Antarctic Science 6 (1): 125–128 (1994)

Book reviews

Antarctic fish Biology: Evolution in a Unique Environment

Joseph Eastman
Academic Press, Inc., New York, (1993).
322 pages. $74.95. ISBN 0 12 228140 3.

As the sub title of Eastman's new volume on Antarctic fishes suggests, the Southern Ocean, indeed, is a unique environment from both oceanographic and ichthyological perspectives. It is vast, accounting for approximately 10% of the planet's marine environment. Species diversity of its fish fauna is unusually low compared to other ocean systems, containing only about 1% of the world's known fishes and dominated by a single suborder, the notothenioids. Waters south of the Antarctic Convergence are a distinctive environment because of their long (>25 m.y.) isolation, stable and severely cold temperature and the unusual hydrogeology surrounding Antarctica. Eastman has exploited all of these characteristics and our growing but still incomplete knowledge of Antarctic fishes to produce a very thoughtful treatise on their biology. But above all, it is a book about evolutionary biology and the physical and biotic forces that shape the process. It is the type of work that can be produced only by a single author and Eastman's expertize in morphology and systematics, plus his understanding of physiology and ecology, make him exceptionally well-suited to the task.

The book logically is divided into three major parts. The first, "Physical and Biological Characteristics of the Antarctic Marine Environment", includes admirable primers on the climatic, geological and oceanographical characteristics of the continent and their histories. It also incorporates a section relating the fossil record of Antarctic fishes to the geological and climatic histories of the continent. The second section focuses upon a description of life histories, systematics and zoogeography of the extant Antarctic fish fauna. The third section is entitled "Organ System Adaptation in Notothenioids", but really contains as much information on cellular physiology and biochemistry of the group as it does systemic physiology. The most distinctive aspect of the book, setting it apart from other volumes on Antarctic fishes, is that all of these topics consistently are treated throughout the volume within the context of evolutionary questions. For example, Eastman makes a point to emphasize how the limited shallow water habitat of the Antarctic continental shelf has affected evolution of the continent's fish fauna. Such physiologically related characteristics as the distribution of antifreeze glycopeptides (AFGPs, kidney glomeruli and presence or absence and forms or hemoglobin are mapped on systematic cladograms developed from more traditional morphological data, permitting insight into how and when these characteristics have evolved within the notothenioid suborder and its families. Eastman has done an excellent job of melding quite disparate pieces of information to support the book's central theme of evolutionary biology.

I am particularly impressed with the even-handed consideration of much information on Antarctic fishes that usually is treated from a dogmatically adaptationist viewpoint. Eastman does not hesitate to recognize such characteristics as the presence of AFGPs as clearly adaptive, yet is careful to point out that other unique features of some Antarctic fishes families (e.g. the haemoglobinless condition of the channichthyid icefishes) may well be due to chance mutations or simply phyletic inertia. The overall tone of the book is scholarly, thoughtful and the product is an excellent synthesis of information on the biology of this fascinating group. Yet all of this is presented in a writing style that is lucid, relaxed and easy to read.

In his preface, Eastman stated that his goal was "... to give the reader an appreciation for the biology of Antarctic fishes and why they hod the interest of those of us who study them ...." I believe that he has achieved that goal admirably and, in the process, produced a book that should appeal to ecologists. Despite my own research experience with Antarctic fishes, I have learned much in my first reading of Eastman's book. I suspect that the next reading will yield even more insight. It belongs on the shelf of any serious student of polar biology or evolution.

BRUCE SIDELL

Field Guide to the Wildlife of the Falkland Islands and South Georgia

Ian J. Strange
Harper Collins Publishers, London (1993).
188 pages. £14.95 (hardback only). ISBN 0 00 219839 8.

This pocket sized book is the first field guide to be published for the Falkland Islands. As such it covers most of the fauna and flora likely to be encountered by a native layman or an enthusiastic visitor. No one is better experienced to write such a book than Ian Strange. He has spent almost 35 years in the islands and has devoted his life to studying the islands' fascinating wildlife, particularly the avifauna. He has written many articles and several books on the islands and various aspects of their natural history. He is also an accomplished artist, illustrating many of his works with line drawings and watercolour paintings, as well as providing the illustrations for numerous sets of the islands' postage stamp designs. His major contribution, however, has been in developing and practising conservation measures for the islands and, through his example and advice, stimulating the Falkland Islands government to adopt a policy for nature conservation.

