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A continent invaded

Invasion Biology and Ecological Theory: Insights from a Continent in Transformation. Herbert H. T. Prins & Iain J. Gordon (editors), 2014, Cambridge University Press. 540 pp. £65.00 (hardback) ISBN 9781107035812; http://www.cambridge.org/

There is little doubt that Invasion Biology has come of age. Look inside any volume of your favourite ecological journal and you will find studies of the dynamics and impacts of alien and invasive species. Entire research laboratories focus their research specifically on mitigating the problems caused by invasive pests, weeds and pathogens. As well as preventing new invasions, there has always been considerable ecological insight gained from studying the behaviour of alien species in novel recipient communities and environments. Australia has an illustrious (perhaps nefarious) history of biological invasions and (as any international visitor knows) now boasts one of the most enviable quarantine and biosecurity enforcement programs in the world.

In this book, the editors return to the foundations of ecological theory and examine our current understanding of invasion biology through a series of 11 hypotheses (or insights). Together, these 11 hypotheses provide a reference to the fundamental ideas behind invasion biology as a discipline. In each of the empirical chapters the authors have been asked to evaluate the support for these hypotheses, from their own examples and perspectives. The book draws its examples unashamedly, and exclusively, from Australia, and is divided into two discrete sections. The first section 'Ancient invaders' considers (mostly) the pre-human biotic invasion of Gondwanan Australia, while the second 'Modern invaders' deals with human-mediated introductions. There is no obvious link developed between the two sections, other than that invasions (whatever their flavour) may be expected to share certain ecological commonalities.

The editors claim that 'The book is quite simply organised'. Yet, they have made little attempt to explain why we are reading about any of the particular species (or clades) included in the book, or to explain the order in which the chapters are grouped. The majority of the chapters are terrestrial, with a great predominance of mammal and bird studies; from the diverse Meliphagid honeyeaters and endemic Australian parrots to Charadriiforme waders. Bird invasions have attracted considerable scientific research effort (Blackburn et al. 2009). Nevertheless, I was surprised by the large number and variety of avian examples included in the book, at the expense of many other taxa. Two particularly interesting chapters consider migratory tendency in birds; an important trait linked to the success of natural colonisation, and the failure of human-assisted translocations.

Australia is popularly known for its marsupials, which arrived in the Australian part of the southern supercontinent Gondwana around 65 Mya and then underwent a spectacular evolutionary radiation that led to seven orders and at least 31 families. Less well-known, I suspect, are the invasion histories of the murine rodents and pteropodid bats, also included in this book. The single aquatic (marine mammal) example is the phylogeography of sirenians, and the invasion of the dugong (*Dugong dugon*) into Northern (tropical) Australia at the transition of the Oligocene to the Miocene (about 25 Mya) following the arrival (invasion) of its tropical food source, seagrass. Plants are further considered through comparisons of the ancient (and modern) invasion of species in the flowering Clade Mimosoideae, and a single chapter on the modern global invasions of Australian *Eucalyptus*, *Acacia* and *Casuarina* species, and *Melaleuca quinquenervia,* outside of Australia.

Two chapters on Australia's geological and climatic history provide a good reference to the tectonic movement and changing climates of Australia. I found it disappointing, however, that the definitions for these stages of invasion were framed (in one case) around Australia's mammal fauna and not more generally across a broader set of flora and fauna. I was also unsure why these defining chapters were not placed before the

'Ancient invaders' section as a geological reference point. Regardless, they were unfortunately unaccompanied by any similar attempt to describe the fascinating sociological history and contemporary processes driving the next stage of invasion, the 'Modern invaders'.

Prior to humans, murine rodents were the most successful placental mammal invasion of Australia but with European arrival new (alien) pest and weed species were introduced in great numbers. It is probably unsurprising that the final (three) chapters of the book are dedicated to a series of charismatic single species mammalian pests (the Australian dingo, *Canis dingo;* European rabbit, *Oryctolagus cuniculus;* Asian water buffalo, *Bubalus bubalis*). Indeed, the Invasive Animals Cooperative Research Centre (in subtly different guises) is one of the longest running Commonwealth Government funded Centres of its type, and is almost entirely focussed on combatting the agricultural and environmental damage caused by a handful of well-established vertebrate pest species (so-called 'key threatening processes'), of which the European rabbit – aptly proposed in the book as 'Australia's worst mammalian invader' – is one.

The eclectic collection of chapters (both 'Ancient' and 'Modern'), and the uncertain mix of single-species accounts interspersed among clade comparisons, mean that despite the editors' best efforts to organise and thematically coordinate the material, this is a difficult book to read from cover to cover. It is not a reference text, and it is unlikely to be widely recommended to ecology students. Yet I found much to learn and enjoy from reading the entire book. Many of the chapters synthesise interesting concepts and contain novel information. Unfortunately, despite an extremely entertaining yet circumspect final critique chapter, I was unconvinced by the dictatorial administering of (and frequently very weak attempt to test) the 11 hypotheses throughout. The original intent, and reasoning, was admirable but, as the editors themselves acknowledge, many of these older ecological hypotheses are well worn. Inspiration is drawn from Charles Darwin, Karl Popper, and John Lawton, and ultimately the editors side with Mark Williamson who 15 years ago wrote that 'predicting the ecological behaviour of a species in a new environment may be effectively impossible' (Williamson, 1999).

It is my own personal belief that we should have already learnt from the vast volumes produced by the Scientific Committee on Problems of the Environment (SCOPE) program on the ecology of biological invasions over two decades ago, that testing conceptual hypotheses using series-upon-series of anecdotal examples is quite frankly doomed. Modern invasion biology is a quantitative multi-disciplinary research field, which drives biosecurity risk management and preparedness. Precautionary it might still be, but predictive it must certainly become.

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