Science for Saving Species

Research findings factsheet

Project 4.2.3

Threatened Species Recovery Hub

National Environmental Science Programme

How rabbit eradication has impacted the brown skua population on Macquarie Island: impacts from loss of prey and secondary poisoning

In brief

Since 2011, all invasive mammals have been eradicated from Macquarie Island. Overall, the eradications have resulted in major conservation benefits for wildlife, plants, and habitats. There were some uncertainties on the outcomes for some native species, in particular native predators. We examined the impact of the invasive mammal eradication on brown skuas, the island's terrestrial apex predator.

Rabbits formed a major component of skua diet for over a century, therefore the eradication of rabbits led to population decline of skuas. Additionally, skuas feeding on poisoned rabbit carcases ingested the toxin, leading to skua mortality in the hundreds – a larger immediate impact than the loss of rabbit prey.

The loss of rabbits as a prey item reduced brown skua breeding numbers and success. Nest numbers dropped by almost half, although recent recoveries are evident. In the absence of rabbits, most skuas now focus hunting efforts on penguins, which are another important prey of skuas.

The findings of this project support increased monitoring of major conservation interventions into the future to assess and reduce impacts to non-target species.

Background

Seal hunters brought cats, rabbits, rats, and mice with them to remote sub-Antarctic Macquarie Island over 140 years ago. These invasive animals were extremely damaging to the island's native flora and fauna. Cats, rats, and mice preyed on nesting seabirds, their eggs and chicks. Mice preyed on the island's invertebrates and seeds. Rabbits grazed extensively on the islands' plants, destroying habitat, burrowing into the hillsides, which led to substantial landslipping and erosion. These pest species decimated local populations of burrowing petrels and other seabirds and threatened native plants.

After more than a century of impacts, rats, mice, and rabbits were all eradicated from Macquarie Island by 2011 in a partnership by the Tasmanian Government's Department of Primary Industries, Parks, Water and the Environment, and the Australian Government's Australian Antarctic Division. Feral cats were eradicated in 2001. The successful eradication of all these animals from the island brought significant flow-on effects to the ecology of Macquarie Island.

Brown skuas (*Stercorarius antarcticus lonnbergi*) are a large native gull-like seabird that nest and hunt on Macquarie Island.

As top-order predators, skuas are important for controlling prey populations. While rabbits were on the island, they formed a significant component of the brown skua's diet, particularly during the breeding season. Skuas hunted rabbits in a variety of ways including working in pairs to capture rabbit kittens escaping from the burrow.

The toxin used to eradicate rabbits and rodents is known to persist and remain toxic in poisoned carcasses. Predators feeding on these carcasses can also be poisoned. To mitigate against this baiting was conducted over winter when skuas and other migratory predators were largely absent from the island. Once poison birds were detected in large numbers, several further mitigation measures were put in place. First, was the release of Rabbit Haemorrhagic Disease Virus prior to whole island baiting. This killed around 90% of the rabbit population without exposing predators to poison. Second, any rabbit carcass found by expeditioners was disposed of to avoid scavenging by native species. These measures avoided a catastrophic decline of skuas on Macquarie Island. Nonetheless, secondary poisoning was implicated in the deaths of at least 500 brown skuas on Macquarie Island.

The University Of Queensland Australia

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Tasmanian Government

Australian Government Department of Agriculture, Water and the Environment Australian Antarctic Division

Australian Antarctic Program

BELOW: The remains of skua prey. Following the loss of rabbits, penguins became the primary prey item for nearly all skuas on Macquarie Island. Image: Julie McInnes

Research aims

We aimed to quantify the impacts of eradicating invasive species on the breeding and nesting success of brown skuas on Macquarie Island.

We also aimed to investigate the role of secondary poisoning and the loss of rabbit prey on the skua population.

What we did

Researchers from the University of Tasmania, the Tasmanian Department of Primary Industries, Parks, Water and the Environment, the Australian Antarctic Division of the Australian Government Department of Agriculture, Water and the Environment, and The University of Queensland collaborated on this project.

Using a 10-year time series of breeding surveys and dietary analysis, we investigated the impacts of the Macquarie Island eradication program on brown skuas.

From the 2009–10 breeding season onwards, skua breeding surveys were conducted in two parts:

1. Breeding effort was measured by counting active nests from November to December
2. Breeding success was measured by counting surviving chicks from January to February.

From these surveys, we assessed the impact of rabbit eradication on the nest density and breeding success of brown skuas, at four breeding locations. We compared short-term and longer-term responses by categorising the survey years into either the early or later post-eradication periods. Early was defined as the first three years after the eradication was completed, while later was the following four years.

