

preface

There has probably never been more general interest in oceans and marine life than there is today. More people than ever before can enjoy the sea's beauty, mystery, and excitement, either indirectly through the many excellent film and television documentaries, photo essays, and worldwide web sites, or directly through such popular pastimes as scuba diving, recreational fishing, and aquarium keeping. There is also a growing awareness of the ocean's importance to human affairs, reinforced by such recent events as the El Niño of 1997–98 and various fisheries disputes. This interest in the oceans is reflected in the continuing popularity of marine biology and related subjects in high schools, colleges and universities, and adult education programs.

While keeping in mind the range of potential users, we have written this text primarily for the largest group: lower-division, non-science majors at colleges and universities. A growing number of these students enroll in marine biology not only out of personal interest, but also to fulfill a general science requirement. Many will take no other college science course. We have made a special effort to include the solid basic science content needed in a general education course, including fundamental principles of biology, the physical sciences, and the scientific method. Our general aim was to integrate this basic science content with a stimulating, up-to-date overview of marine biology. We hope this approach demonstrates the relevance of the physical sciences to biology and makes the study of all sciences less intimidating.

At the same time, we recognize that general science content will not be needed in all marine biology courses, either because the course is not intended to satisfy general education requirements

or because students already have a background in science. The text is designed to give instructors flexibility in the amount of basic science coverage, and also in the order in which topics are covered and in overall emphasis and approach. We have tried to meet the needs and expectations of a wide range of students, from the political science major interested in fisheries policy, to the engineering major interested in ocean technology. We hope that even biology students find it useful.

Another feature of *Marine Biology*, third edition, is its *global, non-regional perspective*. That the world's oceans and seas function as a vast integrated system is among the most important messages of our book. Understanding this requires a new way of thinking for many students. One aspect of our global approach is the deliberate inclusion of examples from many different regions and ecosystems so that as many students as possible will find something relevant to their local areas. We hope this will stimulate them to think about the many relationships between their own shores and the one world ocean that so greatly influences our lives.

CHANGES IN THE THIRD EDITION

As in previous editions, we have updated the text to reflect *new research* and *changes in perspective*. Among the most significant changes is the classification of algae as protists rather than plants in accordance with the almost general consensus among phycologists. Chapter 17 has been reorganized to reflect changing perspectives of the relative importance of habitat alteration and pollution in the marine en-

vironment. There are new boxed readings on ocean imaging and the introduction of invasive species, and many other boxed readings have been substantially revised. New information is presented on harmful algal blooms, including blooms of *Pfiesteria*. The coverage of El Niño–Southern Oscillation phenomenon has been updated with information from the dramatic events of 1997–98. Somewhat increased emphasis has been placed on the role of microbes in marine ecosystems. The text has been reorganized in many places to provide more balanced coverage and improve the logical sequence. We also corrected several errors that were kindly pointed out by reviewers and users of the text.

We have continued to improve the program with many new or updated photos and illustrations. The design has also been improved to make better use of space and improve readability. Among the most exciting developments is the provision of *links to informative and entertaining Internet sites* related to each chapter. They can be accessed on-line via the book's home page <http://www.mhhe.com/marinebiology>.

ORGANIZATION

Marine Biology is organized into four parts. Part 1 (chapters 1 through 3) introduces students to marine biology and related fields of science. Chapter 1 describes the history of marine biology. It also covers the fundamentals of the scientific method, which are essential in understanding the workings of science. This feature presents science as a process, an ongoing human endeavor. We believe it is important for students to realize that science does have limitations and that there is still much to be learned. Chapters 2 and

3 present basic material in marine geology, physics, and chemistry. *Marine Biology* includes more information on these subjects than other texts, but we kept chapters 2 and 3 as short as possible. Wherever possible, physical and chemical aspects of marine environment are discussed in the chapters where they are most relevant to the biology. Wave refraction, for example, is covered in conjunction with intertidal communities (chapter 10), estuarine circulation is discussed as part of the ecology of estuaries (chapter 11), and upwelling is covered with the epipelagic zone (chapter 14). This approach provides the general science coverage that some instructors need, but allows those who don't to use these chapters for background reference. It also emphasizes the importance of the physical and chemical environment to the organisms of the sea. Like the rest of the book, chapters 2 and 3 include original world maps that were drawn using the Robinson projection to minimize distortion.

