Antarctic Science 1 (4): 373–376 (1989)

# Book reviews

## Antarctic ocean and resources variability

Edited by *D. Sahrhage*
Springer-Verlag, Berlin, Heidelberg (1988). 304 pages, 232 figures. DM 198.00. ISBN 3 540 19294 8.

During the past two decades, there has been increasing interest in the inter-disciplinary study of Antarctica's atmospheric forces, water masses and living resources. Not only do such studies have heuristic appeal, the knowledge likely to be obtained is crucial for the effective management of living resources and for the overall protection of the Antarctic marine environment. From a practical point of view, various fora have come to recognize this need for closer collaboration between biologists, meteorologists and oceanographers working in the seas surrounding Antarctica. Coupled with observations of large fluctuations in krill (*Euphausia superba*) distribution, the tantalizing and possible association of these fluctuations with the so called El Niño/ Southern Oscillation (ENSO) event of some six years ago lent support to a proposal for a 'Scientific Seminar on Antarctic Ocean Variability and its Influence on Marine Living Resources, particularly Krill'. Sponsored by the Inter-Governmental Oceanographic Commission (IOC) and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) this seminar was held in Paris in June 1987.

*Antarctic ocean and resources variability* is a product of the CCAMLR/IOC Seminar and contains 26 of the 37 papers presented there. Edited by a distinguished marine scientist (Dietrich Sahrhage), this volume offers both a timely and a substantive contribution to current efforts aimed at improving our understanding of Antarctic marine ecosystem dynamics.

The volume as a whole is well organized, dealing as it does with four basic themes — meso-scale and large-scale variability in the environment, krill variability in relation to the environment and krill variability detected from predator studies. The papers under each theme topic address the wide range of both spatial and temporal considerations necessary to understand environmental and biotic variability. As such, they vary in content from syntheses of relatively long-term data series to rather more conceptual appraisals of important principles in terms of our current knowledge of interactions between biotic variability and environmental stochasticity. Notable contributions include consideration of atmospheric elements at the ocean's surface south of 40°S, spatial and temporal variability in Antarctic phytoplankton in relation to krill distribution, scales of interaction between krill and the environment, large-scale fluctuations in krill distribution and abundance, and long-term trends in the foraging patterns of Antarctic fur seals.

Virtually all the contributions acknowledge the difficulties inherent in quantifying biotic and environmental variability in a dynamic medium such as the Antarctic marine environment. In addition, many authors not only attempt to place our current and limited knowledge in appropriate perspective, they also try to develop suggestions for future work. In this regard, the editor's final summary serves as a succint consolidation of the current state of knowledge and focuses attention on the many problems still to be addressed.

Despite the overall favourable impression and undeniable utility of this particular volume, I did find a number of irritating editorial errors. These ranged from minor typographical mistakes to quite major misprints. I feel that it would be unfair to apportion sole blame to the editor in this regard, and it is certainly not something that one would expect from a publishing house with the prestige that Springer-Verlag enjoys.

In conclusion, therefore, I see this particular volume as a must for all researchers with a genuine interest in the Antarctic marine environment. Furthermore, I feel that it has much to offer those organizations and scientists involved with the difficult problem of developing an effective approach to the conservation and management of Antarctic marine living resources. It is in this context that I have personally found the papers contained in the volume to be most pertinent and as such I cannot over-emphasize its inestimable value. In its entirety, *Antarctic Ocean and Resources Variability* serves as a fitting tribute to its editor who has recently retired from an extremely active and productive career in marine science.

D.G.M. Miller

## Antarctica, the last frontier

*Richard Laws*
Boxtree, London (1989). 208 pages. £14.95.
ISBN 1 852 83247 9.

Several books on the Antarctic have been published during the last years, some of them written for the scientific community, and others describing particular expeditions or ventures. This book by Dr R.M. Laws is different, being a general account of the Antarctic written mainly for the general public. Such an up-to-date popularized description of Antarctic sciences, exploration and politics is indeed welcome. Through his life-long work in the Antarctic Dr Laws has more experience of this region than most others. His fourteen years' directorship at British Antarctic Survey has given him a sound and deep insight into all aspects of Antarctic sciences and politics, an experience he shares with the readers of this book.

