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Summary of Part III

We have seen in previous sections that both accidental and intentional human-mediated introductions of species around the world have resulted in severe impacts for different ecosystems and significant global change. These changes tend to occur fast once non-native species have arrived and established in new habitats and/or ecosystems. In many cases, economic costs and other harm induced by a non-native species encourage spending vast amounts of time, money and effort to manage and control the invader. In some cases those efforts succeed, but in most cases, invaders tend to spread despite all control efforts. In this section, four chapters will cover different responses to well known invasive species in aquatic and terrestrial systems, and further discuss possible management tools and future directions to prevent and control these global environmental threats.

This section opens with an account by Frederico Cardigos and co-authors (**Chapter 12**) describing a variety of tools employed in attempts to eradicate the green algae *Caulerpa webbiana* in a small harbor located in an Azorean island. Its early detection in 2002 was disregarded, and 3 years later it was already too late to control the spread of this algae. The response to this non-native species was only initiated in 2008 when its spread was already out of control. Here, the authors describe the invasion history of *C. webbiana* and further discuss the importance of early detections of non-native species in eradication and management strategies.

Native to South and Central America, the toxic cane toad *Bufo* [*Rhinella*] *marina* is now an iconic invasive species after being transported to Northeastern Australia during the 1930s as a biocontrol for insect pests. After introduction, cane toads started to spread and become a threat to natural biodiversity due to their toxicity. **Chapter 13**, authored by Richard Shine, discusses recent research on the invasion of cane toads in Australia and reviews several attempts to control and mitigate the ecological impact of this well known invader.

The invasion of pines is considered a relevant ecological and economic issue in several regions of our planet. In **Chapter 14**, Aníbal Pauchard and co-authors evaluate the impacts, management, and policy context of pine invasions in South America. The authors encourage a more complete methodology to control pine invasions with the use of tools like prevention, early detection, containment, and population management, restoration, and the inclusion of society in all steps of this process.

Finally, the greatest proportion of marine invasions has been facilitated by the international commercial shipping industry, through the transportation of large numbers of animal and plant species in ballast water and through fouling. The breaking down of natural barriers is possible through this accidental pathway and gives species the chance to cross entire oceans easily. Ship traffic is immense, and the number of species and individual organisms transported in ballast water is enormous. The most effective form of ballast water management is through ballast water

exchange. In **Chapter 15**, Mark Minton and co-authors review the current understanding of ballast water delivery and management in the United States, with particular emphasis on overseas arrivals and discharge. With these data, authors are able to describe the magnitude of ballast water discharge, its variation by geographic source and recipient regions, and differences among ship classes.