Science for Saving Species

Research findings factsheet

Project 4.2.3

Threatened Species Recovery Hub

National Environmental Science Programme

Resurrecting the Macquarie Island red-crowned parakeet

In brief

Macquarie Island, an Australian sub-Antarctic island, has undergone successful eradication of multiple invasive mammals, including predators that drove the extinction of the endemic Macquarie Island red-crowned parakeet in the 1880s. This study examined replacing the extinct parakeet species with a closely related surviving species.

Four other species of red-crowned parakeets occur on New Zealand islands that are geographically close and environmentally similar to Macquarie Island.

We aimed to determine which sister species may be most suitable for an introduction, restoring roles in the ecosystems that disappeared when the species went extinct.

We developed a new decision framework, which can overcome the issue of not knowing which factors, such as climate and vegetation type, will be of greatest importance in determining suitability, by considering a range of scenarios.

Applying this framework consistently identified the Antipodes Island red-crowned parakeet (Reischek's parakeet) as the most suitable species for the introduction to Macquarie Island. This allows any future assessment to focus on this species.

An additional benefit is that the introduction offers the opportunity to create an insurance population for Reischek's parakeet, which occurs on only one small island. Our decision framework will be of use to others pursuing restorative island restoration.

Red-crowned parakeet Cyanoramphus. n. novaezelandiae, *Enderby Island. Image: Aleks Terauds*

Megaherbs (Pleurophyllum hookeri) *on Macquarie Island. image: Justine Shaw*

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Australian Antarctic Program

Coastal habitat on Macquarie Island. Image: Justine Shaw

Background

Reintroducing species to islands, or introducing species to islands as havens, are topics attracting much conservation interest and effort. These introductions, which involve people intentionally moving a species outside its natural range to achieve conservation goals, are becoming an increasingly relevant strategy to help restore, maintain and protect biodiversity in a rapidly changing world. Island species are among the most threatened globally, and present particular opportunities and challenges for such strategies.

Macquarie Island, a sub-Antarctic World Heritage Site and Tasmanian Nature Reserve, has recently undergone a major conservation restoration. Invasion by several vertebrates, including rats, Weka (*Gallirallus australis*), mice, rabbits and cats had caused devastating impacts on vegetation and predation on native species.

These invasive predators contributed to the extinctions not only of the Macquarie Island red-crowned parakeet (*Cyanoramphus novaezelandiae erythortis*) in the 1800s but also the Macquarie Island buff-banded rail (*Gallirallus philippensis macquariensis*). Cat eradication was declared a success in 2002, and a program to eradicate rabbits, rats and mice was declared successful in 2014. The island is now officially free of invasive mammals.

Given this success, there is now an opportunity to focus on further restoration, including bringing one of the closely related extant red-crowned parakeet species to Macquarie Island. Natural colonisation is unlikely in the foreseeable future due to the extreme isolation of the island.

In the case of the Macquarie Island red-crowned parakeet, there are multiple closely related extant species. *Cyanoramphus* parakeets are naturally distributed throughout New Zealand and on many offshore and sub-Antarctic islands. They are separated by crown colour, with the extinct Macquarie Island parakeet belonging to the red-crowned clade, or group, of species. The remaining four populations from this clade occur on islands that are geographically close or environmentally similar to Macquarie Island: *C. n. novaezelandiae* on the Auckland Islands and Stewart Island; Reischek's parakeet (*C. hotchstetteri*) on Antipodes Island; and *C. n. chathamensis* on the Chatham Islands (see Figure 1). Given this array of related species, how do we determine which would provide the best potential source population for a conservation reintroduction to Macquarie Island?

Research aims

We aimed to determine how to choose the best sister species as a source population for translocation to Macquarie Island to replace the Macquarie Island parakeet.

Proactively introducing a closely related species may have multiple benefits. First, it may enhance the island's ecosystems and values, through the parakeets' role in seed dispersal, which would help with island. Second, it may provide an additional insurance population for the chosen species.

