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Book review

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THE BEHAVIOUR, POPULATION BIOLOGY AND PHYSIOLOGY OF THE PETRELS
by John Warham

1996. Academic Press Ltd, London. Pp. 613, 172 mm x 250 mm, no price given.

In his first volume, *The Petrels: Their Ecology and Breeding Systems,* John Warham captivated us with such a wealth of information that I sometimes wondered what was left to cover in a second volume. There would be the physiology and anatomy material, no doubt some literature on behaviour to cover, and, with any luck, an account of research on petrels at sea which, after rapid advances over the last ten years, urgently needed summarising. In his preface to *The Behaviour, Population Biology and Physiology of the Petrels*, John himself confesses that he would have been alarmed to know that five year's work would be needed to review topics not covered comprehensively in the first volume. Now that this second book is complete, I can see that it is, in fact, more surprising, that an additional five years was all it took. Such was the extent and widely dispersed nature of the material to be covered.

Chapter one of *The Behaviour, Population Biology and Physiology of the Petrels* examines petrel populations covering coloniality, population structure, causes of mortality and habitat modification. Although some petrel species have been well studied and much is now known about the age structure of some populations, there are still largely unanswered questions concerning population regulation and the causes of population change. For example, even the reasons for the well documented increase in the Northern fulmar *Fulmarus glacialis* population are uncertain. This is an approach that continues throughout the volume – what is known is summarised but, just as importantly, the gaps in current knowledge and understanding are drawn to the readers attention.

Dispersal, migration and factors affecting petrel distributions at sea are covered in the second chapter. The methods used to study these topics are also discussed. Throughout this volume, the author's attention to summarising not only results and conclusions but also methods, makes this book a valuable reference for researchers contemplating similar studies. Inevitably however, given the rate of technological change and the speed with which the study of petrels at sea is expanding, advances have been made since this book was written. In this volume, published in 1996, the author predicts that further miniaturisation of satellite transmitters will allow the movements of smaller petrels to be monitored. Now in 1998, the first few satellite telemetry studies involving shearwaters are beginning to trickle through (eg Nicholls et al. 1998; Freeman et al. in press).

New techniques are also predicted to shed light on such unresolved debates as when petrels feed (day or night) and whether they take predominantly live or dead squid. The application of stomach sensors to these issues is discussed in chapter three on feeding and foods. This chapter, in particular, highlights the significant gaps in our knowledge of petrel biology and abounds with suggestions for further investigation. For example, what are the relationships of bill structures to food and feeding methods? What variations are there in prey between individuals, populations, sexes and age classes?

Chapters four to six cover petrel behaviour and vocalisations. Chapter four introduces the reader to the communication systems used by tubenoses comprising vocal, visual, and, possibly, olfactory signals. The use of vocalisations in species recognition, mate attraction and colony location are discussed. Just how petrels find their burrows in darkness is still a mystery.

The behaviour of albatrosses is better known than that of the other petrel groups. Their dramatic displays have attracted a great deal of research attention which is well summarised in chapter five *Behaviour of Albatrosses*. This chapter makes good use of descriptions of displays accompanied by line drawings and audiospectrographs of vocalisations. Chapter six surveys the work on behaviour and vocalisations in the other petrel groups and, where available, descriptions of displays and audiospectrographs are given. Comparisons of behaviour and vocalisations among groups and between species suggest a role for behavioural studies in unravelling the systematic status of lesser known groups.

Chapters seven and eight comprise *Physiology and Energetics* and *Biochemistry* respectively. Chapter seven covers adaptations of the digestive, excretory, cardiovascular and endocrine systems to the petrels' marine environment. Sensory systems have been little studied in petrels and the author emphasises the work still to be done in the areas of photoreception, chemoreception and olfaction.

Most of chapter eight is devoted to reviews of procellariiform lipids, notably stomach oils and their composition, and the biochemistry of pollutants in petrels. This section discusses the effects of mineral oils, chlori-

nated hydrocarbons and heavy metals and the differences among species in their physiological ability to cope with these contaminants. Although petrels appear to have protective systems which lessen damage from heavy metals (which occur naturally in marine ecosystems), their ability to detoxify other pollutants awaits closer study.

Locomotion and anatomy are the subjects of chapters nine and ten. In chapter nine the mechanics of walking, swimming, diving and flying in the different petrel groups are compared, with a particular emphasis on the mechanics of flight and aerodynamics. Chapter ten examines the structural features of the skeletal, digestive, excretory, reproductive, circulatory, pulmonary and nervous systems. Attention is also given to plumage and moult in a comparison of feather replacement among the petrel groups.

Chapter eleven surveys hypotheses for the evolution and radiation of the petrels. The evidence for Procellariiformes being an ancient group with reptilian "preadaptations" is reviewed along with work on relationships, both to other major groups and within the order. In the past, phylogenies have been deduced from such features as similarities of structure, plumage, distribution and behaviour all of which are thoroughly summarised in this chapter. Recent progress in molecular genetic techniques is examined and the author concludes that these techniques promise to help resolve the many outstanding problems in petrel systematics, history and demography.

Human interactions with petrels are the subject of chapter twelve, the final chapter in this compendium. This chapter traces the history of human use of petrels; for food, feathers, lamp oil, bone and as fish bait. The present day threats to petrel populations are examined, especially the hazards posed by fisheries 'by-catch' and the efforts which have been made to reduce seabird captures. Exciting new techniques which may aid colony renewal, such as translocation and decoy enticement are also discussed.

As with the first volume, this book is commendable for its detailed referencing which provides comprehensive signposting in to the literature. The work is particularly significant for its emphasis on the current gaps in knowledge and as such will play an important part in directing future petrel research. The extent of information in this volume makes *The Behaviour, Population Biology and Physiology of the Petrels* an essential companion to *The Petrels: their ecology and breeding systems* and together the two provide a complete and authoritative, yet entirely accessible reference work for all with an interest in the tubenosed seabirds.

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