The exciting nature of life in the sea is the subject of part 2 (chapters 4 through 8). Chapter 4, "The Business of Life," is a brief introduction to basic biology aimed at students with a limited background in biology. As with the fundamentals of geological, physical, and chemical oceanography, basic biological concepts are reviewed throughout the book in short Review boxes. Because the most important material is reviewed in these boxes, chapter 4 may be omitted if students have an adequate background in basic biology. Chapters 5 through 8 survey the major groups of marine organisms from the perspective of organismal biology. As in the first part of the book, we provide introductory information that is reviewed and expanded upon in future chapters. In discussing the various groups, we emphasize functional morphology, outstanding ecological and physiological adaptations, and economic importance or significance to humanity. Classification and phylogeny are not stressed. However, a classification scheme for the major groups is given at the end of each of the four chapters in part 2. Terminology has been limited to the bare essentials. Here and throughout the book we selected organisms from

around the world for illustration in photographs, line drawings, and color paintings, but organisms from the coasts of North America are emphasized. Organisms are referred to by their most widely accepted common names; one or two common or important genera are noted in parentheses the first time a group is mentioned in a chapter but we have not attempted to be comprehensive in listing genera. Indeed, at the suggestion of reviewers we have reduced the number of genera that are listed to make the text easier to read. Nomenclature follows for the most part the FAO Species Catalog and Species Identification Guides for groups covered by these references.

The third and most extensive part (chapters 9 through 15) constitutes the heart of the book. The first chapter of this section (chapter 9) introduces some fundamental principles of ecology. As in chapter 4, important concepts presented here are reviewed elsewhere in the Review boxes. In the remaining six chapters of part 3, we describe the major environments of the world ocean, proceeding from nearshore to offshore and from shallow to deep water. This sequence is admittedly somewhat arbitrary but conforms to the teaching sequence followed by the greatest number of our reviewers. The chapters, however, are designed so that they can be covered in any sequence according to instructors' preferences and needs. The basic themes are adaptation to the physical constraints of the environment and the interaction of organisms within the environment. Most chapters include generalized food webs that follow a standardized scheme of color coding to indicate the nature of trophic relationships.

The final part of the book looks at the many ways that humans interact with the world ocean: the use of resources, our impact on the marine environment, and the influence of the ocean on culture and the human experience. These chapters present an up-to-date, comprehensive view of issues and concerns shared by many students. The chapter on resource utilization (chapter 16) looks not only at traditional uses such as fisheries and mariculture, but also at more modern aspects such as the pharmacological use of

marine natural products and the application of genetic engineering to mariculture. In chapter 17, a discussion of human-induced degradation of the marine environment is balanced by an examination of the conservation and enhancement of the marine environment. The book closes with an essay on the impact of the ocean on human affairs (chapter 18) that we hope will stimulate students to reflect on the past and future significance of the world ocean.

TEACHING AND LEARNING AIDS

Because courses vary in content and sequence, *Marine Biology* was designed to be a flexible and efficient teaching aid. Chapters are written as short, readily absorbed units to increase instructors' flexibility in selecting topics. It is not assumed that instructors will follow the order in which material is presented in the book. For this reason, we provide **Review boxes** that briefly explain key terms and concepts from other chapters. Some are illustrated by line drawings. Each box refers to the chapter and page where the concept is explained if more detailed information is needed. We hope this feature reduces the distraction of searching the index for unfamiliar terms.

Key concept summaries, printed in italics, highlight the most important terms and ideas presented in preceding paragraphs. The text is accompanied by a superb collection of photographs and illustrations that were carefully designed and selected to complement and reinforce the text. Some of their captions contain questions that seek to further stimulate the student. There are many maps specifically created for *Marine Biology* to our specifications. The extensive **Glossary** provides complete definitions, and often refers to illustrations in the text or other key terms in the glossary that help explain the concept.

All chapters contain short **boxed essays** that present interesting supplementary information—material as varied as experimental setups, John Steinbeck, intelligence in dolphins, and marine archaeology.