Antarctic Science 1 (2): 179–184 (1989)

Book reviews

Mawson's Antarctic diaries

Edited by *Fred Jacka* and *Eleanor Jacka*
Allen & Unwin, Sydney (1988). 414 pages. $(Aus)49.95.
ISBN 0 043 20209 8.

This is a substantial volume containing Mawson's original diary entries of four expeditions. These were Shackleton's British Antarctic Expedition 1907–09 which he accompanied as a physicist; then as leader first of the Australasian Antarctic Expedition 1911–14, and then two voyages of the British Australasian and New Zealand Antarctic Research Expedition 1929–31.

He was clearly the pioneer of Australia's Antarctic activities, and it is fitting that his dedication to the work should be commemorated by this book.

His introduction to sledging was a severe test, for in 1908–09, together with Prof. Edgeworth David and Dr Mackay, he manhauled a total of over 1200 miles in 122 days when visiting the South Magnetic Pole. Although David was in charge of the party it is clear that Mawson was the real driving force — a fact publicly acknowledged by David when he said, '... Mawson was the real leader who was the soul of our expedition to the Magnetic Pole'.

It is therefore scarcely surprising that he was successful in organizing and leading the Australasian Antarctic Expedition. It was during that expedition that Ninnis and Mertz were lost and Mawson struggled home alone. The day-to-day account of that tragedy is revealed in his diaries, which become more descriptive although retaining their factual content. Although by superhuman efforts he successfully reached base, it was too late to catch the ship and he, with six companions, were compelled to endure a second winter. On his return to Australia in 1914 he was knighted.

In 1929 the Commonwealth Government Antarctic Committee invited Mawson to lead the BANZARE expedition which was split into two voyages — October 1929 to March 1930 and November 1930 to March 1931. There were two objects, the claiming of newly discovered land, and scientific studies. At the time the former may have been considered the most important by the expedition sponsors, but not by Mawson whose scientific vision led to remarkable results.

The diaries themselves yield little scientific information, presumably this is in other records, but it is clear that Mawson's breadth of knowledge was a driving force which encouraged everyone to do their best in their own subject. Such leadership is apparent in all the expeditions, and when necessary Mawson could mediate — but always on the side of science. This becomes more than plain, almost obsessional, on the first BANZARE voyage when his difficulties with the unco-operative Captain Davis could have brought the expedition to a premature conclusion.

Despite Davis' outburst claiming that Mawson was overworking and alienating both crew and scientists, it seems that the men themselves had little complaint. Indeed, it is clear that apart from his own geology he knew enough of biology and other disciplines to be able to play a part in all the scientific programmes. Time after time we find him sorting dredged material on a freezing and heaving deck.

This book is for the polar enthusiast or historian seeking details of the past. There is an excellent introduction by the editors, Fred and Eleanor Jacka, besides numerous illustrations and seven rather small-scale maps. It should certainly be in every polar library.

V.E. Fuchs

Microbial ecosystems of Antarctica

Warwick F.Vincent
Cambridge University Press, Cambridge (1988). 304 pages.
£37.50. ISBN 0 521 32875 6.

The Antarctic region is receiving increasing public, political and commercial attention, especially as the Antarctic Treaty approaches 1991. Fortunately, scientific commitment to studies of Antarctic ecology is escalating as the fragility of the global environment is recognized and the importance of the Antarctic in this becomes increasingly evident.

The microbial component of the Antarctic ecosystem has been shown to be the bio-geochemical 'engine room' of fundamental biological processes and the basis of remarkably short food chains in the Southern Ocean, in freshwater and on land. The timing of this book is therefore apposite and the author has been outstandingly thorough in covering the diverse niches of the region. Perusal of the contents shows a comprehensive and methodical survey of the field. Moreover, the style is eminently readable and strategically illustrated with diagrams and photographs.

