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Biology of the Southern Ocean

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Book Reviews

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Biology of the Southern Ocean

George Knox
CRC Press, 2007.
ISBN 978 0-849-33394-1, 640 pp, £99.

At the start of my interest in Antarctic research I looked around for a general reference that provided an overview of physical, chemical and biological oceanographic processes in the Southern Ocean. A colleague suggested reading the *Discovery Reports*, but the idea of reading even a subset of these reports, which occupied most of a long shelf in the university library, was daunting at best. In 1994 the first edition of *Biology of the Southern Ocean* by George Knox was published. The book was impressive in its breadth and in its coherent synthesis of a large amount of information and unlike anything else available on the Southern Ocean. I wished the book had been published sooner because it would have been an easier introduction to Southern Ocean literature for me. It soon became the primary reference that I suggested for graduate students who were beginning Southern Ocean studies or that I consulted to refresh information. However, eventually this comprehensive reference became dated in its treatment of some topics and provided limited coverage of other topics as Southern Ocean science advanced. Therefore, I was pleased when a second edition of *Biology of the Southern Ocean* was published in 2006.

The second edition consists of 21 chapters; the last three of which are new. The general structure of the revised edition is similar to the first. It begins with an overview chapter that outlines Southern Ocean evolution, bathymetry, climate, sea ice, large-scale and regional circulation and water mass patterns. The next nine chapters (Chapters 2–10) are organized around a standard ecosystem structure that progresses from the lowest to highest trophic levels. Benthic, fast-ice and ice shelf, and ice-edge communities are the subjects of the next three chapters (Chapters 11–13). Organic matter and microbial processes are given a separate chapter, as is ecosystem dynamics (Chapters 14 and 15). Chapters on resource exploitation and its effect on Southern Ocean ecosystems (Chapters 16 and 17) follow the descriptions of the Southern Ocean ecosystem components and provide an entry into the chapter on management of living resources (Chapter 18). To this point the second edition follows the outline of the first, but with new information added to each chapter. The final three chapters (Chapters 19–21) on ultraviolet radiation, global warming and Antarctic marine ecosystems, and human impact provide overviews of research areas that have emerged as important since publication of the first edition. The detailed table of contents for each chapter provides a convenient guide for easily locating specific information. Similarly, the detailed index facilitates finding information on specific topics. The reference list is extensive, over 3000 references including many citations to lesser known publications - a real testimony to the author's many years of effort.

The chapters that focus on individual components of the marine food web (Chapters 2–10) start with a large-scale perspective of species composition and distribution (biogeography), which is followed by descriptions of specific geographical- (e.g. Ross Sea) or physically-defined (e.g. ice edge, bathypelagic) regions. The latter material is new and reflects the understanding of regional and environmental structuring of species distributions and productivity that has developed since the first edition was published. The remainder of these chapters focuses on physiological and environmental controls and population processes that are relevant to individual trophic levels. New material has been incorporated throughout these sections. For example, the sea-ice microbial communities chapter (Chapter 3) includes a new section on sea ice as a habitat.

Krill are given a separate chapter (Chapter 5), highlighting its importance in Southern Ocean food webs. This chapter has been reorganized and new information incorporated throughout. The sections on krill distribution have been updated to include regional descriptions, such as the Ross Sea and Weddell Sea. Also, the section on factors affecting krill distribution has been expanded to include sections on biomass and density variability, environmental factors, and biological controls, such as predator food demands.

The chapters on zooplankton, nekton, fish, seals, whales and birds provide good summaries of distribution, major taxa, and population processes. The uneven treatment of similar topics between these chapters provides insight into where knowledge of higher trophic levels in the Southern Ocean is limited.

The chapter on decomposition, bacteria and protozoa provides an overview of processes involved in cycling of particulate and dissolved organic carbon and has been updated to include sections on viruses and nutrient cycling. However, it was surprising that more use was not made of the results from the Southern Ocean Joint Global Ocean Flux Study in this chapter where major advances have been made. The ecosystem dynamics chapter attempts to synthesize the many and disparate concepts presented in the preceding chapters. A useful aspect of this chapter is the summary of food web diagrams proposed for different areas of the Southern Ocean, which are based on energy flow analysis (discussed in the Appendix to the book). However, little of the work done in the past 10–15 years on studies of potential alternative food webs (e.g. salps versus copepod versus krill-based food webs) is included

as part of the ecosystems dynamics discussion, even though some of these results are from the Convention on Conservation of Antarctic Marine Living Resources (CCAMLR) studies from which much of the material in this chapter is drawn. Studies that couple circulation and ecosystem models to investigate energy flow in Southern Ocean food webs are also not included.