*Antarctica, the last frontier* has a foreword by Lord Buxton pointing out that the book is the mirror and counterpart of a television series on the Antarctic and the political dilemma over its future. It is easy to imagine that the book and television series must form a fascinating pair, supplementing each other. For the reviewer it is an advantage not to have seen the TV series, making it easier to judge the book on its own.

In modern books the illustrations play an important and integrated role. The present book is no exception, and I have seldom seen such a superb selection of fine photographs from the Antarctic. They have been selected with great care both for their pedagogic value as well as their artistic appearance. The composition and colours of some of the scenes are excellent. It is perhaps not fair to point out any particular pictures, but I have neither seen such a clear shot of a sea spider, nor such a strange scene as the mating activities of limpets. Several of the photographs are taken by the author, and others have been taken by photographers from 'Survival Anglia' and British Antarctic Survey scientists. The use of satellite images is also interesting, and the big satellite mosaic picture on pp. 10–11, showing the entire Antarctic continent, is most fascinating. In contrast some of the black and white diagrams seem old-fashioned, and could have been improved by a more modern layout, in keeping with the rest of the book.

Basically *Antarctica, the last frontier* falls into three sections. Firstly, the physical sciences describing the Antarctic lands and the Southern Ocean, secondly the biology of Antarctic organisms, and finally the use and impact by man on this remote region of the world.

Personally, I think the first part of the book could have been more detailed and informative, in particular with regard to geology, glaciology and meteorology. The Southern Ocean is better described, and a detailed diagram depicts its huge water masses and currents. An understanding of basic oceanography is necessary for an understanding of the marine ecosystems.

The chapters on the biology of Antarctic plants and animals start with aspects from life on land and of the inland waters, before moving on to the shore and sea floor. Life in the ocean is particularly well treated, including plankton, squids and fishes, seals and whales, as well as the Antarctic and subantarctic birds that find their food in the ocean. In this way the reader is presented with an ecological transect, which develops an understanding of the interactions and role of the different organisms. The author has a remarkable ability to point out essential aspects without burdening the reader with too many details.

The basic role of plant plankton and krill in the Antarctic ecosystems is emphasized. A map of the highest concentrations of krill in the Southern Ocean also shows the main feeding grounds of whales and other animals. Directly or indirectly, the tiny crustaceans form the food of whales, seals, birds, fishes and squids. In the chapter on oceanic plankton one may wonder, however, why there are two photographs of comb jellies, when their ecological role is not described in the text. One of them looks like a big balloon, and some comments would have been informative. Other critical remarks on the life sciences section could also be made, but mostly as insignificant details. The description of endolithic plants, as an example, on pp. 50–51 seems unclear, and the main text and figure text do not agree.

The chapters on birds and mammals are fascinating reading. The author explains how the biology of the different species are closely related to the changing conditions of their environments. Penguins and other birds forage in different niches, sharing the resources of the ocean. The flightless penguins are the great divers, seeking their food down to 250 m, while flying birds depend on resources closer to the surface. In a similar way the Antarctic seals have their different diets. They also differ in breeding biology and reproduction, each adapted to their own way of life. Since Dr Laws, through his own research, has contributed greatly to our basic knowledge of Antarctic seals, it is not unexpected that his account of these animals is particularly well written.

Perhaps the most interesting chapter is the one on 'Man and the Antarctic', describing so clearly the past and present situation with an outlook to the future. Starting with the early explorers, Dr Laws outlines the history of the Antarctic and the exploitation of natural resources. An interesting comparison is presented of the biomasses harvested during early sealing, the following whaling period, and the recent krill and fish fisheries. These activities have greatly upset the balance of the Antarctic ecosystems, but the extent of their impact is far from adequately known. Following protection, fur seals and elephant seals have returned, and the population of fur seals may be larger than before the hunting started, with further ecological impact. It is too early to know if the large blue and sei whales will recover, but the population of the small minke whale may be larger than ever. How the exploitation of krill and fish may affect the penguins and flying seabirds is also to be seen.

Indirect human impact is also of great importance to the continent, and of great consequences for the whole world. The author gives a clear and realistic description of the problems related to 'the green house effect' and 'ozone hole'. The discovery of the 'ozone hole' over the Antarctic is an example of the importance of Antarctic science, and an early warning of what may happen.

International agreement was achieved through the Antarctic Treaty, and conventions under the Treaty are aimed at the protection and regulation of biological and mineral resources. Dr Laws cannot give a recipe for future political arrangements, and the problems may not be easy to solve. But, as he points out 'the consultative parties have shown great ingenuity in adapting the Antarctic Treaty System to meet new requirements'. This gives hope for the future.

