



THE COSTS OF BIOLOGICAL INVASIONS

Pimentel, D. (ed.) (2002) *Biological invasions: economic and environmental costs of alien plant, animal, and microbe species*. CRC Press, Boca Raton, Florida, USA. x + 369 pp, figs, tables, halftones, index. Hardback: Price US\$129.95. ISBN 0849308364.

This book reviews the impact of introduced organisms on both human-dominated and natural ecosystems, and tries to cost these impacts. Some staggering figures are presented including a current world-wide estimate of damage caused by invasive species of US\$1.4 trillion a year. The seriousness of the problem is highlighted by the outbreak of the introduced *Helminthosporium oryzae*, a disease of rice, in Bengal in 1943 that resulted in the death of around 2 million people. Numerous examples are given, many of which, while being less dramatic than the Indian famine, have vast impacts on agricultural production, human health and the environment. The relative balance of information provided on impact and costs is variable between chapters.

Eighteen chapters, three of them published elsewhere before, are grouped into nine sections, seven of which deal with specific regions (called 'countries'); these are Australia (3 chapters), British Isles (3, but Ireland hardly gets a mention), Brazil (1), India (1), New Zealand (4), South Africa (2) and the USA (1). In addition there is one introductory and two overview chapters. Themes addressed are: pathogens (2 chapters), plants (4), invertebrates (2), vertebrates (5), diseases (1) and mixtures (4). An overview of ballast-mediated invasions would have complemented the themes covered. Although these topics would suggest a good coverage of the invasive biodiversity around the earth, the book is in fact highly biased towards the rich world. Other than the two chapters on pathogens in Brazil and India, there is no information relating to plants and animals in the Developing World. Indeed, this information is limited and the total financial costs may be small compared with those estimated for Western countries; however, relatively

the costs may be much greater to these poor rural populations, and their ability to deal with these issues is limited.

The coverage for the regions represented is good and provides an excellent overview. However, there are some repetitions — for instance, the two New Zealand invertebrate chapters should have been amalgamated. Also, there are some surprising omissions. In the case of the British Isles there is no mention of the invasive New Zealand flatworms. Chapter 18, by Pimentel *et al.* is a world overview of economic costs caused by biological invasions, and logically one would expect that it would incorporate and summarize the information provided in previous chapters. But this is not the case, as the chapter was published elsewhere almost two years before most of the other contributions were completed. Chapter 18 should have been updated in the light of the rest of the book — for instance, New Zealand does not get a mention even though it constitutes a substantial part of the book — but the relevant information is summarized instead in the introduction. The final chapter deals with six introduced global diseases and provides a short, focused account of the history, impact and costs of each of them. However, this chapter has no introduction, discussion or conclusion, and the book ends abruptly with its section 18.6.4, a single paragraph on Hepatitis C.

A recurrent theme highlighted by most authors is the difficulty of estimating costs, especially those relating to the environment, including species extinction (this theme is also reflected by the controversy sometimes generated by the size of cost estimates in the literature). Most financial figures (given in local currencies) are based primarily on the impact of the invasions on agricultural systems, or human health. Figures for environmental costs are available in some cases. Clearly we need to have more data, and here the limitations of the book are clear. How does one identify problematic species? How does one go about estimating costs? What are the pitfalls? For instance, how should one approach the rapid, but largely ignored, spread of *Prosopis* spp. in much of the dry tropics? These questions, which in a

way reflect the general state of the subject (much is unknown and few certainties exist), are not addressed. At the very least, an appendix should have been included to provide a lead into the assessment of impact and economic costs, as well as to provide guidelines.

On the whole, this book is well put together, with few typos, but unfortunately the index is not up to standard. Common names instead of scientific ones are used and listed under headings, often arbitrarily, but more importantly the pages of many entries are wrong. References are presented at the end of each chapter and are inconsistent — they are either listed chronologically or alphabetically, and with or without full pagination. Most chapters have a conclusion but one has an abstract and three others end abruptly. The quality of the figures varies from generally good to very poor (e.g. Figure 9.1).

