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OPINION[1]

Are the risks of conservation introduction worth taking?

Climate change alters the environmental conditions and the interactions at all ecological levels. Its negative effects on species survival have stimulated scientists and environmentalists to propose novel strategies for saving biodiversity elements from extinction. Focusing on species living in unique or sparsely isolated habitats threatened by climate change, Thomas (2011) suggested that those species should be introduced into areas outside of their native range, if those areas lack endemic species of their own, or if their endemics are specialists with different environmental requirements. He justifies his proposal based on (1) the fact that, in the past, people introduced a myriad of species throughout the world and will continue doing so in the future, for economic exploitation, (2) the urgent need for action in some cases, and (3) the assumption that an increase in species richness (even human-induced) is beneficial. The last is an ecological oversimplification that hides many dangers. We concur with him that climate change is a potentially serious threat to species that are endemic to narrow ranges, but we also highlight that the proposed strategy, named "conservation introduction", is only recommended as the last management option by the IUCN Re-Introduction Specialist Group (2002). We advocate that past mistakes should not be used to justify premature and risky actions in the name of conservation, and warn that biodiversity responses to climate change are still poorly understood (Ricciardi & Simberloff 2009, McMahon *et al.* 2011), and that habitat patches immersed in an inhospitable matrix in cultural landscapes are functionally islands. Thomas' (2011) contribution also fails in providing a definition of "broad geographic region" and an analysis of the trade-offs between investing money on habitat protection *vs.* assisted colonization. Finally, we caution that focusing on the threatened species rather than the prospective recipient communities is a mistake. It is akin to focusing on the individual rather than the population, a well-established paradigm in conservation biology.

Alien species are a major cause of biodiversity loss. They may act as predators, herbivores, competitors, disease agents, vectors or hosts. Furthermore, in some instances, they hybridize with native relatives, among other undesirable consequences (IUCN/SSC Invasive Species Specialist Group 2000, Matthews *et al.* 2005, Ricciardi & Simberloff 2009). The deliberate release of alien species by conservation introduction carries risks similar to those resulting from accidental introductions, because there is no reliable way of assessing how the new species will interact with the native taxa, and whether (and when) they will become invasive (Sol 2007, Ricciardi & Simberloff 2009). There are countless examples of the destructive power of alien, especially invasive, species on native taxa. These examples allow us to paraphrase Janzen (1974): "The most insidious kind of introduction is the introduction of ecological interactions". Thomas (2011) fails to acknowledge that these risks are particularly relevant to species that have evolved in isolation (IUCN/SSC Invasive Species Specialist Group 2000). Such species are likely components of the prospective recipient communities of the so-called, specialized, climate change "refugees". Furthermore, those habitats considered suitable for introduction will necessarily share most traits with the endangered, original habitat. Therefore, the recipient community and its respective habitat will likely contain their own endemic taxa and may also be subjected to similar climate changes.

The release of alien micro and macroparasites that may be pathogenic to taxa in the destination range (Anderson *et al.* 2004, Breed *et al.* 2009, Ricciardi & Simberloff 2009) is a critical hidden danger of assisted colonization, which has been ignored by Thomas (2011) and other authors (McLachlan *et al.* 2007, Seddon 2010). Micro and macroparasites represent a poorly known portion of the world's biodiversity, and assessing the outcomes of their introduction is a complex and difficult task. The risk that conservation introduction will promote the emergence and spread of infectious diseases to both wildlife and humans is real, and needs to be taken seriously.

Although Thomas (2011) appropriately recognizes some limitations for putting his strategy into practice, he urges the development of a 'shopping list' of potential target species, so that management decisions are made as soon as possible. We advise that extreme care and responsibility shall be exercised to avoid that each species released becomes an ecological Pandora's box for the destination communities. Opening this box is likely to increase, rather than decrease, the list of globally threatened taxa in the long-term.

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