In conclusion, Dr Laws has given us a most valuable and interesting book on the Antarctic, describing its nature, eco-

systems and relation to human activities. Although popular in style, the concise text gives a clear presentation of facts and problems. Such a book should have a great appeal to the general public, but will also serve as an excellent introduction and overview for scientists and other personnel operating in the Antarctic. Hopefully, the book will increase the public understanding of Antarctic sciences, and the importance of the Antarctic region for the rest of the world.

LAURITZ SØMME

## Natural history of the Antarctic Peninsula

*Sanford Moss* (illustrated by *Lucia de Leiris*)
Columbia University Press, New York (1988).
208 pages. $US27.50. ISBN 0 231 06268 0.

This book presents a broad overview of the Antarctic that is ideal for the layman or Antarctic scientist preparing for their first trip south, or for any reader not familiar with the Antarctic who is looking for an introductory text. The book title is a misnomer. This book covers the entire Antarctic and not just the Antarctic Peninsula.

The easy writing style lends itself well to a rapid reading, yet facilitates comprehension of a large number of facts. The charcoal sketches throughout the book are especially helpful for gaining an image of the plants and invertebrates. Penguins once again captivated the artist as they have many others; the result was a few too many sketches. I also found the captions from de Leiris' notes more distracting than helpful.

This book is also an excellent starting point because of the comprehensive list of suggested readings at the end of the chapters. Even the most enthusiastic readers will find enough material to keep them busy for some time.

There are 10 chapters, each followed by a list of references. Chapters 1 and 2 discuss physical attributes of the land and sea; chapters 3 and 4 the plants and herbivores; 5 through 7 the secondary consumers; 8 and 9 the secondary predators, i.e., those that consume prey other than invertebrates; and 10 reflects about the future of Antarctica.

Occasionally the author gets a little carried away with his prose. For example, on Page 95, in regard to a penguin colony, '... one, ..., encounters a wall of ammoniacal pungence that drains from the sinuses for days afterward!' Either he has sensitive sinuses or colonies on the peninsula are more rank than those that I have visited in the Ross Sea. Also, some of the statements are so remarkable that one would like to know specifically where they were obtained. This is not easy because of the lack of reference citations within the text. For example, I am skeptical that 30 to 40% of breeding-age Adélie penguins die every year. I would like to read more on this matter, but it is not easy to determine the source of the information. This is also true of the improbable description of the way crabeater seals feed on concentrated krill (p. 119), in which they swim through a swarm with their mouth agape. However, most of the natural history described within the book seems accurate, and, overall, it is an excellent primer for the Antarctic.

G.L. KOOYMAN

## BIOMASS Scientific Series No. 9. Biology and ecology of the Antarctic krill (*Euphausia superba* Dana): a review

*D.G.M. Miller* and *I. Hampton*
SCAR and SCOR, Scott Polar Research Institute, Cambridge (1989). 166 pages + ix. £15.00. ISBN 0 948 27709 2.

The ecological significance and economic potential of Antarctic krill have attracted a great deal of scientific, industrial and political attention over the past twenty years. Perhaps inevitably a number of myths have become ingrained in the public consciousness: that krill is the central organism of the Southern Ocean food web, that krill may solve the world's protein resource problem, and more recently now that green politics have risen to importance, that exploitation of krill must be severely constrained (or even stopped altogether) else the Antarctic food web will collapse. As with all myths, their persistence has little to do with their hold on reality, but perhaps the more extreme versions will be tempered following the timely appearance of this major review of krill biology.

Since the major publications of the Discovery Committee, the most significant compilations of information on krill have been the volumes edited by George (The biology of the Antarctic krill *Euphausia superba.* Proceedings of the first international symposium on krill, Wilmington, North Carolina, 16–19 October 1982. *Journal of Crustacean Biology,* Special Issue No. 1, 337 pp. 1984) and Schnack (On the biology of krill *Euphausia superba.* Proceedings of the seminar and report of the Krill Ecology Group, Bremerhaven, 12–16 May 1983. *Berichte zur polarforschung, Sonderheft,* **4**, 303 pp. 1983). Neither was as comprehensive, nor covered the ground of this latest review by Miller and Hampton.