The author has skilfully compartmentalized the environment, community structure, microbial processes and trophic structure for each habitat. This approach clarifies the characteristics of each ecosystem whilst not losing sight of their inter-connections. The physico-chemical attributes of each habitat are presented in outline in the text, whilst these essential data themselves are wisely consigned to comprehensive appendices at the end of the book. These appendices will greatly help the non-Antarctic specialist to develop a feel for the environmental parameters potentially influencing the microbiota. A cautionary note about inter-site and inter-season variation should, however, be borne in mind.

The paradoxical scarcity and localization of microbes in

https://doi.org/10.1017/S0954102089250277 Published online by Cambridge University Press

the vast reservoir of potentially life-supporting water, immobilized in the form of snow and ice, is well explained. In contrast, the account of relatively abundant microbes in sea-ice and the Southern Ocean and their contribution to nutrient cycling and food-chain draws attention to the need for continued research at this basic level as well as at the level of harvestable resources.

Attention is drawn to microbial responses to unusual environmental conditions such as the elevated dissolved oxygen concentration due to ice freeze-out in permanently ice-covered Lake Hoare. This is one of several examples of extreme habitats which are so valuable for microbiological ecosystem research. The relative simplicity of many Antarctic ecosystems permits the tracing of elements through the food chain and the optical or physiological detection of microbial responses to natural and artificial perturbations.

The endolithic microbial ecosystem, best seen within the rocks of the Ross Desert, is a classic example of a community developed in response to environmental pressures and amenable to analytical study. It is well-described here, but, surprisingly, does not lead to discussion of one of the prime motivations for past (and future?) Antarctic microbiological research — exobiology. NASA funded development of life-detection systems and quarantine procedures in Antarctica for the 'Viking' Mars lander utilizing the extremely cold desert soils and rocks of the Dry Valleys as a Martian analogue.

Associated with microbial life-support is the crucial problem of water shortage, particularly in continental Antarctica. Although discussed in Chapter 8, more attention might have been focussed on the importance of measuring water stress as experienced by the microbial cell in its environment. Vishniac's work on the concept of 'water potential' as an ecologically meaningful measure of water availability in Antarctic deserts would have been a valuable inclusion. It certainly merits future study in this region. The 'avoidance' rather than 'adaptational' strategies of many Antarctic microbial groups such as those in endolithic niches are well-discussed and appropriately emphasized in the context of the environmental extremes summarized in the appendices. Moreover, the reader is led clearly through the mathematical principles of the physico-chemical processes central to microbial survival and growth.

The brevity of the section on the terrestrial nitrogen cycle emphasizes one of the areas where more research is needed. In contrast, the nutrition of lakes and streams is well-documented and clearly described.

The inclusion of a comprehensive glossary shows commendable initiative in a field riddled with jargon. However, I was surprised to note that epifluorescence microscopy allegedly 'does not differentiate viable and non-viable cells', considering that it has been successfully used to demonstrate the active 'nooses' of FDA-stained nematophagous fungi, and viable bacteria treated with fluorochromes and INT. Many scientific books are let down by inadequate indexes, but this one is commendably thorough and efficient.

The final chapter not only covers the influence of microbes on man but also man on microbes and their environment — an appropriately topical finale to this excellent and stimulating review of a diverse and globally relevant field of microbial ecology. This is a much needed standard reference work for current and future polar microbiologists.

D.D. WYNN-WILLIAMS

Biology of the Vestfold Hills, Antarctica

Edited by *J.M. Ferris, H.R. Burton, G.W. Johnstone & I.A.E. Bayly*
Kluwer Academic Publishers Group, Dordrecht (1988).
304 pages. Dfl. 250.00. ISBN 9 061 93616 0.

What are the properties of Antarctic ecosystems which differentiate them from their temperate latitude counterparts? How are Antarctic communities structured and what are their temporal dynamics? What are the forcing variables for biomass and species composition, and how resilient are the community parameters to environmental change? This new volume from the 'Developments in hydrobiology' series (also published as *Hydrobiologia*, **165**) contains a wealth of information derived from one locality in Antarctica that will allow some of these important ecological questions to be further developed and evaluated.

