



Prioritizing rat eradication on islands by cost and effectiveness to protect nesting seabirds

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ABSTRACT

To prioritize conservation actions on Italian islands we used the case study of the eradication of the Black rat *Rattus rattus* to protect Cory's shearwater *Calonectris diomedea* and Yelkouan shearwater *Puffinus yelkouan*. We evaluated for each island the effectiveness of rat eradication by means of two different indices, both based on the relative importance of the island's nesting population of the two species at the national and regional scale, but differing in the parameters set at the divisor, i.e., respectively, the number of nesting pairs in rat-free islands and the number of islands occupied by shearwaters. We estimated analytically the monetary costs of rat eradication on each island. Islands at high risk of recolonization were excluded from further analyses, while costs and effectiveness of rat eradication were compared for the remaining islands. Rat eradication was most cost-effectively carried out on the island hosting the largest colony of *P. yelkouan*. Eradicating rats from all the islands in the ranking provided benefits to 63.9% of the Italian population of *P. yelkouan*, but only to 7.1% of that of *C. diomedea*. Comparing costs and effectiveness of all possible island combinations, ranging from a minimum budget of 50,000 € and a maximum of 1600,000 € (i.e. the cost for eradicating rats from all the listed islands), the maximum increase in effectiveness (marginal effectiveness) fell around a relatively small budget (200,000 €). For both species, when adopting the cost/effectiveness rankings, the number of pairs protected for 1000 € of investment was significantly higher than adopting rankings of effectiveness alone, demonstrating that conservation priorities are more efficiently identified by including monetary costs in the analysis.

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1. Introduction

The detrimental impact that alien species may have on native ecosystems has been well documented in the last decades. Island ecosystems are especially prone to the negative consequences of introductions (e.g. Manne et al., 1999; Baillie et al., 2004), the main reasons being the following: (i) in the new habitat alien species often lack natural predators, pathogens and parasites (Settle and Wilson, 1990; Shea and Chesson, 2002); (ii) specific population processes occur on islands, where, due to limitation of dispersion, an increase in the number of individuals implies automatically an increase of density (Courchamp et al., 2003); (iii) high isolation implies higher probabilities that endemic taxa are present (Duncan and Blackburn, 2004); (iv) the absence of native predators may have not allowed the evolution in endemic taxa of predator-escape responses, making them easier preys of incoming predators (e.g. Roff, 1994; Atkinson, 2001; Duncan and Blackburn, 2004).

On the other hand, natural isolation makes islands ideal places for implementing eradication programmes. In last decades, the restoration of island ecosystems by the removal of alien predators has become a reality, and a large number of eradication programmes have been worldwide put into effects. However, as the implementation of the control strategy can be quite demanding in terms of monetary costs, restoration programmes in the various islands are inevitably in competition for the same limited monetary budget. Therefore, strict criteria are needed to select islands in which eradication of alien species are worth being carried out, and prioritizing the actions can be a useful guide for managers, conservationists and politicians (Wilson et al., 2006, 2009; Pressey et al., 2007; Howald et al., 2007; Jones et al., 2008). Among others, the need for prioritizing actions against alien species has been also stated by the European Union (e.g. Genovesi and Shine, 2003).

There are many studies that deal with methods for priority-setting, but very few include the costs of the actions, and most only rely on ecological benefits achievable. However, the idea that the failure to consider economic costs reflects in a loss of efficiency of the investments is now gaining credit (Choquenot and Hone, 2002; Naidoo et al., 2006; Murdoch et al., 2007). This is especially

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