

Preface

At no time in the nearly four billion years since the origin of life on earth has our planet seen such tremendous environmental change. Even the major mass extinctions in prehuman earth history (Raup & Sepkoski, 1982) are mere blips in comparison with the current biodiversity crisis. Human actions and impacts such as the elimination, fragmentation, and conversion of habitats; mass poisoning; overharvesting; species introductions; and climate change dramatically alter the local and global carrying capacities of other species. But they also do more. By modifying the challenges organisms face, and the resources they have to address those challenges, we are altering the conditions under which behavioral and physiological traits are expressed and in which ecological interactions occur. These changes affect the selective environments encountered by organisms, influencing evolutionary dynamics, which in turn feed back to affect ecological dynamics. Conservation problems are thus eco-evolutionary in nature, rather than just ecological, demographic, or genetic (Kinnison & Hairston, 2007). This ecoevolutionary nature of responses to environmental change is the focus of this book.

There is thus a clear and present need to develop practical approaches to managing our biodiversity problems that consider a role of evolution occurring during the time frame of the conservation program. Evolutionary theory is the predictive core of the biological sciences, and it

provides the foundation for designing new and integrative strategies. Central to our perspective is the discovery that a great many organisms, from microbes to trees, are rapidly evolving in response to their changing environments. As risks and resources change in form, distribution, and abundance, they create new niches, affect competition, add or subtract enemies, and generally recast the landscape for surviving taxa. Selection is now operating in new directions and at new intensities, and the degree to which populations respond adaptively can determine their capacity to persist. Moreover, adaptive evolution, emerging from the demographic and genetic chaos suffered by "refugee taxa," may prove to be of foremost importance in altering the form and structure of species, interspecific interactions, and communities in the coming years, decades, and millennia.

If heretofore unanticipated, widespread evolution is itself a major component of global change. Static models—those that treat the ecological players as passive bystanders in the ecological play—are now obsolete. Understanding and managing ongoing adaptation to global change requires new perspectives to accommodate, exploit, and manage evolutionary processes of conservation concern, which include population structuring and the pace and extent of gene flow, the maintenance and expression of phenotypic polymorphisms and plasticity, niche specialization versus generalism, costs versus benefits of harvesting and of genetic

engineering, and diversity management decisions above and below the species level. If we succeed in protecting species and biota demographically, a chief outcome may be to provide raw material for both targeted and unmanaged evolution. Accordingly, the principal challenge of evolutionary conservation biology is to predict and then manage evolutionary dynamics, and make conservation (and preservation) plans that maximize evolutionary potential—for example, by protecting communities that have unprecedented assemblages of juxtaposed, and rapidly evolving, remnant taxa. It is our hope that the authors of this volume provide insights that ultimately contribute to the success of such efforts.

This volume is intended to introduce, explore, and elaborate evolutionary approaches to conservation biology. The volume is divided into five parts, each of which is preceded by a brief introduction and commentary. The chapters in Part I, "Population Structure and Genetics of Threatened Taxa," present the history and general concepts of conservation genetics, and examine the interaction of genetic and demographic factors. Part II, "Conserving Biodiversity within and among Species," focuses on evolutionary processes, their relationship to biodiversity at different taxonomic levels, and how they influence practical conservation issues, including the reintroduction of threatened taxa and the loss of distinctive populations to hybridization. The chapters in Part III, "Evolutionary Responses to Environmental Change," examine both genetic and phenotypic modes of adaptation to the stresses and opportunities associated with global change phenomena. Part IV, "Conservation of the Co-evolving Web of Life," examines the evolutionary and co-evolutionary causes and consequences of changing interspecific dynamics, including species invasions, extinctions, and host parasite dynamics. The fifth and concluding portion of the volume, "Evolutionary Management," presents evolutionary analyses of three critically important areas: reserve design, management of transgene flow into the wilds, and the sustainable harvest of wild populations.

All chapters in this book were reviewed by peers, usually two or three scientists with expertise in the topics covered by the chapter. These reviewers offered insightful commentary on the chapters and have made this a much better volume. We thank Karina Acevedo-Whitehouse, Paul Agapow, Fred Allendorf, Suzanne Alonzo, Mike Angilletta, Tristan Armstrong, Leslie Blancas, Janette Boughman, Juan Bouzat, Linda Broadhurst, Jeremy Burdon, Mar Cabeza, Christina Caruso, Denis Couvet, Richard Cowling, George Gilchrist, John Kelly, Holly Kindsvater, Mike Kinnison, Mike Loeb, Arne Mooers, Patrick Nosil, Stephen O'Brien, Julian Olden, Otso Ovaskainen, William Perry, David Reed, Gerald Rehfeldt, Kevin Rice, Kim Scribner, Mike Singer, David Tallmon, John Thompson, Peter Thrall, Andrew Weeks, Alastair Wilson, and a few reviewers who asked to remain anonymous, for their constructive comments on individual chapters. We especially thank Mike Loeb for copy-editing chapters and compiling the final version of the book.

Last, and most important, we thank the authors for their dedication to this project. The success of this volume, and its influence on the conservation community, ultimately depends on the quality of the chapters and thus on the hard work, creativity, and insight of the contributing authors. Thanks to all of you!

Scott P. Carroll
Charles W. Fox

REFERENCES

- Kinnison, M. T., & N. G. Hairston Jr. 2007. Eco-evolutionary conservation biology: Contemporary evolution and the dynamics of persistence. *Funct Ecol.* 21: 444–454.
Raup, D., & J. Sepkoski. 1982. Mass extinctions in the marine fossil record. *Science* 215:1501–1503.