The locality is on and near the Vestfold Hills, an ice-free coastal 'oasis' of about 400 km^2 in East Antarctica. The region contains a diverse array of habitats, from the seasonally ice-covered ocean in Prydz Bay to the soils, rock and lakes of the coastal environment. *Biology of the Vestfold Hills* captures this diversity with studies upon the lakes (11 papers), inshore marine habitats (4), terrestrial environments (6), penguins and other birds (4), and seals (2). Two short methodological papers are also included.

The Vestfold Hills emerged from the sea 5–8000 years ago and some of its lakes contain relict sea-water that was trapped at that time and then further concentrated by evaporation and freezing. The limnological contributions to this volume provide a fascinating account of these distinctive waters, as well as of some of the less extreme lacustrine environments. A remarkable feature of these studies is the number of seasonal data sets, which up until the present have been completely lacking from the Antarctic continent. Separate contributions describe the dramatic annual cycle of stratification and mixing in Deep Lake (hypersaline, ice-free even in winter), the layered phytoplankton distribution and succession in Ace Lake (meromictic, ice-out in late summer), benthic and planktonic algal production over the course of a year in Watts Lake (slightly saline, continuously ice-covered most years), and the dynamics of photosynthetic bacteria over the course of a year in Burton Lake (ice-covered, meromictic, seasonally tidal). Valuable seasonal records are also presented for the inshore marine ecosystem off the

https://doi.org/10.1017/S0954102089250277 Published online by Cambridge University Press

Vestfold Hills, with studies of the plankton, sea ice biota, benthic plant and animal communities, and the diet of the Adélie penguin throughout the breeding season.

Several papers in the volume present broad descriptive overviews of the distribution of biota in this region of East Antarctica. These studies with their detailed habitat information on specific groups of organisms such as lacustrine bacteria, terrestrial plants and tardigrades, inshore marine fishes and the birds of Prydz Bay will provide the basis for hypothesis formulation and testing for many years to come.

A further theme in this attractively presented volume is the adaptation of Antarctic organisms to their severe environmental surroundings. The effect of temperature on the growth of isolates of aquatic bacteria is examined. The ultrastructure of the cuticle of terrestrial mites is related to survival in their freezing soil habitats, and the adaptive muscle biochemistry of penguins is used to infer their diving capabilities. Other papers within the book are focussed upon habitats rather than the biota, such as a description of the changing geomorphology of the Vestfold Hills during the late Quaternary with the retreat of the glacier ice, the subsequent flooding by sea-water, and then drainage during isostatic uplift of the region in the Holocene.

Like all symposium-derived collections this volume suffers from the heterogeneous and somewhat random assemblage of contributed topics (from penguin viruses to neogene sedimentology), in this case often unified only by geographical location. However this breadth of material is also a strength for it provides an impression of the span of work conducted in or near the Vestfold Hills, and offers a useful compendium of descriptive information that will complement the earlier volume by Pickard (*Antarctic oasis: Terrestrial environments and history of the Vestfold Hills.* Academic Press, Sydney, 1986) on terrestrial environments and the geological history of the region.

WARWICK F. VINCENT

Reindeer on South Georgia. The ecology of an introduced population

N. Leader-Williams
Cambridge University Press, Cambridge (1988).
319 pages. £20.00. ISBN 0 521 24271 1.

This book, the 10th in a series on research in polar regions, focuses on adaptation to a new environment, and on comparison with other introduced and indigenous populations of reindeer and other cervids.

