

Acknowledgements

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Foreword

Birds are a truly special group of vertebrates in many ways. They fly, mostly, and while we easily accept this because of its familiarity, it is a very special lifestyle and we are still uncertain as to how it evolved. Mammals are often considered to be the vertebrates that dominate the continents but birds occur over more of the Earth's surface and play important roles in ecosystems on a global scale. They are excellent bio-indicators in our changing world and improving our knowledge of them is crucial to our understanding of these global environmental developments. The importance of this new volume on the *Ecological and Environmental Physiology of Birds* sits squarely within this greater context.

From a personal perspective, a casual foray into bird ecophysiology markedly enhanced my insights into the adaptive responses of birds in a variety of challenging environments. Birds are generally one of our first interfaces with wild animals, be they city pigeons, garden sparrows or the gulls at the beach. These encounters can lead to a continuing fascination with birds, perhaps as amateur bird watchers or even as professional biologists, such as the contributors to this volume. My career in ecological physiology grew from such early experiences. A collection of bird eggs obtained during my pre-teen wanderings in the dry bush near my home in the Australian rangelands is my first remembered step along this path. A curiosity about the odd Australian mammals (such as kangaroos) that were also encountered in this environment has dominated much of my research over the years but my interest in birds continued and increasingly I realised that birds were functioning in extreme environments in ways that far exceeded their physiological abilities, as then understood. It was the Emu (*Dromaius novaehollandia*) a supposedly primitive, giant bird that really awoke me to the very different physiologies of birds and mammals and the adaptive potential of birds. While the kangaroos at our field site hid in the shade to avoid the summer sun the Emus spent the day foraging in the open desert, yet their reported urine concentrating abilities were far lower than those of the kangaroos.

These observations resulted in a major excursion into avian ecological physiology, with a necessary steep learning curve for my students and me to gain insights into the unexpected complexity of the descendants of the dinosaurs. Luckily, we had support from colleagues, several of whom are contributors to this volume. William Calder III, a friend from my postdoctoral days in Knut Schmidt-Nielsen's lab at Duke University, visited and gave me my first lessons on avian metabolism. William Dawson from the University of Michigan also visited and he

recommended the sturdy Bill Buttemer as someone with knowledge of bird thermal biology who might also handle large Emus. We were doubly rewarded when Bill also brought Lee Astheimer to the University of New South Wales. Erik Skadhauge, a friend from my Duke University days came on sabbatical from Denmark and provided much on-site training in bird excretory physiology to my students, Shane Maloney and Robert Herd and me. Mark Chappell came to look at Australian birds and gave much help, as did Eduardo Bicudo when he was consulted on bird energetics. Eventually we came to understand the fascinating features of the physiological ecology of the Emus, which also provided a refreshing insight into the biology of kangaroos.

When Eduardo Bicudo was planning this book he asked if I would like to contribute. I declined, however, since my knowledge is rather narrow and bird comparative physiology has progressed significantly in the last few years. Fortunately, I was able to make some appropriate suggestions leading to some of those now contributing to this volume. Eduardo has kindly let me read chapters as they have progressed and my education has continued apace.

Much knowledge across the spectrum of bird physiology has been gained in the years since the Emu studies, but the authors of this volume have avoided an exhaustive "laundry list" approach. Instead, they focus on our current understanding of a set of topics in ecological and environmental physiology that are of particular interest to ornithologists, but also have broad biological relevance. The introductory chapter covers the basic body plan of birds and their still-enigmatic evolutionary history. The focus then shifts to a consideration of the essential components of that most fundamental of avian attributes: the ability to fly. The emphasis here is on feather evolution and development, flight energetics and aerodynamics, migration, and as a counterpoint, the curious secondary evolution of flightlessness that has occurred in several lineages. This sets the stage for subsequent chapters, which present specific physiological topics within a strongly ecological and environmental framework. Chapter 2 covers gas exchange and thermal and osmotic balance, together with the central role of body size. Chapter 3 addresses "classical" life history parameters – male and female reproductive costs, parental care and investment in offspring, and fecundity *versus* longevity trade-offs – from an ecophysiological perspective. Chapter 4 – "*Adaptations and specializations*" – offers a comprehensive analysis of feeding and digestive physiology, adaptations to challenging environments (high altitude, deserts, marine habitats, cold), and neural specializations (notably those important in foraging, long-distance navigation, and song production). Throughout the book, classical studies are integrated with the latest research findings.

Of course, numerous important and intriguing questions await further work, and the book concludes with a discussion of research methods and approaches – emphasizing cutting-edge technology – and a final chapter on future directions that should help point the way forward for both young and senior scientists. This

volume is broad and incisive; a similar one would have been invaluable when my group started researching Emus in the 1980s. An informed colleague was not always on hand.

Finally, returning to a more personal and subjective level, I believe it is important for even the most dedicated and dispassionate of scientists to acknowledge and, indeed, embrace the special emotional appeal of birds. The contributors to this book are a diverse group of professional biologists from across the globe, each with their own particular specialized training and expertise. Each is thoroughly versed in the rigorous, disciplined, and objective methods of science and has used them to build a career, in whole or in part, probing physiological questions and adding to our understanding of how avian biology "works" at a mechanistic level. But from a more emotive and aesthetic perspective, all have a boundless enthusiasm for, and appreciation of birds simply as the beautiful, elegant, and utterly fascinating creatures that they are. I hope the contents of this volume will add to that special sense of wonder engendered by the sight of a bird in the sky.

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