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Editor's choice: Unintended trophic cascades from feral cat eradication

D. Bergstrom, K. Kiefer, A. Lucieer, J. Wasley, L. Belbin, T. Pedersen & S. Chown (2009) Indirect effects of invasive species removal devastate World Heritage island. *Journal of Applied Ecology*, **46**, 73–81.

Island ecosystems hold a special place in the biological invasions literature. Islands both experience the greatest impacts from the invasion of non-indigenous species as well as being at the forefront of efforts to eradicate problematic species and mitigate negative impacts. Joseph Dalton Hooker was one of the first to comment on the fact that island biota seem to readily give way to non-indigenous species (Hooker 1867), and this is a pattern repeatedly observed (e.g. Lonsdale 1999). Not only do islands appear more susceptible to invasions than mainland ecosystems, they are also more likely to result in species extinctions (Fritts & Rodda 1998; Sax & Gaines 2008) and changes to ecosystem processes (Fukami *et al*. 2006). Given such delicate ecosystems, and the fact that there are celebrated classic examples of successful control of non-indigenous species (e.g. Groves 1989; Huffaker 1951), islands are often the target of intensive eradication measures.

For this issue's Editor's Choice selection, Bergstrom *et al.* (2008) elegantly study the habitat and ecosystem consequences from the eradication of feral cats from Macquarie Island, a subantarctic island and a World Heritage site administered by the state of Tasmania, Australia. Both cats and rabbits were introduced to Macquarie Island in the 19th century and prey-switching from rabbits to native birds by cats resulted in drastic declines in seabird populations, probably causing two extinctions. Since available evidence indicated that cats had a detrimental effect on island life, a cat eradication programme began in 1985 with the last cat killed in 2000. The authors recognized that the feral cats had become fully ingrained in the island food web, and hypothesized that cat eradication could result in complex and potentially unanticipated cascades. This study is a wonderful example of utilizing multiple sources of data across spatial scales to assess the consequences of cat removal. The authors show that despite the introduction of the *Myxoma* virus prior to the cat eradication, rabbit populations exploded in size after the cat removal. As a result of the increased rabbit density, vegetation composition changed after the cat removal. The authors sampled plots before and after the eradication and found that vegetation in these plots shifted from large, long-lived plants to smaller, faster-growing species, some of which are themselves non-indigenous to the island. Finally, the authors were able to scale up the rabbit-induced vegetation change using satellite images taken before and after the eradication. This imagery revealed that more than one-third of the island has since undergone vegetation change, resulting in large-scale habitat alterations.

The results of this research from Bergstrom *et al*. reveal that the consequences of species eradication may be complex with unintended results. Non-indigenous predators and mesopredators can become important components of island food webs – so important that their subsequent removal can have repercussions felt throughout the entire food web (e.g. Courchamp & Caut 2006; Roemer *et al*. 2002). While trying to protect seabird populations is undoubtedly worthy of management action (including eradication programmes), adequately predicting ecosystem-level consequences should be the basis directing such activities. Because of ongoing problems with non-indigenous species on Macquarie Island, especially from high rabbit densities, the Australian government has committed AU$24 million for further management efforts. Such costs are an unintended risk associated with species eradication, and this paper should serve as a call to explicitly consider and plan for potential cascading effects of non-indigenous species removal. Planning for such management activities must include information gained through ecological modelling and experimentation, as well as natural history. By using all available tools and knowledge, management activities can have a better chance of succeeding and the probability of harmful unintended consequences can be minimized.

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