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Book Reviews

Fishes of Antarctica: a biological overview

Edited by G. di Prisco, E. Pisano & A. Clarke
Springer-Verlag, Milano (1998).
363 pages. Price DM 198. ISBN 88 470 0028 9.

This handy, small-format book bears an ambitious title suggesting a more comprehensive overview than it actually presents. The volume summarizes a conference that was held in Siena, Italy in 1997. This was the final event of a series of workshops and conferences since 1994 organized as part of a network funded by the European Science Foundation. This network successfully linked many of the European countries engaged in scientific research on Antarctic fish and extended later to colleagues from the United States, New Zealand and the former Soviet Union. The goal of the network was to focus formerly individual research efforts that existed in various disciplines in a co-ordinated multinational framework. Such synergistic effects should produce increasing sharing of studies and publications integrating the diverse disciplines. Taking this book as an indicator, progress in multi-disciplinary studies is slow. What has grown however, is the number of multi-lab approaches in physiology and systematics with results from palaeoclimate, palaeo-oceanography and geology being increasingly utilised by ecologists. Much of the volume dwells on the evolutionary adaptation of the Antarctic ichthyofauna to the cold Southern Ocean. A total of 30 papers are presented in three parts. The introductory overview paper by J. Eastman and A. Clarke gives an interesting and overdue comparison between adaptive radiation of Antarctic fishes and those of freshwater ichthyofauna in tropical, temperate and boreal lakes. They use information on age of habitat, species richness, molecular divergence times, key innovations and degree of morphological and ecological divergence with respect to phyletic divergence. They have also considered some recent new insights from palaeoclimatic, geological and statigraphic research. Similar to ancient lakes, the Southern Ocean is an insular evolutionary site with radiations or species flocks of fish and provides an excellent *in situ* laboratory for retrospective studies.

The first part on ecology features a variety of topics. K.-H. Kock and I. Everson revisit age and growth issues of Antarctic notothenioid fish. Their review corroborates earlier assumptions that growth performance, albeit variable, is within the range of ecologically similar species from boreal and temperate waters. However, ecological constraints are likely to affect growth rate during the year more than temperature alone would do and hence account for differences in growth performance between species. J.S. Christiansen *et al.* consider maternal output in polar fish reproduction, whilst M.G. White discusses the vulnerability of the pelagic early life history to dispersal and advection from settling grounds. G. Duhamel presents results from a joint ornitho-/ichthyological study of the pelagic fish community of the Kerguelen Islands. The results are a step towards elucidating the role of predators such as king penguins as a control of pelagic resource abundance. B. Hulley dwells on the taxonomy of the myctophid fish tribe Electronini and presents an interesting and comprehensive model of their evolution against a background of key geological events. K. Zdzitowiecki reports on the diversity of digenean fish parasites. The 44 species of which 30 are endemic are a surprisingly high number, although there is yet only one host-specific plathelminth parasite, found in a bathypelagic fish.

The second part on physiology and biochemistry is the largest section. G.N. Somero and co-workers outline the gains and losses of cold adaptation in Antarctic notothenioids. The achievement of performing physiological tasks where less cold-adapted ectotherms would cease to metabolize goes hand-in-hand with a narrow range of temperature tolerance, although both features may have been caused by different factors. This gain is paired with a loss of heat shock protein production, a unique phenomenon in vertebrates and which is outlined in more detail by L. Carratu and co-workers. In general, the use of biochemical indicators for studies of cold adaptations seems preferable to whole-organism approaches for various reasons. This is, however, counter-balanced by C. Zimmermann and G. Hubold. They present extensive experimental data showing that respiration after sufficient acclimation is mostly dependent on activity patterns. Knowledge of these patterns are prerequisite for metabolic rate comparisons. A. Wöhrmann highlights some aspects of eco-physiological adaptations in Antarctic fish, especially the increase of membrane lipid fluidity at near-zero ambient temperatures and its significance for brain gangliosides. B. Giardina *et al.* report on oxidative metabolism as one peculiar aspect of cold adaptation, whilst H.W. Detrich describes adaptations of microtubules and microtubule motors. Cold adaptation of protein function is shown to be compatible with substantial conservation of protein structure. V. Carginale *et al.* report on the low amounts of metallothionein present in Antarctic fish. M.R. Coscia and U. Oreste studied Antarctic fish immunoglobulines, especially immune responses against nematode parasites. S. Egginton and J.C. Rankin report on vascular adaptations for a low pressure/high flow blood supply to locomotory muscles of icefish using vascular casting, and R.F. Robertson *et al.* report on ventricle and locomotory muscle masses in Antarctic fishes. These parameters can be used as indices of the effort

