the relatively recent discoveries of sulfide-dependent bacteria and symbioses that are present in these unique communities. Large-scale gradients in biodiversity are discussed in Chapter 17 along with explanations for patterns in biodiversity among and within ocean basins. This discussion leads to the very timely topic of biodiversity, invasions of marine species into new habitats, and the emerging importance of conservation genetics. This chapter concludes with a brief section on current federal programs and legislation designed to conserve marine biodiversity.

The final section of the book (Chapters 18 and 19) focuses on the impact of human beings on the marine environment. Chapter 18 reviews the basics of fisheries biology and some well-known examples of overexploitation by commercial fisheries on several species of fishes and whales. The concept of marine protected areas is appropriately introduced and discussed here as one management tool to mitigate the impacts of fishing. The chapter concludes with a discussion of mariculture and a somewhat out-of-place section on harmful algal blooms. The final chapter presents a depressingly familiar list of human-related pollution and impact on the marine environment, from toxic metals and other substances, to pesticides and PCBs, eutrophication, and oil and thermal pollution. Greenhouse warming and the predicted global changes in the marine environment that will result are the final topics of the chapter.

One of the strengths of the book is the consistent organization of the chapters around important points that are highlighted in color. Many chapters also are highlighted by one or more related sections, called Hot Topics in Marine Biology, that present recent advances, current issues, and/or controversies in the field. These sections are referenced and provide an excellent segue to the primary literature on the topic. Each chapter also has a list of further reading, organized by topic, that directs the student to the primary literature. The concluding section of each chapter has a set of review questions that could be used by students to focus their attention on the important topics covered.

Included with the book is a CD entitled, “Marine Biology Explorations 3.0.” The CD opens with Internet Explorer (but apparently not with Netscape) and contains many color images of marine organisms and habitats, a list of marine biology–related web links, a list of web links to marine laboratories and graduate programs, and a set of reference archives on selected marine biological topics. These visual and web resources are valuable additions to the traditional textbook and will be much appreciated by visually oriented, web-savvy students.

I found the overall quality of presentation of the book to be very high, but of course no book is without errors or shortcomings. While the quality of the line drawings and figures is high and the number of typographic errors minimal, there are a few figures for which the reader is referred to line colors that don’t exist. For topics with which I am most familiar (e.g. kelp forests and coral reefs), I found that reference lists were somewhat dated and did not include
some of the more recent papers. Nevertheless, I believe the author has achieved success with the herculean task of updating a very diverse literature and presenting a complete and well-organized text that effectively conveys the complexity of the marine environment, the elegance and beauty of its inhabitants, and the excitement of discovery and study that is inherent to the field. I expect this book will serve as the introduction to the marine realm for many students in the years to come.

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