This review was commissioned from the SCAR Group of Specialists on Southern Ocean Ecosystems and their Living Resources by the Scientific Committee of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) in 1983, and it complements a previous such review of the Southern Ocean fish stocks. It covers many aspects of the biology of krill and, as the authors admit, it concentrates on recent developments. Attention is focussed primarily on those topics which are most applicable to the effective management of krill exploitation within the provisions set out by article II of the Convention for the Conservation of Antarctic Marine Living Resources. Major

consideration is given to the valuable results of the various research programmes loosely co-ordinated under the auspices of the SCAR BIOMASS (Biological Investigations of Marine Antarctic Systems and Stocks) Programme, although recent US work is also covered.

There is a brief Introduction which mentions (although only in passing) the pioneering work of the Discovery Committee, and includes yet another variation of the Southern Ocean food web which illustrates the central importance of krill by leaving almost everything else of significance out. Krill are certainly important, but ignoring all other zooplankton (especially copepods and salps), the benthos, the microbial loop and vertical flux processes distorts the picture rather badly. There then follow four major sections.

The first deals with krill distribution and abundance. The basic hydrography of the Southern Ocean is outlined and the distribution (both vertical and horizontal) of the various life stages of krill described. There is an excellent section discussing the problem of abundance estimation in krill; this is nicely highlighted by a table summarizing the various indirect estimates of total krill biomass made during the 1970s. These range from 55 to 7000 million tonnes. Given the problem with net surveys and the very wide geographical range of krill the only feasible technique is acoustic estimation, and there is an excellent discussion of the present state of this field. The main difficulty is the lack of reliable knowledge of target strength, and how this varies with krill size, orientation and density.

The next section covers krill production and deals in turn with three methods for attempting to estimate this, namely calculation from biomass using P/B ratios, calculation from the energetics of individuals, and estimates from amounts consumed by predators. There are considerable gaps in our knowledge here, for we are only now starting to get a reliable feel for the lifespan and growth rate of krill (including possibly degrowth in winter in some areas). Furthermore it is becoming clear from comparison with other euphausiids that our estimates of the energy consumed by krill (at least in summer) are probably too low, although this work is so recent as to have escaped coverage in the review. Knowledge of growth and food intake is well summarized. A useful compilation of the various estimates of consumption of krill by predators ends with the conclusion that this is probably of the order of 250 million tonnes per year over the Southern Ocean as a whole. The authors list a number of suggestions for improving this estimate, and they conclude that neither current production estimates nor any of the present models of the interaction between krill and predators (including man) are adequate for setting optimum harvesting levels for krill.

The next section covers the difficult topic of krill aggregations. Classification of the various aggregations is beset by the problem of scale, particularly the likelihood that different factors act at different scales. The biological characteristics of various types of aggregation, the physics of aggregate formation, and the various models of aggregation are all discussed. This is a difficult area of study, but one which it is vital to pursue for so much of what we need to know about krill is tied up in the biology of swarms. The authors have made an excellent summary of present knowledge.

The final section deals with the management of krill fisheries. This is a short but important section, particularly in the elaboration of the argument for an ecosystem approach to management. One has only to look at the state of most fisheries in northern seas to see where the traditional single species approach has lead. It is only by developing effective management through a multi-species approach that we can hope to avoid a repeat performance. The problem is that this approach is difficult, and requires a great deal of knowledge.

I have found this review readable and well put together. One major test of a review is to see how thoroughly the literature has been covered; this passes with flying colours. There are over 650 references, and all the expected ones are there. The authors have gone back into history, and the key works of the early part of the century (Marr, Mackintosh and Baker) are all listed. Inevitably the bulk of references are to the 1970s (163) or 1980s (390), although there are relatively few after 1986, perhaps reflecting a long gestation period for this review to be published? Some recent work is covered, notably the 1987 IOC/CCAMLR Paris symposium on Antarctic Ocean Resources and Variability (SAHRHAGE, D. *ed. Antarctic Ocean and Resources Variability*. Berlin: Springer-Verlag, 304 pp. 1988). I would criticize the use of some rather old diagrams which have rather outlived their usefulness, but overall the choice of illustrations is good.

Valuable as the BIOMASS Research Series is, it does not appear on every library shelf. It will be a pity if this excellent review of the biology of krill, in my opinion the best currently available, does not reach the audience it deserves.

ANDREW CLARKE