required to maintain an active life-style. M.C. Cerra *et al.* present an account of natiuretic peptides in Antarctic teleosts, especially in cardiac receptors of two species and M.A. Masini *et al.* report on atrial natiuretic peptides. P.L.M. van Dijk *et al.* summarize the available data on the ability of cold adapted fish to perform strenuous exercise and to recover from this situation of high energy turnover. M. Maffia and colleagues give an account of ion and metabolite transport through the intestinal luminary membranes. Like many other specialized studies in this bookt, the authors point to the need for further studies. G. Tagliafierro *et al.*, reporting on the neuroendocrine system in the intestinal tract and pancreas, found a peculiar pattern of peptide immunoreactivity in the digestive system.

The third part includes studies explicitly dedicated to evolution and phylogeny. L. Bargelloni and G. Lecointre present their work on notothenioid systematic using DNA sequence data. They compare these with previous "conservative" phylogeny data, challenging several classifications of morphology-based studies, e.g. the monophyly of the family Nototheniidae. Their results also cast doubt on the vicariance of the nototheniid subfamilies due to Polar Frontal Zone formation. Other analyses, however, arrive at coherent events in oceanographic/geological and phylogenetic developments, e.g. W.-J. Chen *et al.* Their results from two mitochondrial genes allowed reconstruction of a complete phylogeny with the exception of *Chaenocephalus*. Most of the clades obtained from morphological characters are confirmed. O. Clement *et al.* describe the allozymic polymorphism and phylogeny of the Channichthyidae. C.C. Cheng reviews recent findings on the evolution of the antifreeze glycoproteins of notothenioids and of the unrelated northern cods. Molecular analysis shows that glycoproteins derive from trypsinogen and have emerged by partial recruitment and *de novo* amplification in the mid-Miocene in notothenioids. Arctic cod antifreeze substances have convergently evolved. J.C. Montgomery and J.A. Macdonald report on the evolution of sensory systems by comparing Antarctic and deep-sea fish faunas. The study is a source of open questions in the field of sensory systems in notothenioids, but also shows many similarities between the two groups which appear as a trend in the Antarctic group, possibly due to the shorter time scale of adaptation. G. di Prisco outlines molecular adaptations of Antarctic fish haemoglobins. Many findings are well in line with morphological analyses and other molecular approaches. They also throw an interesting light on the coupling with the time scales of other important processes such as cold adaptation during notothenioid evolution. W.T. Stam *et al.* conclude the book with a report on teleost haemoglobin sequences as a basis for evolutionary studies. It is suspected that during notothenioid evolution there has been a specialization leading to the dominant expression of only the few "major" haemoglobin genes.

In summary, there is much to learn about new fields of Antarctic fish research and about new insights in traditional fields in this book. I hope there will be more science networks of this kind and that the good work will be continued. The volume is certainly worth buying.

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Keyguide to information sources on the polar and cold regions

William Mills & Peter Speak.
Mansell, London and Washington (1998).
330 pages. Price £70. ISBN 0 7201 2176 0.

This guidebook to the extensive resources available to scholars and others interested in the polar and cold regions provides an invaluable service. The Introduction notes that this book will probably prove most helpful to upper level students but, in fact, it will prove to be of interest to a much wider audience, including polar researchers operating outside of their specialized areas.

The book is at once an overview, an annotated bibliography, and an international directory of relevant organizations. Although nearly half of the volume (Part II) is devoted to bibliographic sources, this type of guide, which Mansell publishes in profusion, goes beyond bibliography to include, in Part I, a survey of the polar and cold regions with an overview of all types of information sources, and, in Part III, a directory of selected organizations.