The book is produced in typical field guide format and contains a remarkable volume of observational information. In his Introduction, Strange points out that "the main emphasis is on the birds and mammals found in and about the Falkland Island archipelago, although the work is also designed to assist identification of species found in South Georgia and extended to cover certain fish, invertebrates and plants, largely selected for their relation to birds and mammals". He does not indicate at whom the book is aimed but it is clearly for the benefit of the rapidly growing tourist market in the islands. The Introduction (24 pages) provides a concise account of the islands' geography (mainly physical features), climate, marine environment, land environment and habitats, history of depredation, conservation, laws and the country code (including protected areas and South Georgia legislation), and administration of reserves. Unfortunately, apart from informing us that South Georgia lies about 1450 km east of the Falklands and that there are three categories of reserves (although the sites are not named), very little other information about this subantarctic island is provided.

The larger part of the field guide is on birds (62 pages, 31 line drawings, 12 colour plates). This includes a checklist of all breeding species, annual visitors and vagrant species, together with the breeding species for South Georgia. Land mammals (all introduced) and marine mammals (particularly the cetaceans) occupy 35 pages (with 25 line drawings and one colour + three black and white plates). Silhouettes of whales at the sea surface are especially useful for their identification from the deck of a ship. However, fewer people are likely to have the opportunity to use the key to cetacean ear bones. This is followed by a section on fish (seven pages, eight line drawings), including the two native freshwater species, but surprisingly not the introduced brown trout which is of some economic importance in sport fishing. The section on marine invertebrates (eight pages, one black and white plate, four line drawings) covers several species of molluscs and crustaceans. Terrestrial invertebrates (four pages, one colour plate) include a few of the most prominent spiders, beetles, butterflies, moths and camel cricket.

The islands' flora (23 pages, three colour plates, 14 line drawings), including the commoner seaweeds, is arranged according to the plant formation in which each species is most typically represented. The more scientific observer will find fault with several of the ecological definitions and brief accounts. There is also a short botanical glossary. The guide concludes with a short selected bibliography and a species index.

The strength of Ian Strange's book is in the sections on birds and marine mammals, emphasizing the author's personal interests and expertise. His delightfully stylized illustrations, typical of his postage stamp vignettes, add considerably to the attractiveness and value of this field guide. Unfortunately, his depiction of graminoid plants is oversimplified and will not prove too helpful for their identification. While the book will undoubtedly be an asset to most natural history enthusiasts, the more discerning user will detect some weaknesses. No scale is provided on most of the maps or in any of the figures; no reference to the figures is given in the text; the map of skua distribution is confusing as the species names differ from those in the text; several terms are incorrectly used; several species (e.g. fish, spiders) have been seen only once or twice in or near the islands (should they be included in a general guide?); most of the selected bibliography (almost 50% of which are by Strange himself) are incompletely referenced and several are in obscure sources, while some useful ones are omitted (surely T.H. Davies and J.H. McAdam's beautifully illustrated *Wild Flowers of the Falkland Islands* (1989) merits inclusion?). However, the major disappointment about this Guide is that, despite its title, there is virtually nothing about South Georgia apart from a check list of the breeding birds and a note on the introduced reindeer (without reference to the authoratative monograph on these animals by N. Leader-Williams); the only reference to the island given in the text (R.K. Headland's comprehensive account of the island, its history and biota) is not included in the bibliography. Since South Georgia is included on the route of many Southern Ocean tour cruises, it is a pity it does not receive more attention in the Field Guide.

Despite these criticisms, Ian Strange's field guide is an excellent compilation providing brief descriptions adequate for the identification of a wide range of wildlife, supported by basic biological, ecological and distributional information. There is a wealth of illustrations to aid identification of a most of the commoner species. The small size of the book makes it ideal for the pocket, and the price is very reasonable. It should prove very popular with visitors to the islands, especially tourists most of whom have a particular interest in wildlife.