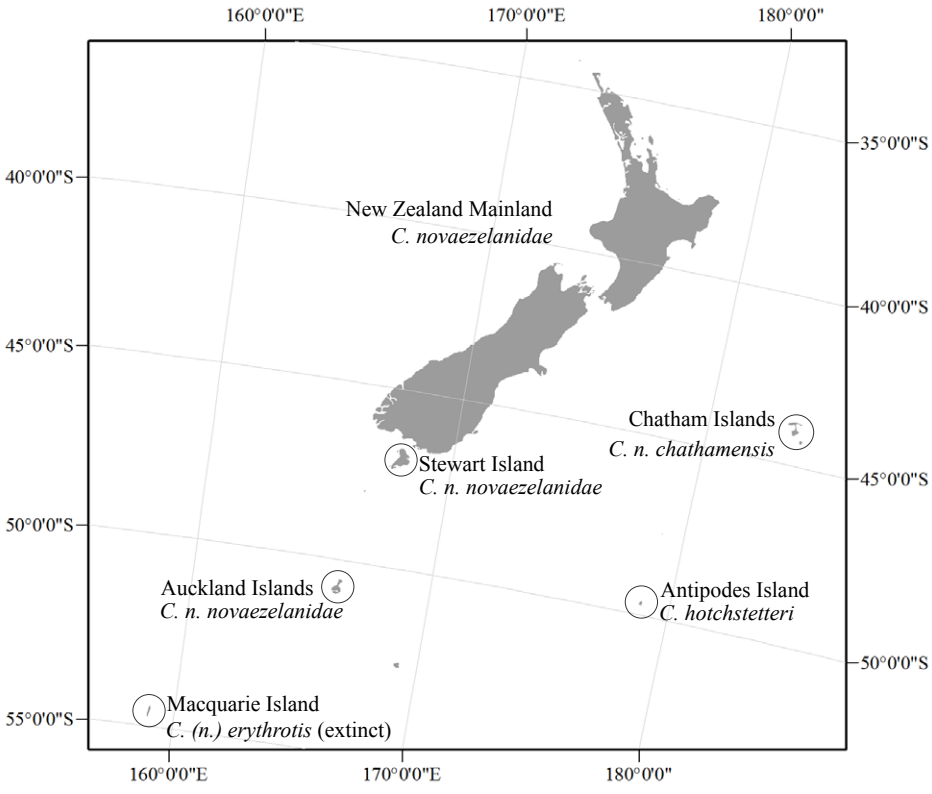

Figure 1. New Zealand and surrounding islands, showing populations of the red-crowned clade of parakeets, Cyanoramphus novaezelandiae. *The mainland population is presumed extinct.*

What we did

To determine the relative suitability of all closely related red-crowned parakeets for introduction to Macquarie Island, we undertook structured decision-making, using a systematic four-step process:

1. Identify the suite of potential source populations
2. Identify attributes that can be used to choose among the possible source populations
3. Weight these attributes according to which are likely to be the most important to source population survival on Macquarie Island.
4. Rank the suitability of the sources by summing the attribute values by the attribute weights for each.

First, we gathered information about the populations of red-crowned parakeets on neighbouring islands and quantified various habitat variables (listed below) to see which habitats were most similar to Macquarie Island.

Because we don't know whether certain habitat variables are more important to the parakeets than others, we iteratively weighted different variables to see if different source populations performed better when different variables were weighted highly.

The six variables we chose were (1) beta diversity, that is, the similarity of vegetation between the two islands; (2) maximum temperature; (3) minimum temperature; (4) rainfall; (5) tree presence; and (6) distance to Macquarie Island. To weight the relative importance of attributes, we ran six analysis iterations. In each, we chose one attribute, weighted it as x times more important than the others, combined attribute values with these weights, and determined which source population was the most suitable. We then repeated the process for values of x of 2, 4, 6 and 8 (see Figure 2).

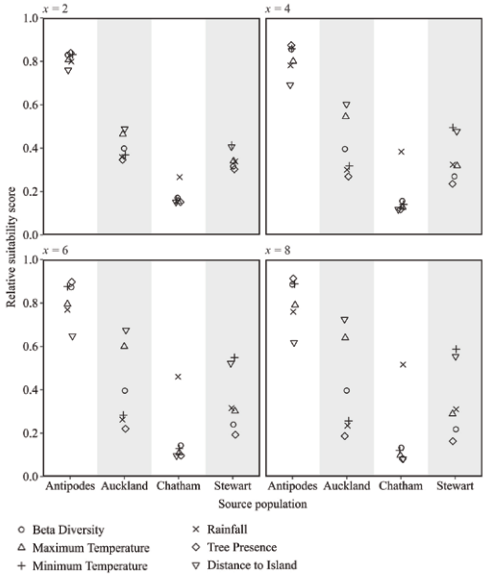

Figure 2. Relative suitability scores of four potential source populations of Cyanoramphus species parakeets being considered for a conservation introduction to Macquarie Island. The higher the score, the greater the suitability for translocation between that source and Macquarie Island, relative to other sources. As it is unknown which of the variables considered will be of most importance in determining suitability, we ran scenarios with attributes weighted differently – symbols indicate which attribute was weighted as x times (2, 4, 6 or 8) more important in that iteration.

