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Summary of Part IV

Invasion dynamics are being affected by global-scale changes, and new invasions have been detected in increasing numbers in several biogeographic regions, partly due to global warming but also the ability of many successful invaders to tolerate stressful conditions better than similar native species. Moreover, research in invasion science has been expanding in the last decade due to several insights. This kind of research already requires several levels of expertise in different lines of research within invasion science, particularly molecular tools to confirm the origin and history of invasions and models to anticipate future scenarios and responses to management actions. This last section of the book will contribute to different approaches in the future of biological invasions. The importance of molecular tools in examining the origin of invasive populations is discussed as well as climate change potentially promoting the spread of non-native species. Furthermore, dynamic models are presented with advanced spatiotemporal methods.

In terrestrial systems, non-native plant species pose a serious threat to the integrity of ecological systems and have detrimental economic and health impacts on society. During the last twenty years, research exploring the potential of human-induced climate change to accelerate the impact of invasive plants on native flora and ecosystems has been growing. **Chapter 16,** by Michelle Leishman and Rachael Gallagher, reviews recent investigations into the response of invasive plants to climate change drivers and to changes in temperature and rainfall patterns. The authors examine how climate change may influence the abundance and distribution of invasive plant species and draw conclusions, from manipulative experiments and from species distribution modelling, about the potential effects of climate change on several ecological aspects of plant invaders.

In addition, new spatiotemporal models have been developed over the last decade to explicitly address species responses, taking into account landscapes' heterogeneity. **Chapter 17** by Mário Santos and co-authors outlines these novel modelling techniques applied to forecasting and management, with a particular focus on biological invasions. Based on key examples of prominent biological invasions, the authors discuss the concepts, requirements, and potential outcomes of various modelling methods.

In the last two decades, DNA-based approaches have been increasingly used to study non-native species and to analyze the processes leading to introductions and invasions. Using numerous examples from different environments and taxa, **Chapter 18** by Frédérique Viard and Thierry Comtet highlights how modern molecular tools may tackle several aspects of biological invasions, such as detection of non-native species, identification of sources and routes of introductions, range expansion in invaded regions, and description of the consequences of introductions on native communities. Molecular ecology will undoubtedly have a central role in our attempts to understand the experimental evolution that is taking place accidently due to the human-assisted invasion of a multitude of species.

The impact of biological invasions in freshwater and estuarine ecosystems is well known with some of the highest rates of extinctions and endangerment of native species worldwide. In 1996 Peter Moyle and Theo Light investigated the nature of fish assemblages in highly invaded aquatic ecosystems in the context of assembly theory, and proposed twelve rules likely to regulate interactions among native and non-native species in forming new assemblages. Almost twenty years later, the same authors in **Chapter 19** of this book reassess these rules by examining them in a series of case histories of freshwater and estuarine fish assemblages with significant components of invasive species. The authors conclude with a discussion of reconciliation ecology as a framework for conservation of novel aquatic ecosystems.