In view of the plethora of books currently being published on biological invasions, and considering the reservations made earlier, the obvious question is: should one buy this book? There is a great need to convince both the public and politicians that introduced organisms are a serious cause for concern world-wide, and this book highlights the problems humanity faces in relation to the impacts and costs of biological invasions by providing a wide array of examples. It also conveys the message that, unless action is taken to deal with established invaders and prevent the introductions of more organisms with potential to cause havoc, the economic and social costs will become prohibitive. On that basis this tome is recommended, but its high cost will preclude it from having a large audience.

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SONORAN DESERT INVASIONS UNDER THE SPOTLIGHT

Tellman, Barbara (ed.) (2002). *Invasive exotic species in the Sonoran Region*. The University of Arizona Press and The Arizona-Sonoran Desert Museum, Tucson, Arizona, U.S.A. xxvi+424 pp., figs, line drawings, tables, glossary, appendices,

index. Hardcover: Price: \$75.00 (Available from <http://www.uapress.arizona.edu>). ISBN 0-8165-2178-6.

Deserts, like tropical forests and savannas, have lagged behind other biomes in suffering severe impacts from rampant alien species. Several reviews have shown deserts to be among the least-invaded systems worldwide, at least in terms of the number of naturalized and invasive species (e.g. Lonsdale, 1999). Ecologists are divided on whether this means that deserts are inherently less susceptible to invasions than other systems, or whether the pattern simply reflects the greater number of introductions to other biomes that are generally more amenable to, and more modified by, humans. The number of widespread and hugely damaging invasions in arid areas throughout the world has increased rapidly over the past few decades. For example, several species of alien grasses have spread rapidly over large areas in the deserts of western North America. *Pennisetum ciliare* (buffelgrass) has invaded large parts of the Sonoran Desert, changing fuel properties and causing more-frequent and larger wildfires, decreasing water infiltration to the soil and changing nutrient-cycling regimes. Such changes threaten to eliminate many native plant species, converting these desert shrublands to alien-dominated, fire-driven grasslands. Such invasions are forcing ecologists to look more closely at the dynamics of introduced species in arid systems.

This book, the product of a 1998 symposium in Tucson, provides the first detailed account of biological invasions in any desert region. It deals with North America's Sonoran Region which includes the Gulf of California coast and its islands; the low desert, desert uplands and grasslands of southern and central Arizona, northern Sonora, south-eastern California and Baja California in Mexico; and the lower Colorado River through the Grand Canyon.

The first four chapters provide a 'broad perspective': van Devender describes the 'deep history of immigration' in the region, Tellman discusses the history of introductions, McLaughlin compares the Sonoran Region with the rest of the Western USA with respect to invasions, and Mack gives a general account of natural barriers to naturalization and invasion. These contributions provide an excellent background, by clearly

showing how changing physical conditions, notably due to fire management, dam construction and overgrazing in the twentieth century, have paved the way for the naturalization and invasion of a rapidly increasing number of introduced species. Tellman's selection of case studies (*Erodium cicutarium*, *Apis mellifera*, *Cynodon dactylon*, *Sorghum halapense*, *Ailanthus altissima*, *Tamarix ramosissima*, *Passer domesticus*, *Sturnus vulgaris*, *Salsola tragus*, *Alhagi maurorum*, *Salmo* spp. and *Rana catesbeiana*) is excellent for demonstrating the many interacting factors that have sown the seeds of the problems that the region now faces with invasive aliens.

Part 2 of the book has nine chapters grouped under the heading 'Exotics in various areas of the Sonoran Region'. Special attention is given to the Central Gulf Coast and the Gulf Islands, Sonoran desert thornscrub, grasslands and riparian areas. The nine chapters in this section provide a solid review of the status of invasive aliens in the region. There is, however, surprisingly little quantitative data on distribution patterns or species–environment interactions.