In the first part he reviews the taxonomy of reindeer and other comparative studies on cervids. He emphasises that traditionally lichen availability has been considered to play a central role in limiting numbers of reindeer. But continental and other indigenous island reindeer have been shown to shift diets, as lichens become scarce, with a comparable loss in population growth rate. The important fact here is that all reindeer herds without lichens as a major part of their diet are comparatively more limited in population growth than dietary unrestricted herds. On South Georgia very little lichen was available and population growth since introduction was of the order of 40% of that in populations introduced to lichen-rich areas or naturally expanding into such areas on mainland continental wild reindeer habitats. I find it surprising that Leader-Williams does not recognize this. I find this difference dramatic and of significant interest in terms of reindeer evolution, population dynamics and stability.

The most distinctive feature of South Georgia is the almost total dependence in winter by reindeer on the tussock grass *Poa flabellata*. He provides a detailed description of the development of the three herds on the island from the time of the introduction at the beginning of this century. He compares the peak densities at South Georgia with other herds. There are some inaccuracies in the irruptive density comparisons, and the comparison of 'irruptive' and 'stable' population densities of unhunted and human-hunted herds is of little scientific value since in cases where the herds are hunted the attained population density is based on a management decision as to the size of annual cullings and not on herd dynamics.

He discusses why there exist differences in the willingness of the South Georgian herds to move across mountain passes on the island to find better food. He suggests that this is due to their woodland origin. I find this suggestion awkward since their origin in Norway is of mountain-woodland mixed stock (as almost all reindeer in Norway are and they readily cross mountain passes).

In comparisons between reproductive potential of different species bearing single or several offspring, I find figure 4.22 surprising since red deer and *Dama dama* are, within their continental range, forest and not open-habitat species. In the figure they are classified with open-habitat species with singlets as compared to woodland species with twins and triplets. He discusses factors determining calving seasons in *Rangifer*. Although several studies on factors determining or delaying calving date in reindeer are available he does not use them.

In the section on food habits he discusses potential differences between the sexes but obviously the environment does not allow such differences to develop since they are singularly dependent on the same winter and, to a large degree, summer food.

His discussion of the significance of antlers does not consider behavioural work which does explain this in terms of sexual and natural selection. There is also no mention of the significance of fat deposition in relation to reproductive ecology of the two sexes. He also states that body condition is related to reproductive costs in the two sexes but such costs are not shown.

Since his analyses are based on culled animals I would

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have expected more data on foetal weights and on differences in growth and size between his South Georgian herds. Instead he focuses on sine wave functions which is a debatable way to show growth.

He discusses the ecology of introductions to islands in terms of population stability and regulation. I do not find this part convincing, particularly since food limitation and limitation by density are not the same thing. I also find the discussion of predated *v.* food-limited herds of reindeer weak. The lack of reference to work on anti-predator behaviour, e.g. use of refuge terrain, migration to escape predation during calving, the effects of predation in single *v.* several prey species communities is obvious. In fact predation as a significant population regulating factor for caribou has only been shown for caribou on isolated small mountains within the boreal zone, surrounded by moose as alternative prey for wolves.

He presents a detailed description of the grazing effect on the vegetation, the sequence of over-grazing, and the use of exclusion experiments to document the progression of the vegetation degradation.

In conclusion, the book presents a detailed picture of the ecology of an introduced species of ungulate and its biology, with emphasis on the physiology of reproduction, on growth, mortality and grazing. Most of the scientific data on which this work is based was published around 1980. That part of the book represents good descriptive ecology. In the parts where he makes comparisons with other introduced and continental populations of cervids living under different population influences, here are unfortunately some shortcomings in relation to advances during the last 6–8 years, both on descriptive as well as population theoretical levels.

TERJE SKOGLAND

Biology of polar bryophytes and lichens

R.E. Longton

Cambridge University Press, Cambridge (1988). 391 pages. £55.00. ISBN 0 521 250153.

This is the first time that a whole book has been devoted to the biology of two major groups of arctic and Antarctic cryptogams. The aim is to balance our well-established knowledge about arctic bryophytes and lichens with that gained only more recently in Antarctica. Royce Longton has much first-hand experience in both polar regions.

