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Invasive species: reality or myth?

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Abstract In view of the recent debate on the future of invasion biology, we argue that species could be regarded as invasive only when after adaptation in non-native habitats they reach yet another fitness maximum. We suggest that invasion biologists need to unambiguously clarify what constitutes being "invasive" to refute those who call for an end to invasion biology.

Keywords Invasion biology · Invasive species

The recent, rather acrimonious debate on invasive biology (Thomas 2013; Simberloff and Piero 2013; Richardson and Rcciardi 2013; Valéry et al. 2013; Blondel et al. 2013) has set us thinking, not least about who is right, but about the appropriateness or otherwise of using the adjective "invasive". Our difficulty arises from a basic consideration, and that is, every species on this planet has evolved into a specific habitat through the course of its evolution. This habitat, often referred as the "ecological niche", is where the fitness of the species is maximised. Outside of this niche, the fitness of the species is severely compromised. Thus everything else remaining constant, movement of species outside of its niche is likely to be strongly selected against. It is therefore unlikely that any species can actually "invade" a niche or habitat to which it is not evolved into. And therein lies the myth of "invasive" species.

(Hutchinson 1957, 1978), an important protagonist of the ecological niche theory, argued that for every species, only a fraction of its potential niche is ever realised (this is

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called the realized niche); thus for camels that have evolved, in say, the Thar desert of India, though other deserts of the tropical world might be potentially suitable, they are not realized. However for some reasons, natural or man-mediated, if the Indian camels were to move into the sub-Saharan desert or the Negev desert, it is likely that these would take to it, like fish to water. Because, by doing so, all they are doing is expanding their ecological niche from the Indian deserts to the other deserts. Qualitatively their niche characteristics remain unchanged and so do their fitness. Under this hypothetical scenario, Indian camels in the African desert or the Negev desert could hardly be called "invasive". Or for the matter, African desert or the Negev desert, could hardly be called as "non-native" habitats for the Indian camels.

There is only one condition where species could be regarded as "invasive" into a "non-native habitat"—that is when they have adapted into the new habitat and reached yet another fitness maximum. But by doing so, they are playing a Schrodinger's cat. The state of the original species has changed and so have the rules. Thus here again it appears that under the strict framework of the ecological niche theory, no species can be "invasive".

In summary, while the future of invasion biology is debated, it would serve well for invasion biologists to ponder about some basics of what constitutes being "invasive".

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