In Part I, I found an exceptional ten-page chapter devoted to higher education courses and possible careers in the polar regions which seemed to be potentially very helpful. On the whole, Part I provides an excellent introduction for the serious beginner in polar studies who would need some orientation to take full advantage of Part II. This second part is a very comprehensive selected bibliography, with 1123 enumerated sources divided into regional and general sources, including bibliographic databases, and subject-specific information sources. Each of the many sub-sections begins with a short discussion placing the sources into context. Reference is made to appropriate electronic information, with addresses, which is vital in this age of changing information technologies. Part III continues within the same numbering scheme, ending at source number 1781. This final section brings together organizations mentioned elsewhere in the Keyguide, and provides address (including electronic) information which was current at the time of collection for this book. National and international organizations, libraries, archives, museums, publishers, and specialist book suppliers are all listed. A comprehensive index completes this very useful Keyguide.

William Mills has had previous experience in the keyguide business (Reid *et al.* 1990) and is Keeper of Collections at Scott Polar Research Institute at the University of Cambridge,

the pre-eminent polar library in the English speaking world. Peter Speaks is a Research Associate at the same institute, where he has been Course Director of the MPhil in Polar Studies.

This book should be available somewhere in all organizations requiring information concerning the polar regions. Although no single library will contain all of the sources listed, many will contain enough to get projects started and to lead the user to remote sources available through loan.

References

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Martha Andrews

Plate Tectonics and Crustal Evolution

Kent C. Condie
Butterworth-Heinemann, Oxford (1997)
288 pages. Price £24.99. ISBN 0 7506 33867.

Plate Tectonics and Crustal Evolution is now in its fourth incarnation. With a new edition appearing every seven or eight years since 1976, Kent Condie has kept abreast of the many new developments in plate tectonics over the intervening decades. Based on a course taught by Condie at the New Mexico Institute of Mining and Technology, the book is aimed at the graduate or advanced undergraduate student, but is also intended as a general and up-to-date reference work for specialists who want to keep in touch with broader advances in geology. It is divided into seven chapters, the first of which presents an overview of plate tectonics that, rather than attempting to gloss over the whole, touches on areas of interest such as plate boundaries or stress distribution. Chapters 2 and 3 address the geological and geophysical nature of the Earth's crust, and its recent and ancient tectonic settings. The structure and behaviour of the mantle and core are handled in Chapter 4, and Chapter 5 deals with general evolution of the mantle and crust, including changes in plate tectonics with time and models for Archaean plate tectonics. The final two chapters cover the origin and evolution of the atmosphere, oceans and life, and comparative planetology of all major bodies in the Solar System, respectively. The text is well-organised and clearly written with carefully chosen illustrations. Each chapter finishes with a very useful point-by-point summary, and, for the more interested reader, a short list of "suggestions for further reading" is complemented by an up-to-date list of key references at the back of the book. Overall, Condie has adopted an holistic approach, taking examples from all of geological history, in contrast to more chronologically ordered texts such as "The Evolving Continents" (1995). This allows for a very broad range of processes to be described, although breadth is achieved at the expense of some depth. This is not a major criticism, however, and the book is an excellent and up-to-date introduction to almost every aspect of plate tectonics. All in all, this comprehensive work would enhance any general geological bookshelf, and I can unreservedly recommend it. Whether you are a final year undergraduate looking to consolidate your understanding with a good summary, or an advanced specialist in your field wishing to catch up with recent developments in the wider geological world, you will find what you are looking for in the pages of Plate Tectonics and Crustal Evolution.

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Alan P.M. Vaughan

The Biology of Polar Habitats

G.E. Fogg
Oxford University Press, Oxford (1998).
Paperback. 263 pages. Price £18.50. ISBN 0 19 854953 9.

When Aldolf Erik Nordenskiöld journeyed into the interior of the Greenland ice cap in 1870 he joked to the botanist on his expedition, Dr Sven Berggren, about "the singularity of a botanist making an excursion into a tract, perhaps the only one in the world, that was a perfect desert as regards botany." But as he was later forced to admit, "this expectation was not confirmed. Dr Berggren's keen eye soon discovered, partly on the surface of the ice, partly in the [grey rock dust] powder, a brown polycellular alga" (Leslie 1879) now known to be cyanobacteria rich in UV-screening pigments that absorb solar radiation and cause 'cryoconite' meltholes in the ice. The incongruity of life, such as these abundant cryoconite communities, in the apparently hostile wilderness of the polar regions has long held a special fascination for biologists. In 'The Biology of Polar Habitats', Professor G.E. Fogg provides us with an overview of the remarkable diversity of life that is found within the Arctic and Antarctica, the physical, chemical and biological properties of their surroundings, and the inter-relationships between microbes, plants, animals and humans in these environments.