The book is well divided into eight main chapters. It starts with a general discourse about the similarities and differences in the geography and phytogeography of both polar regions. Particular attention has been given to the terminology of vegetation zones and to discussion of the provenances of polar cryptogamic floras. The second chapter describes the cryptogamic vegetation, and problems of classification are discussed. A general classification of polar plants according to growth forms is feasible. The compilation of vegetation formations and communities is based on different literature sources for Arctic and Antarctic types. The third chapter deals with pattern and processes in the cryptogamic vegetation as a response to environmental parameters such as temperature, water relations, wind, snow and edaphic factors. Of particular interest is the section on colonization and succession.

The environmental factors 'Radiation and micro-climate' are analysed providing much basic information about the physical components and the action of energy. The reader may be particularly interested in the discussion of the role of snow cover, especially as regards the light regime of plants. It is questionable if the dark pigmentation of the thalli correlates significantly with a chionophobous character of the lichen (pp. 121, 122). Much literature about the temperature regimes in bryophyte and lichen canopies is cited, reporting dramatic gradients and extreme values. However, these values are not important to the activity of cryptogams if concurrent observations of other factors, such as moisture, are missing. Such studies could have been more critically considered in this chapter. Chapter 5 deals with 'Physiological processes and response to stress'. The chapter begins with critical comments on the different methods used to measure CO_2 exchange of cryptogams. Net photosynthesis data in the literature up to 1985 are extensively reviewed. Unfortunately, few field investigations were carried out in the Antarctic before this date compared with the period since. The last part of the chapter deals with environmental stress and adaptation.

The next chapter 'Vegetative growth' treats growth pattern and, so far as is known for the bryophytes, translocation of assimilates. It reviews in detail annual and seasonal growth increments and the factors which control them. Chapter 7 'Cryptogams in polar ecosystems' summarizes knowledge of standing phytomass and phytomass production, the importance of cryptogams as an energy-binding system, as well as consumption, decomposition, and nutrient cycles in both polar regions. This chapter also discusses different kinds of human influence on polar cryptogams with critical consideration of conservation strategies in the Arctic and regulations in Antarctica. Chapter 8 'Reproductive biology and evolution' gives an especially well-conceived view of these processes for cryptogams in general and those of polar cryptogams in particular. In the discussion on dispersal and establishment, Longton contributes new ideas and viewpoints to the question of origin and evolution in the Arctic and the Antarctic, especially with respect to polyploidy in bryophytes, variability in species and endemism.

Using 750 references, Longton provides a very extensive review and covers most of the relevant aspects. It is an excellent compilation of current results. Compilation is a necessary process, particularly for the more descriptive chapters 1–3 and 6–8. It may not be as helpful when treating

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the literature on functions and processes, where it leads to a repetitive style, for example enumerating in the text all findings supporting and contradicting a certain phenomenon. In this case, tables could briefly summarize all data and only the resulting trend should be critically discussed. Consequently, a general comprehensive conclusion about physiological adaptation to the polar environment is not attained. On the other hand, Longton is successful in introducing the interested reader to the principles and terminology relevant to these chapters, although handbooks about lichens and bryophytes, (e.g. V. Ahmadjian & M.E. Hale, *eds. The lichens.* New York & London: Academic Press. 1973) were not specifically mentioned. Taxonomists may not always agree with the species names used for the Antarctic lichens according to D.C. Lindsay (The macrolichens of South Georgia. *British Antarctic Survey Scientific Reports,* No. 89, 91 pp. 1974), since several taxa were revised recently. The book is well illustrated by many line diagrams and graphs. The photographic illustrations would be more delightful if they were printed on glossy paper.