Key findings

In this project, we developed a new decision framework for choosing the most appropriate source population to replace an extinct species on an island. This novel framework determined that the species that lives on Antipodes Island, Reischek's parakeet, consistently performed as the most suitable choice for an introduction to Macquarie Island to replace the extinct Macquarie Island parakeet.

Regardless of which attribute was heavily weighted, Reischek's parakeet from Antipodes Island outperformed the others in almost all cases; only when distance to Macquarie Island was weighted ≥6 times more important than other attributes did the Auckland Island parakeet outperform it.

An incidental advantage of this choice is that Reischek's parakeet comprise only a very small wild population, which only occurs on a tiny island (22km^2 *cf.* Macquarie Island, 127.8km^2), and could benefit in the future from the establishment of an insurance population.

While the exact functional role of the extinct Macquarie Island parakeet cannot now be properly understood, elsewhere the closely related sister species of red-crowned parakeets forage on seeds and berries, and may contribute to plant propagule dispersal, especially in the light of prior research that indicates that the role of parrots as seed dispersers has been widely overlooked. Most plant species consumed by Reischek's parakeet on Antipodes Island are also present on Macquarie Island, and given that red-crowned parakeets are adaptable with a varied diet, their dietary needs are likely to be met. Reintroduction of Reischek's parakeet may therefore fulfil an ecosystem niche that can contribute to ongoing restoration of vegetation on post-eradication Macquarie Island.

*Megaherbs (*Pleurophyllum hookeri, Stilbocarpa polaris*). Image: Justine Shaw*

Red-crowned parakeet. Image: Aleks Terauds

Applications

This research presents a structured way to identify suitable source populations to replace extinct species from island ecosystems. As eradication of invasive species on islands increases worldwide, opportunities for proactive, restorative conservation are going to become increasingly commonplace, and our method provides structure and guidance to the first step in the process. As such, it will be of most importance to island ecologists, island managers, restoration ecologists, translocation scientists and eradication scientists. It will be of further practical use to island restoration teams, sub-Antarctic island managers, the New Zealand Department of Conservation, and staff of the Lord Howe and Norfolk Island National Parks.

Short grassland on Macquarie Island. Image: Justine Shaw

Cited material

Wauchope, H. S., Fuller, R. A., Shanahan, D. F., & Shaw, J. D. 2018. Restoring islands and identifying source populations for introductions. *Conservation Biology* 33(3), 729–732.

Recommendations

Our research gives some general recommendations for scientists and managers when they are considering restoring island biodiversity after an eradication. It is essential to first determine whether any surrogate or sister species may be suitable for introduction and therefore able to restore roles in the ecosystems that disappeared with the extinct species. Look to neighbouring populations or sister species from similar ecosystems and determine their suitability to the newly restored island habitat.

With regard to the restoration of parakeets to Macquarie Island, what we have achieved via our novel decision framework is a narrowing of the field of potential sister species so that further analysis assessing suitability can be conducted for Reischek's parakeet, the population best suited to Macquarie Island. Identifying the most suitable source species allows a management focus on that sole species for further assessment of diet, physiological constraints, habitat, behavioural requirements, and impacts to source population and recipient ecosystem.

This research aims to help identify suitable source populations. Once appropriate source populations have been identified there are obviously multiple considerations prior to a reintroduction taking place. Consideration is needed to determine whether there are likely to be any perverse outcomes from reintroducing a parakeet to the Macquarie Island ecosystem. Detailed research will be required to determine the health and robustness of the source population. Already we know that Reischek's parakeet survived well in captivity during the recent mouse eradication on Antipodes Island, and the immediate impact on the source population of keeping these individuals captive did not appear to be severe. While research shows many species of bird and animals naturally move between these islands, the consideration of legal requirements and any biosecurity risks are obviously essential prior to a reintroduction. While there has never been a conservation introduction to Macquarie Island, it is not unprecedented to introduce new species to Macquarie Island for management purposes: the European rabbit flea (*Spilopsyllus cuniculi*), myxoma virus and rabbit haemorrhagic disease virus have all been introduced to the island. Now that eradication of vertebrate mammals is completed for the island, managers are left to determine what restoration "looks like" for Macquarie Island.

Further Information

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This project is supported through funding from the Australian Government's National Environmental Science Program.