R. I. Lewis Smith

The Antarctic Paleoenvironment: a perspective on global change. Part one

Edited by *J.P. Kennett & D.A. Warnke*
American Geophysical Union, Antarctic Research Series, Volume 56, 1992.
385 pages. ISBN 0 8 7590 8233.

There can be no doubting the major role that ocean drilling has played in the development of our knowledge of Antarctic palaeoenvironments. Within the last five years alone, a profusion of ODP-based papers has enhanced considerably our understanding of latest Mesozoic and Cenozoic palaeoclimates in the high southern latitudes. The origins of large-scale (continental) glaciation are now pushed back firmly into at least the early Oligocene and the Southern

Ocean palaeotemperature curve is one of the most detailed within the geological record.

This volume is essentially a compendium of the latest ODP findings, with a major emphasis on results from Legs 113, 114, 119 and 120. It is the product of a meeting held in Santa Barbara in August 1991 where the accent was very much on Antarctica's role in global change. As might be expected, there is a full gamut of papers on topics such as stable isotope geochemistry, micropalaeontology and oceanography, plus some surprises! The last encompasses a few brief excursions into the terrestrial realm (chiefly onshore Seymour Island) and seem somewhat out of place. If I have a criticism of the contents, it is that the onshore work on Antarctic palaeoenvironments is surely under represented. After reading the first half of the book I felt that I wanted to know more about both the crucial La Meseta Formation and some of the exciting new developments in Antarctic palaeobotany.

I enjoyed the scene-setting tectonics paper by L.A. Lawver *et al.* and am sure that their very detailed PLATES reconstructions will be used by many. However, there are still considerable problems with the precise pre-break-up positions of the core gondwanan tectonic blocks. The intriguing possibility of Late Cretaceous transantarctic seaways is highlighted in the review of calcareous plankton by B.Huber & D. Watkins. A sharp decline in taxonomic diversity through the terminal Maastrichtian stage is linked to climatic cooling, and corroborative evidence for this trend can be found in both stable isotope and palaeobotanical data. In her review of Late Cretaceous–Early Tertiary vegetation, R. Askin suggested that warm- to cool-temperate climates with high rainfall prevailed in the Antarctic Peninsula region. Warm-temperate conditions might also be suggested for the late Eocene by the exceptionally rich vertebrate assemblages known from Seymour Island. However, both J. Case & D. Long plump for cool-temperate environments; perhaps coastal upwelling was also important? The remarkable polar warming event at the Paleocene–Eocene boundary, first highlighted by the senior editor and colleagues, is reflected in a global mass extinction of deep-sea benthic foraminifera. A major change in oceanic circulation patterns is indicated, and E. Thomas suggests that this may have been due to high-latitude warming of surface waters. The major late Eocene–early Oligocene cooling event is reflected in both benthic foraminiferal assemblages and clay mineral associations (where illite predominates – C. Robert & H. Chamley).

Quantitative estimates of calcareous and siliceous fractions within Site 689 (Maud Rise) indicate that during this interval a stratified, four-layered ocean existed in the Weddell Sea (L. Diester-Haas).Turning to the Neogene, the story is very much one of a detailed chronology of glacial erosion and depositional events. For example, F. Rack & A. Pittenger demonstrate how core measurements of bulk density can be used to detect alternating carbonate and siliceous units, which in turn are linked to fluctuations in the strength of the circumpolar current system. The utility of ice-rafted debris is stressed by D. Warnke *et al.*, and J. Anderson & L. Bartek have used seismic reflection profiles to develop a glacial history for the Ross Sea region. It would appear that the early Miocene may have been a time of particularly intense glacial activity in West Antarctica.Finally, to some brief comments about what is undoubtedly one of the most important papers in the volume. Over the last few years an intense, indeed at times acrimonious, debate has raged over the nature and extent of early Pliocene climatic warming and deglaciation in Antarctica. D. Hodell & K. Venz add significantly to the story by presenting a set of subantarctic stable isotope data (Site 704, Leg 114) which includes $\delta^{18}0$ values only 0.5–0.6‰ less than those of the Holocene. Such figures are incompatible with temperature rises in the region of 5°C and reductions in the extent of the ice cap to one third of its present size; grist to the mill here surely for those who have advocated the permanency of cold polar desert conditions since the late Miocene. Nevertheless, how much weight should we place on the results from one subantarctic site, and are there not some notorious mismatches between palaeotemperature estimates from the marine and terrestrial realms in the Pleistocene? This is an enjoyable and thought-provoking volume which is particularly successful in synthesizing the subsurface Cenozoic record of Antarctica.