The book provides a most useful reference for anyone interested in polar research projects. It helps to bridge the gaps between specialists who might only see the research on polar cryptogams either as bryologists/lichenologists or as physiologists/phytosociologists. Until recently, the literature usually addressed either the Arctic or the Antarctic. This book, weighted equally towards both polar regions, is an important source for researchers and students looking for both general and specific phenomena in the Arctic and Antarctic. Moreover the book is recommended to those interested in biology in general. It will help students of vegetation science, ecology, and physiology to understand general and particular phenomena with regional aspects. The hard-cover book is reasonably priced.

L. KAPPEN

Satellite image atlas of glaciers of the world: Antarctica (USGS Professional Paper 1386B)

Charles Swithinbank

US Geological Survey (1988). 278 pp + 2 maps. $(US)40.00. ISSN 8760 0497.

This attractive volume is one of eleven that comprise US Geological Survey Professional Paper 1386, *Satellite image atlas of glaciers of the world.* The aim is to use remotely sensed images, mainly from Landsat 1, 2 and 3, to document, monitor and study glacierized areas of the world. This particular volume of 278 pages has been written by Charles Swithinbank with sections contributed by Trevor Chin on the dry valleys of Victoria Land and on the Landsat images by Richard Williams and Jane Ferrigno.

The first part of the atlas introduces the reader to aspects of the Antarctic and a general classification of ice features such as ice shelves, outlet glaciers and dolines. This is a useful introduction to the meat of the volume which is a 126-page regional description of different sections of the Antarctic. The continent is divided into regions comprising the Transantarctic Mountains, Indian Ocean sector, Atlantic Ocean sector, the Antarctic Peninsula and Pacific Ocean sector and each of these is further subdivided for description. For each area there is a successful attempt to combine the best available satellite derived map, imagery and vertical photography. The satellite images are often annotated and combined with ice surface and ice depth contours where available. The images vary from splendid to truly spectacular. Highlights are the digitally enhanced false colour images of several areas and remarkable Landsat RBV images of part of the Transantarctic Mountains. It is a sheer delight to turn the pages and see yet more and more remarkable images. It is particularly effective to be able to compare parts of the images with aerial photographs of particular points.

The overriding impression is the sheer quantity and quality of information available on the images and how much remains to be analysed. Ice surface features of varying wavelengths, snow dunes, nunatak morphology, melt-water features, snow drifting and icebergs are easily visible and the atlas provides an effective means of gaining continental-wide perspectives. It is extremely useful to see surface features related to ice surface contours, while the map of the thickness of the Amery Ice Shelf superimposed on the image is most effective. For each area at least one image is fully annotated with the names of glaciers, mountains and national bases. In places, details of features such as individual volcanoes are shown clearly.

The text is economic and efficient. It describes the main features visible and summarises the glaciological information available, such as ice velocity and temperature. It gives references to the basic glaciological, geological and geomorphological literature for each area. The references amount to a full 2-column, 7-page bibliography.

There are limitations to the coverage imposed by weather and orbit. There are no usable images of the subantarctic islands and, of course, no images south of latitude 80°S which is beyond the orbiting coverage of Landsat.

The second part of the atlas details the coverage of Landsat imagery. There is a large fold-out map showing the best available coverage for each of the 2514 scene centres. This is supplemented by a 107-page table of the details of optimum images showing details of Landsat image identification, date, sun angle, cloud cover and an overall classification of an image's value for glaciologic, geologic and cartographic applications. There is also a 17-page table of usable or marginally usable Landsat 3 RBV images. A short introduction draws attention to the main problems and possibilities in using the data.

Overall the atlas is a splendid addition to the literature. It conveys an immense amount of information in an effective

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and attractive way. Readers will revel in the magnificent quality of the image reproduction and the sheer visual impact of the scenes. It is the sort of book that is of great scientific use and yet will also appeal to the casual reader. We are all indebted to the writers for the immense labour involved in scrutinizing some 10 000 images in order to select the best for each area and in integrating place names and glaciological data with the images. Praise also is due to the publishers for such high quality reproductions.

DAVID E. SUGDEN

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