Part 3 of the book is devoted to management and includes an account of the USDA's Plant Protection and Quarantine Program to exclude foreign pest species, a history of biological control of alien plants, and a detailed account of management strategies for *Pennisetum ciliare* in Arizona's Organ Pipe National Monument.

There are three useful appendices providing a list of laws, agreements and executive orders dealing with exotic species, and checklists of naturalized plant and animal species. I would have liked to see some criteria for inclusion of species in these lists and some attempt to classify species according to their status as aliens.

This is a timely summary of what is known about biological invasions in one of the world's best-studied desert regions. The problems are getting much worse very quickly, and scenarios for further invasions, especially with climate change, are dire. Hopefully this book will help to raise awareness of the severity of the problems and focus research efforts.

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REFERENCE

- Lonsdale, W.M. (1999) Global patterns of plant invasions and the concept of invasibility. *Ecology* **80**, 1522–1536.

A PLANT MANUAL FOR THE CALIFORNIA DESERTS

- Baldwin, B.G. *et al.* (eds) 2002 *The Jepson desert manual: vascular plant of southeastern California*. University of California Press, Berkeley, USA. xiv + 626 pp., tables, line diagrams, halftones, colour plates, glossary and index. Paperback: Price £24.95 \$35.00. ISBN 0-520-22775-1.

The Jepson desert manual is the first in a series of more compact guidebooks to be distilled from the much larger *The Jepson manual: higher plants of California* (1993). As its title suggests, this new guidebook is focused on the plants that grow in the southern Great Basin, the Mojave Desert, and the Sonoran Desert regions of California, regions that do not fall within the California Floristic Province, with its distinct Mediterranean climatic regime. It does not, however, contain information on the desert plants of the Modoc Plateau of the northern Great Basin. This book follows the original 1993 manual in style and abbreviations, including the use of geographical regions rather than counties to describe where a plant occurs. This was an innovation that has been both a blessing and a curse, for although the regions are more meaningful geographically, sometimes the regions are so broad that one is not quite sure where a species occurs exactly (and one goes back to previous floras to see if it occurs in a particular county).

Although designed as a more compact guidebook, this is definitely not a book for beginning botanists. It is a taxonomic work with identification keys and scientific descriptions of species; and names are not emphasized. However, the addition of 300 new illustrations and 130 photographs not included in *The Jepson manual*, will help beginners gain an entry point to the book. In addition, following the philosophy of the original *Jepson Manual* (and the glossary of that book), the terminology is not as dense as that found in Munz and Keck's (1974) *A flora of southern California*. The point of this book is to

be inclusive of all desert species (except typical California Floristic Province species that happen to spill over in a few places), to provide keys to the species, and to provide descriptions. It is not meant to replace picture books of a more informal nature that specialize in a narrower geographical range such as Knute's *Plants of the East Mojave* and Stark's *A flower-watcher's guide to wildflowers of the western Mojave Desert*.

The guiding influence for this particular effort was Bruce Baldwin, Jepson Curator at the University of California, Berkeley, who as lead editor saw this project to completion. He made numerous plant-collecting trips to the deserts of California to increase his knowledge of particular plant species and their distributions, therefore adding information not available in *The Jepson Manual*. The addition of flowering times to the species descriptions is a very welcome change, for instance. Baldwin also added interesting new chapters on the history and floristic diversity of the Californian deserts. Much of the information in this book is exactly the same as in *The Jepson*

Manual. The 'up side' of this decision is that this book is compatible with the original work in terms of nomenclature, symbols, and abbreviations — something that many Californian botanists will appreciate. The down side is that some changes that should have been made, such as updating the information on species rarity, were not made. The decision to leave the nomenclature 'as is', despite the marked changes that have been proposed in families and genera will probably be welcomed by most Californians. The editors do provide information on new names for some species at the end of the species treatments; this is a compromise most of us can live with.

All in all, this book is a wonderful addition to current floras and will be added to the library of most Californian desert explorers.

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