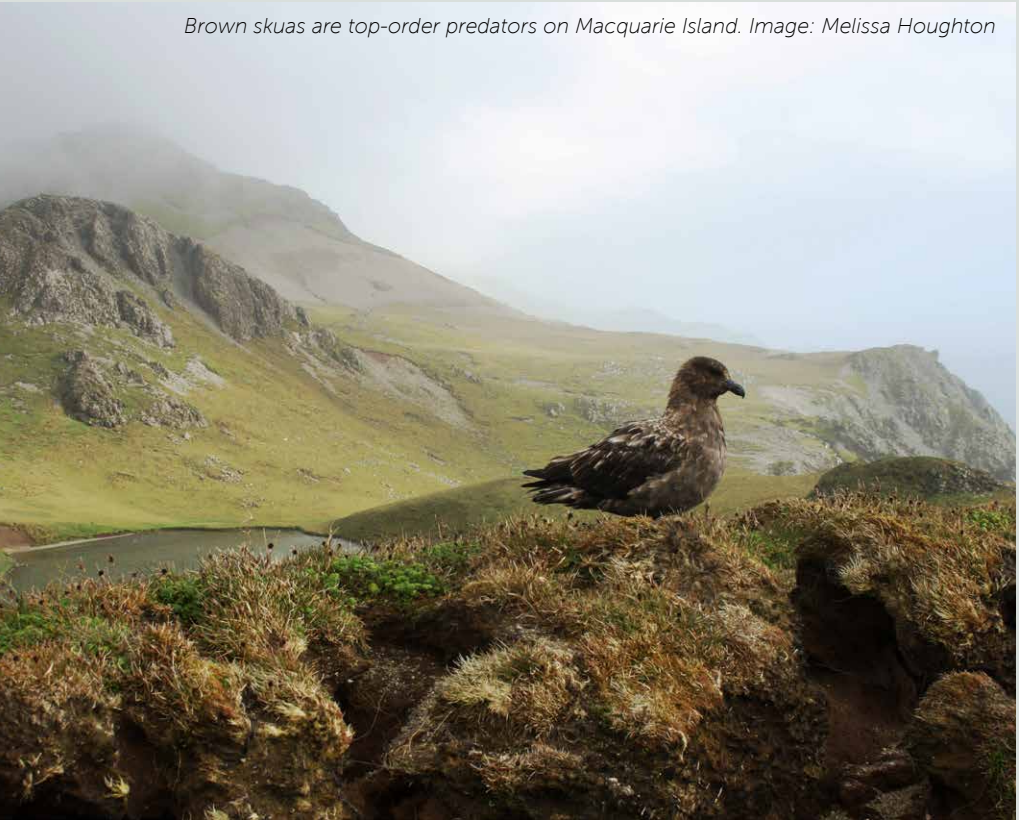
To understand how brown skua diet changed with the eradication of rabbits, we compared the stable isotope ratios of carbon and nitrogen in both skua feathers, and tissue from prey items.

We collected feathers from recently fledged chicks in years both before and after rabbit eradication. We sampled skua prey by collecting tissue of dead animals. By comparing the isotope ratios of skua feathers with prey tissue, we determined what prey items were likely to feature prominently in skua diet.

Penguin and their eggs are important prey for skuas. We divided skua sites into two groups depending on the proximity of their nests to the nearest penguin colony. We then examined how diet preference changed after the eradication of rabbits, relative to the proximity of the skua nests to neighbouring penguin colonies.

We quantified how secondary poisoning and the loss of rabbits as a prey item reduced the skua population. We measured the actual decline of skuas due to eradication, and compared this with a modelled decline in skuas based on just prey loss. This highlighted the additional role of secondary poisoning.

Brown skuas are top-order predators on Macquarie Island. Image: Melissa Houghton



What we found

Our most significant finding was that the eradication of rabbits from Macquarie Island had a significant negative effect on the nesting density and breeding success of the brown skua population. Following the eradication, skuas dropped to their lowest breeding population size on record.

Nest numbers

Skua nest density dropped from 7.14 nests per km^2 in the nesting season before eradication of rabbits, to 3.73 nests per km2 in the first three years post-eradication. Some signs of recovery were apparent in the four years following, where nesting density slightly improved to 4.46 nests per km^2. The severity of this impact on nest density varied across the island, and the rate of recovery depended on the local availability of alternative prey species. We found that skuas nesting closer to penguin colonies had the most pronounced rates of recovery. The nesting sites on the island's interior plateau and the barren sections of coast had slower recoveries.

The number of nests in the northern central plateau declined most severely. Here, nest numbers fell to 45% of pre-eradication levels in the early post-eradication period. These sites showed no significant sign of recovery in seven years post-eradication. Nest numbers in all other survey regions similarly declined but began to recover from four years after eradication. In the final year of our survey populations peaked at 78% of pre-eradication nest numbers, in the north-west coastal survey site.

Secondary poisoning contributed to the overall decline in numbers of skua nests. Immediately following the eradication, the loss of rabbits explained the severe decline in nest densities at three of the four survey areas. In the fourth area on the west coast, however, secondary poisoning was responsible for up to 95% of the decline in nest numbers.