The chapter on resource exploitation is a useful historical summary of harvesting and exploitation of Southern Ocean marine resources. However, the resumption of scientific whaling of Southern Ocean whale stocks and changes in the krill fishery since the demise of the Soviet Union are not mentioned. The chapter on ecosystem changes resulting from resource exploitation has been expanded to include summaries of changes that have occurred in whale stocks as a result of exploitation and a discussion of the "whale reduction-krill surplus" hypothesis. Management of Southern Ocean marine living resources is discussed within the framework of the monitoring programs developed through CCAMLR. The importance of the ecosystem-based approach to resource management is clearly brought out in this chapter.

The new chapter on ultraviolet (UV) radiation provides background on why this is an issue for the Southern Ocean. This chapter also provides a good overview of environmental and biological factors that affect UV radiation exposure and possible UV radiation effects. Similarly, the global warming chapter begins with a summary of the major climate signals that manifest in the Southern Ocean and provides a summary of observed environmental and biological changes that are attributed to the effects of climate warming. The second portion of this chapter addresses potential impacts of global warming on Antarctic marine ecosystems, most of which are related to changing sea ice cover. The final chapter makes the important point that human influences on the Antarctic have been extensive and profound, which is often surprising to those not familiar with the Southern Ocean. The historical perspective given in the Epilogue highlights how much understanding of Southern Ocean ecosystems structure and function has evolved over the past 50–60 years.

The synthesis nature of the book results in coverage of many topics that is limited to general statements, uneven treatment of material in places, and limited or no coverage of some areas of research, such as regional habitat differences and consequences for ecosystem structure and function (e.g. role of Circumpolar Deep Water), relationships between predators, habitat structure and prey availability, and modelling studies of specific components of the ecosystem (e.g. sea ice biota, krill life history, predators, coupled ecosystem-circulation processes). However, sufficient information and references are generally available to allow the interested reader to go further. The strength of this book is that it provides a single point of reference for a large volume of information in many disciplines.

Knowledge of the path by which our scientific understanding advances is often as important as knowing where we are on the path. *Biology of the Southern Ocean* provides an assessment of where we are on this path and summarizes much of the information that was obtained along the way in a very coherent fashion. As such, it gives us a perspective on Southern Ocean biology that is unique. This book, like its predecessor, is sure to become a standard, reference for Southern Ocean research.

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Encyclopedia of the Antarctic

edited by B. Riffenburgh
Routledge, New York, 2007.
ISBN 0-415-97024-5. 2 volumes. £285.

This two volume work sets a new benchmark for Antarctic Encyclopaedias with some 495 entries of between 500 and 6000 words. Edited by B. Riffenburgh the editorial team assembled to oversee this project is, in the true spirit of Antarctic Research, a multinational one consisting of many leading players in Antarctic Research today. The group of contributors (over 300) is equally impressive and reads like a who's who of Antarctic Research - lending weight to the significance of the two volumes as an authoritative account of the here and now of Antarctica. The topics, not surprisingly, are dominated by science with contributions on biology, geology, palaeontology, physics, glaciology, climate, oceanography and many others. What is an excellent addition to the book is the range of topics that deal with the humanities and social sciences including entries on "Art", "Music", "Books", "Fiction and Poetry", "Film" and "History of Antarctic Science".

Although some of the topics are somewhat eclectic they do serve to capture the current point in time when international focus is on the polar regions through the International Polar Year. However, I suspect in a year or two the entries on polar research programmes (e.g. ANDEEP) or instruments (e.g. ICESAT) will no longer be relevant as these topics deal with projects rather than raw information. In a similar vein the entries on national operators will also date quickly as new players enter the Antarctic arena, and old players will have shifted focus as politics and science demands. Although such topics will serve to date the edition in a short timeframe they are nevertheless important as they provide a fixed view of the scientific and political landscape in Antarctica in 2007. This will be a valuable resource for those that come after us who want to understand what was happening around in Antarctic research around 2007.