The book begins with two introductory chapters on the physical and biological characteristics of the polar regions. The first chapter has sections on energy balance, climate and micro-habitats, and ends with a brief sketch of the geological history of the Arctic and Antarctic which then sets the stage for subsequent discussions about the ecology and evolution of high latitude biota. The second chapter considers some of the general problems faced by organisms at high latitudes: the

extreme seasonality of radiation, the effects of persistent cold temperatures, freeze-thaw cycles and desiccation, prolonged exposure to UV radiation, invasion, colonization, and the opportunities for escape from environmental extremes.

The next six chapters provide a systematic account of the ecology of different types of polar habitat, each drawing on examples from both the Arctic and Antarctica. The first of these examines life in snow and ice such as the cryoconite biota, ice shelf ecosystems (now also known to occur in the Arctic) and snow algae. Separate sections examine the microbiota isolated from Antarctic ice cores, and the likely existence of microbial life in the deep, sealed basins of liquid water (e.g. Lake Vostok) which lie 3–4 km beneath the East Antarctic ice sheet. Chapter 4 considers terrestrial habitats such as microbial communities on and within rock and permafrost, the vegetation and animal communities of the Arctic tundra, and the habitats and biota of subantarctic islands such as tussock grasslands. The author draws attention to the similarities -for example in the general patterns of vegetation coverage and production - but also striking differences between the two polar regions; e.g. the Arctic has some 900 species of vascular plants and 48 species of native land mammals, while the corresponding figures for the Antarctic are 2 and 0.

Lakes and rivers are treated in the next chapter, with emphasis on their great variety of physical and chemical characteristics: glacial lakes, thermokarst (melted permafrost) ponds, saline lakes, permanently ice-capped lakes, coastal waters, Antarctic streams, and the massive rivers which discharge into the Arctic Basin. Again there are some similarities, for example in the importance of benthic production in Arctic and Antarctic lakes, but the contrast between the two polar regions is pronounced in many respects, such as in the complexity of food webs and the importance of external inputs of organic carbon from the surrounding catchments. Unfortunately, most of the Arctic material in this chapter is focused on Char Lake which we now know to represent an extreme in Arctic limnology (Vincent & Hobbie 1999), and there is no reference to the extensive body of literature from Toolik Lake (Alaska) which has been the site of long term ecological studies for more than 15 years. However, there are welcome sections on subarctic lakes and on the Vestfold Hills, as well as the more well-known Signy Island and McMurdo Dry Valley lakes and streams.

A group of three chapters describe the marine ecosystems of the polar regions: firstly the marine littoral, then sea ice and marginal ice zone, and finally the open ocean. The book concludes with a chapter summarizing some of the general features across polar ecosystems and their importance. The author notes that far from the popular image of the Arctic and Antarctic as remote and isolated regions, they have important connections to the rest of the Earth system, and provide a sensitive indicator of change in the planetary environment.

'The Biology of Polar Habitats' is a significant achievement in several respects. The book integrates material from a broad array of disciplines and from all types of high latitude environment. Furthermore, it provides a valuable introduction to the ecology of both polar regions. So often the literature in this field is entirely restricted to one polar region or the other with the authors showing little awareness that parallel habitats exist on the other side of the planet. The bias is somewhat towards the Antarctic in this book, however all of the chapters try to achieve a bipolar perspective, and they each have fascinating discussions of the similarities and differences between the Arctic and Antarctica.

This is an introductory volume rather than a research text, and the coverage is necessarily brief relative to the vastness of the literature that now exists for each habitat type. The need for brevity has also meant that it is difficult to pinpoint the source of many of the statements in the book which are either attributed to general review articles or unreferenced. Overall, however, this volume fills an important niche and it provides a stimulating and integrative account of the great diversity of habitats and communities which characterize the polar regions.

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W.F. VINCENT