Breeding success

All of the survey areas showed reduced skua breeding success following the eradication of rabbits with no observed recovery. The decline in skua nest numbers was compounded by breeding success falling by more than 50%. While previously, skuas had on average one chick per nest, once rabbits were removed this dropped to less than one chick for every two nests.

After eradication of rabbits, the largest falls in breeding success were observed in areas far from penguin colonies. The north-west coastal survey area was the most productive nesting ground before the removal of rabbits but breeding success in this area dropped by 87% following the eradication, making it now the least productive of all the survey areas.

Diet

Skuas nesting near penguin colonies had diets dominated by penguins. The removal of rabbits from Macquarie Island changed the diet of skuas, particularly for skuas nesting away from penguins. Following the loss of rabbits, penguins became the primary prey item for nearly all skuas on the island. Given the size of penguin populations on Macquarie Island and the reduction in the skua population following rabbit eradication, no impacts on the penguins of Macquarie Island are envisaged.

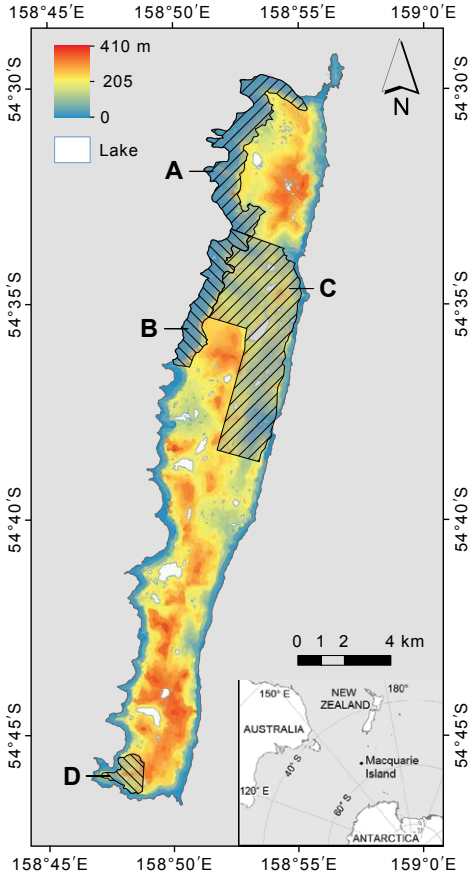


Figure 1: Map of Macquarie Island showing the four skua breeding survey areas. Inlay shows location of Macquarie Island relative to Australia, Antarctica, and New Zealand.

The eradication of rabbits from Macquarie Islands had a significant negative effect on the nesting density and breeding success of brown skuas. Image: Toby Travers

Implications

This research is important for conservation managers operating on islands and who are undertaking targeted invasive species removal programs, and/or reintroductions of threatened species.

This study builds on and supports the growing body of research that highlights the need for increased monitoring and research associated with island biodiversity and island eradications to better understand, predict and hopefully avoid unintended negative impacts on native species.

We showed that the population of skuas on Macquarie Island was significantly and negatively impacted by the eradication program, both due to the loss of prey and due to secondary poisonings associated with feeding on poisoned rabbit carcases, and possibly poisoned ducks, gulls and other birds. While there was some anticipation of secondary poisoning occurring in the project planning, the scale, extent and consequence was not specifically quantified. The actual impacts were greater than what most managers anticipated.

These findings should encourage managers to implement monitoring and review their modelling and predictions prior to starting management actions, such as eradications. Managers of future eradication programs could reduce uncertainty by considering comprehensive mitigation methods when native predators or scavengers are present.

Some measure for consideration include the creation of insurance populations during baiting, or assisted reintroductions after baiting, particularly for remote island predators and scavengers.

Macquarie Island's brown skuas are now showing strong signs of recovery. If eradication projects on other islands cause declines in native predators which are slow to recover, populations may need to be supported with supplementary feeding programs, breeding programs and the translocation of native prey. These would all act to support ecosystem restoration in the long term. Eradication of cats, rabbits, rats and mice on Macquarie Island has had ecosystem wide benefits.

Cited material

Travers, T, Lea, M-A, Alderman, R, Terauds, A and Shaw, J. (2021). Bottom-up effect of eradications: The unintended consequences for top-order predators when eradicating invasive prey. *Journal of Applied Ecology*. https://doi.org/10.1111/1365-2664.13828

Rabbits once formed a major component of brown skua diets on Macquarie Island. The toxin used to eradicate the introduced rabbits caused secondary poisoning in many of the skuas. Image: Toby Travers

Further Information

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Cite this publication as NESP Threatened Species Recovery Hub. 2021. How rabbit eradication has impacted the brown skua population on Macquarie Island: impacts from loss of prey and secondary poisoning, Project 4.2.3 Research findings factsheet.

This project is supported through funding from the Australian Government's National Environmental Science Program and the Australian Antarctic Division, Australian Antarctic Science project 4305.

This project was also supported by The Holsworth Wildlife Research Endowment & The Ecological Society of Australia