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Advances in modelling projections for reintroduced populations

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Summary

The use of predictive modelling to plan reintroductions and manage reintroduced populations has increased steadily since the mid-1990s, with Australia and New Zealand at the forefront. We overview the types of models commonly used for species reintroductions, focusing on Australian and New Zealand examples. Site selection, release strategies (e.g. number, composition and timing), population viability and management impacts are the key issues often investigated. We discuss how to deal with uncertainties associated with parameter estimation, stochasticity, model selection, integrating modelling approaches and decision making. Finally, we highlight three promising modelling approaches for planning species reintroductions and modelling reintroduced populations: decision theory and optimisation, individual-based modelling and Bayesian hierarchical modelling.

Introduction

Seddon *et al*. (2007) identified that, although modelling is becoming more popular, most published papers in the reintroduction biology literature make little to no mention of quantitative models. Yet, species reintroduction is a costly intervention with low success rates (Griffith *et al*. 1989; Fischer and Lindenmayer 2000; Godefroid *et al*. 2011). One way to reduce the risk of failure is to use predictive modelling as a tool for planning and intervention. Predictive modelling is an umbrella term for many kinds of models. It refers to statistical models, where relationships between variables are estimated statistically, and more complex models that combine multiple processes. An example of the first type of predictive model is a habitat suitability model, where landscape features of sites occupied by a species are used to derive a statistical relationship between probability of species presence and landscape characteristics, and this relationship is then used to predict the suitability elsewhere (Elith and Leathwick 2009). Another type of predictive model is a population model, in which models for survival, reproduction, and sometimes dispersal, are combined to predict the dynamics of a population. Of course, statistical models are often integrated into more complex models: for example, where statistical relationships for vital rates (survival and reproduction) are incorporated into population models (see 'Combining modelling approaches').