Preface

Adaptive radiation, allopatric speciation and local adaptation, alongside sexual selection, are the key evolutionary processes that have generated the current biodiversity. Globally, steadily increasing trade and the movement of humans across continents have broken the original distribution ranges of species by increasing the rates at which biological organisms enter non-native locations. Certain species have also been introduced on purpose with the goal of increasing the variety of fished, hunted or otherwise utilized species. Biological homogenization due to the intentional and unintentional movement of species is practically an irreversible process and one of the greatest threats to global biodiversity.

When leaving the original native environment, species are often released from their natural enemies as described by the enemy release hypothesis. On the other hand, an invasive species typically reaches new areas as only a small subset of individuals, causing a genetic bottleneck. To explain the great success of many invasive species in new environments, we must understand the ecological interactions between native and invasive species, niche structures and environmental characteristics in relation to the requirements of the invading species. We also need to understand if and how the invasive species adapt to their new environment and how the surrounding ecological environment adapts to the presence of the new species. At more subtle levels, we need knowledge on the evolutionary processes that determine if two related species or forms will interbreed and lose their special characteristics due to hybridization. Such fine-scaled processes and their consequences cannot be understood without support from modern genetics.

Sometimes, invasive species have detrimental ecological effects on local ecosystems by out-competing native species or by predating on endogenous species that severely suffer or become extinct as witnessed in Lake Victoria after the introduction of the Nile perch in 1954. Unfortunately, invasive species rarely travel alone, but are often accompanied by a wide variety of parasites and diseases. For example, diseases that arrived in Europe along with imported North American crayfish have driven most of the native European crayfish populations to extinction. Global climate change is altering the distribution of hosts, but also the distribution of their parasites. As some of the invasive hosts act as disease vectors for human diseases, invasions also increase human health concerns. Some invasive species are agricultural pests or weeds, and induce substantial economic losses. In rare cases, invasive species improve the ecosystem functioning by providing a new direct or indirect resource for the existing fauna.

This open-access, printed-on-demand book, edited by Dr. João Canning-Clode and written by the leading authors in their discipline, provides an up-to-date overview of the central themes in invasion biology and ecology. The open access publishing format, still a novel one for scientific books, will make science accessible not only to scientists but also to journalists, decision makers, and the general public. More

importantly, the present open access format also guarantees full no-cost accessibility to students, thus significantly increasing the efficiency of education across the globe.

Efficient transfer of knowledge from the scientific community to the rest of society is central to successfully preventing and controlling the harmful impacts of biological invasions. The crucial distinction between native and non-native species by ordinary citizens will often have strong conservational implications, as the problems cannot be solved without recognizing them. For example, well-intended release of pets such as aquarium fish and crayfish to natural waters forms a serious disease risk for native species.

This book starts by describing the vectors and history of biological invasions in different systems and within different taxonomic groups. Understanding the past and current mechanisms of how invasive species have been transferred to new areas is crucial for the planning of any management measures taken to prevent invasions. The second section focuses on the impacts of biological invasions, especially in host-parasite systems. Environmental parasitology is a rapidly developing research field, and of importance for predicting both the outcomes of biological invasions and global climate change. Section III deals with practical examples of how biological invasions can be managed in both terrestrial and aquatic systems. Finally, section IV reviews contemporary modelling and DNA-based methods that can be used to study both the mechanisms of invasions and their predicted future outcomes. This last section also discusses how climate change might interfere with invasions, and how aquatic communities might reach new assemblage structures due to invasions by new species.

As a whole, this book provides illustrative examples of biological invasions, synthesizes the current knowledge by identifying general patterns and factors that impact the resilience of biological systems, and gives insights into practical management problems. As such, I anticipate this work will have valuable use as a reading material for university students and anyone interested in learning more about the ecology and biology of invasions. The book has a strong conservational message: the once-invaded species cannot often be eradicated. Introducing a new species into an ecosystem is a one-way choice that needs to be based on prior, careful, holistic, and precautionary impact assessment. Thus, any unintended species translocation is to be avoided, and developing barriers to stop unintentional species migrations is a timely management challenge.

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