ALISTAIR CRAME

Waves and Turbulence in Stably Stratified Flows

Edited by *S.D. Mobbs and J.C. King*
Clarendon Press, Oxford (1993).
465 pages. £65.00. ISBN 0 19 85 36615.

The volume contains most papers presented at the third conference sponsored by the Institute of Mathematics and its Applications on the dynamics of stably stratified flows, held at the University of Leeds in December 1989. A theme for the meeting was set, but contributions dealing with any aspect of stably stratified flows were accepted. As a result a very wide range of material is included without much integration. The level of mathematical treatment is quite involved at times, as to be expected from the sponsoring organization.

Three papers deal with fundamental turbulence questions. Etling discusses turbulence collapse as observed in the laboratory and its possible application to the atmosphere. Derbyshire and Hunt, and Derbyshire consider local turbulent scaling, and make use of the results of large eddy simulations where the main energy-carrying eddies are explicitly represented. The remaining seventeen papers cover a wide range of practical applications from Antarctic topics considered below, to such questions as gravity waves in the atmosphere (Samah & Thorpe, Shutts & Kitchen), waves in

stably stratified fluids (Davies *et al.*, Castro), dispersion of dense gas (Melia & Britter, Witlox), and buoyant jets (Hunter, Sinai). Numerical studies are strongly represented along with field observations and laboratory analogues.

Heinz Lettau termed the Antarctic atmosphere a test tube for meteorological theories, particularly those dealing with strong stable stratifications. The book contains a primarily European sampling of recent studies in this topic area. Kottmeier *et al.* consider the behaviour of boundary layer winds and temperatures as a function of slower changes due to cyclones and more rapid changes due to horizontal and vertical displacements of the postulated shallow frontal zone between the cold air blowing off the continent and the warmer maritime air over the ocean. Simple theoretical arguments involving entrainment and advection are offered to explain the observations during one winter near the ice shelf station Georg von Neumayer. Andre *et al.* describe the vertical structure and downslope evolution of strong katabatic winds and relatively tranquil winds downstream, the so-called hydraulic jumps first investigated theoretically by F.K. Ball.

The next four papers relate to results from the STABLE experiment conducted by the British Antarctic Survey in the austral winter of 1986 at Halley. King contrasts his Antarctic boundary layer results over an ice shelf with those characteristic of the mid-latitude night-time boundary layer, and concludes that the principal cause of the discrepancy is the strong Antarctic stratifications, which is maintained to some extent even during strong winds. Culf discusses the backscatter characteristics of low level wind maxima measured by a monostatic acoustic sounder operated during STABLE. In a companion paper, Culf & McIlveen describe the echo characteristics of ground-based stable layers, near-neutral layers, gravity waves, and density currents at Halley, as observed on the acoustic sounder backscatter plots. Finally, Rees & Mobbs numerically investigate the impacts of large eddies on the stably stratified boundary layer.

Overall, the book is well produced and fairly readable for someone with postgraduate training in meteorology. It is basically a conference proceedings with a central theme of stratification effects in fluids; for example, there is no index. The material is so broad and discontinuous that it not suitable for most personal book collections except those of directly interested specialists, but could usefully be purchased by libraries that have interests in the topic areas covered. A student could expand his knowledge of recent Antarctic boundary layer studies by reading the well written papers described above, but would not get a balanced overview of the current status of knowledge. Unfortunately, a significant and rapidly growing gap in coverage exists between that summarized in Schwerdtfeger's (1984) landmark book, and the situation today.

DAVID BROMWICH