

An Invasions Special Issue

Michael E. Hochberg¹ and Nicholas J. Gotelli²

¹Génétique et Environnement, ISEM – Université Montpellier II, Place Eugène Bataillon, CC 065, 34095 Montpellier Cedex 5, France

²Department of Biology, University of Vermont, Burlington, VT 05405-0086, USA

'Invasion' evokes images of non-native species wreaking havoc on peaceful ecosystems. Certainly, there are horror stories of 'invasional meltdown' [1], but there are also quantitative studies that have demonstrated no measurable effect of invaders on native species [2]. There is a prejudice, somewhat merited, in science that invasions are bad.

From a wide range of disciplines, this special issue of *TREE* brings together eight articles with 'invasion' as their focus, ranging from the invasion of communities, to species, genes, and even cultures. Some and possibly most invasions are destructive to some extent, but others can be viewed more positively. For example, the introgression of genes from one natural population to another might be a major force in adaptive evolution and diversification. We intend that this special issue should encourage greater interest in the range of topics covered and lead to increased recognition of the commonalities between, and specificities among, them.

Although invasions are as old as life itself (as discussed by Conrad Labandeira), when discussing 'invasion', most biologists think of contemporary biological invasions, particularly the role of humans in accelerating the introduction rate of non-native species into new environments. International trade is a significant instigator of invasions, but there is little consensus on how to curb future introductions of non-native species. Charles Perrings *et al.* argue that importers and exporters must be given incentives to curb the risk of invasions. However, governmental organizations still need a way of identifying which species are likely to be of concern. Until now, most governments have assumed that new introductions will be benign unless proven otherwise, but this is a dangerous assumption, as Daniel Simberloff emphasizes. He suggests governments should adopt the precautionary principle, in which precautionary measures are taken if there is good reason to believe an introduction will be destructive.

Even though the consequences of species introductions are potentially serious, most introductions have not developed into full-scale biological invasions. A major push in invasion biology lies in understanding what kinds of adaptation an invading population needs to establish successfully in a possibly hostile environment. Case histories of successful biological invasions do not reveal a clear-cut set of species traits, perhaps because humans might be the main drivers of biological invasions, through persistent, repeated introductions. Here, Julie Lockwood *et al.* emphasize that 'propagule pressure' is likely to be a key reliable predictor of invasion success. By tackling the economic and policy issues surrounding invasions

seriously, there is no reason why the number of introductions, and thus the potential for future invasions, cannot be reduced.

Biological invasions can also have consequences for human health, the most serious being emerging infectious diseases. Mark Woolhouse *et al.* argue that novel pathogens have features in common and that these should be used as risk factors in their prevention. However, many invasions involve not only species but also their genes, and, through hybridization and subsequent introgression, endemic species might be altered by invasive relatives. In the arena of transgenic crops in particular, these issues are politically explosive. Rosie Hails and Kate Morley examine justified concerns that genetically modified genes might become established in native species, and emphasize that evolutionary, genetic and ecological measures will be necessary elements of any risk assessment programme.

When considering these issues, we should be careful. James Mallet warns against adopting the common view that hybridization is always unnatural and usually the consequence of anthropogenic environmental disturbance. He presents compelling evidence that hybridization and introgression are a major force in adaptive evolution.

Invasion is not only a hallmark of genetic evolution, but also of cultural evolution. William Wang and James Minett explore the parallels between biological invasions in natural communities with language invasions in human societies. Since their origin, languages periodically come into contact, resulting in processes that can be considered analogous to gene introgression and species invasion. These processes have traditionally led to language change and, occasionally, to loss. However, with the increased size of the human global community, many extant languages are under unprecedented threat of extinction.

Invasions are emerging as an interdisciplinary science, although the desire to turn invasion biology into a predictive science might be illusory. This is not to say that we should treat invasions uniquely on a case-by-case basis, but rather that invasions integrate large-scale ecology and evolutionary biology in a human-dominated world; thus, the complexities of invasion biology call for a range of interacting theories and approaches. Invasions, be they of communities, species, genes or cultures, have not rained down on us from another planet, but are sometimes a feature of life itself.

References

- 1 Simberloff, D.S. and Von Holle, B. (1999) Positive interactions of non-indigenous species: invasional meltdown? *Biol. Inv.* 1, 21–32
- 2 Farnsworth, E.J. (2004) Patterns of plant invasions at sites with rare plant species throughout New England. *Rhodora* 106, 97–117

Corresponding authors: Hochberg, M.E. (hoch@isem.univ-montp2.fr),

Gotelli, N.J. (ngotelli@zoo.uvm.edu).

Available online 25 March 2005