

## PREFACE

Will the great migrations of birds survive? Many biologists believe that migratory birds are at greater average risk of extinction due to changing climate than are resident species. This idea is based on the fact that migratory birds depend on different habitats and resources in different locations during their annual cycle and on the fact that the failure of any of these could be fatal. A second general belief is that the climate is now changing at a rate faster than birds have experienced in the past and that evolutionary adjustments by birds may not be able to keep pace with this change.

The thesis of this book is that many migratory birds exhibit a high degree of ecological and evolutionary adaptability and that many are now showing rapid adjustment to climatic changes. A subsidiary thesis, however, is that for other species, climate change can severely constrain or prevent full ecological and evolutionary adjustment, putting their survival at risk. The objective of this book is therefore to evaluate the capacity of migratory birds to respond to the challenges of changing climate.

The book is a review, synthesis, and interpretation of recent scientific literature on migratory birds and their responses to changing climate. We begin by characterizing the patterns of migration shown by birds of different ecological and taxonomic groups, and the frequency of migration in different world environments, from polar regions to the tropics. The nature of climate change throughout the world is examined, and the impacts of this change on bird habitats are evaluated. The special threats of change to particular habitat types and resources utilized by migratory birds are examined and the constraints on responses by birds considered. The particular patterns of influence of climate change on migratory land birds are considered for different biogeographic regions and for special bird groups, including raptors, freshwater birds, and marine birds. Finally, the capacity for ecological and evolutionary adjustment is examined, and the adequacy of current conservation programs is evaluated. No treatment of bird migration has pulled together these diverse topics, which are of critical importance to human efforts to protect biodiversity.

Most of the topics in the book have been addressed for specific groups

of birds or for birds in specific geographical areas. Some topics, such as the impacts of climate change on migratory tropical birds (Chapter 10) and evolutionary adaptability of water birds (Chapter 18), have received only spotty attention other than that directed at a few species. Other topics for which no recent syntheses have been attempted include worldwide alteration of migratory bird habitats (Chapter 3), migratory land birds of the temperate Southern Hemisphere (Chapter 9), shorebirds (Chapter 12), waterfowl (Chapter 13), oceanic birds of the North Pacific and Southern Hemisphere (Chapters 15 and 16), evolutionary ability of land birds (Chapter 17), and overall capacity for ecological and evolutionary adjustment (Chapter 19). Recent symposia have tended to focus on land bird responses to changing climate in North America and Europe, but interest is increasing rapidly in Australia. We really know little about how migratory land birds of South America, eastern Asia, and Africa are responding to climatic change, but all indications are that major changes are occurring.

Birding has become not only a hugely popular outdoor activity for millions of people but also an activity that brings people face to face with biodiversity and the threats to its survival. I have not met a birder who is not concerned about protection of bird habitats and about the impacts of changing climates on birds, whether resident or migratory. I hope that this account increases awareness of the changes that migratory birds are experiencing and stimulates readers to participate in efforts to keep the great migrations in motion. See the appendix, as well as [www.birdmigration.org](http://www.birdmigration.org), for a list of the common and scientific names of species discussed in the text.

I am indebted to many friends and colleagues who have reviewed portions of the book, especially Ben Becker, Keith Bildstein, Christian Both, Richard Brewer, Lynda Chambers, Glenn Conroy, Hugh Dingle, George Divoky, Peter Dunn, Fred Gehlbach, Frank Gill, Phil Hockey, Steve Oberbauer, Jane Phillips-Conroy, Robert Ricklefs, Kurt Riitters, Tim Sparks, Nils Stenseth, Nils Warnock, and S. Joseph Wright. Many others graciously took time to help me find literature for particular regions or topics: Tatsuya Amano, Ken Chan, Tim Coppack, Victor Cueto, Tom Ebert, Ken Green, Louis Hansen, Stuart Hurlbert, Alex Jahn, Leo Joseph, Brian Linkhart, J. Alan Pounds, Michael Scott, Kim Scribner, Rob Simmons, Liliana Spescha, Wayne Trivelpiece, Rick Wessels, Ed Willis, and Ben Zuckerberg. I especially thank Darla Cox, my wife, for sharing many birding experiences and for reviewing many of the chapters of this book.

George W. Cox  
Santa Fe, New Mexico