# FEASIBILITY STUDY REPORT

**Title:** Feasibility Study for the Eradication of Rats from Far and Away Islands, Republic of Pacifica.

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**Reviewers:** N. Moore (Moore Consulting) and R. View (Moore Consulting).

## Version History:

| VERSION | DATE | AUTHOR | REASON FOR CHANGE |
|---|---|---|---|
| Version 0.9 | 15th August 2009 | V. Reed and M.Toa | First complete draft for independent review |
| Version 1.0 | 1st September 2009 | V. Reed and M.Toa | Changes made after independent review |
| Version 1.1 | 15th September 2009 | V. Reed and M.Toa | Inclusion of biosecurity prevention measures used on site visit. |

## Citation:

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**[NB. This is a fictitious example that is intended for training purposes, based on real islands but with some details altered to present a particular scenario. Be aware that some situations, references and a few names are real, most are not! ]**

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# EXECUTIVE SUMMARY

*Explanation: An executive summary previews the main points of the report and contains enough information for the reader to get an overview of what is discussed in the full report.*

*Prompts*

- *Write the executive summary after you write the main report, and make sure it is no more than one page in length.*
- *List the main points the summary will cover in the same order they appear in the main report. Include information on:*
  - *What the purpose of the document is, i.e. To establish if the proposed eradication is feasible*
  - *Where the project is – country, island, summary of key characteristics*
  - *Is the project feasible?*
  - *Why, when and how is it being undertaken and by whom*
  - *Are there any risks and challenges*
- *Write a simple explanatory sentence for each of the main points and add supporting or explanatory sentences as needed, avoiding unnecessary technical material and jargon.*
- *Read the summary slowly and critically, making sure it conveys your purpose, message and key recommendations. You want readers to be able to skim the summary without missing the point of the main report.*

This report looks at the feasibility of National Parks and Conservation Department (NPC) eradicating the Pacific rat from the Far and Away Islands, Republic of Pacifica.

The Windward Islands group consists of four islands; Far, Away, Near and Furthest. The Near and Furthest Islands have not been included in the current proposal, as they are considered low conservation priority. For more information, see *Near and Furthest Islands (page 16).*

The Far and Away Islands have been identified as highly significant sites for conservation. They hold populations of species currently found nowhere else in the country, including some threatened species, e.g. ground dove, crimson pigeon and Pacifica broadbill. They are also some of the very few offshore islands large enough and far enough offshore to be considered as refuges for several species threatened on the larger islands by introduced mammalian invasive species. A key step in the restoration of these islands is the eradication of the only mammalian invasive species known to be present, the Pacific or Polynesian rat *(Rattus exulans*).

The feasibility study concludes that hand-broadcasting of brodifacoum pellets is the preferred eradication technique. While some issues have been raised, as all are considered resolvable, it is concluded that the proposed project is feasible.

The key issues identified:

1) The risk posed by toxic bait to the ground dove populations.
2) The need for strong participation in the biosecurity measures if further invasions are to be avoided.
3) Public concern over the environmental and health issues of using toxic bait.
4) A number of approvals will be required.

Each of these issues is considered resolvable and recommendations are presented in the report.

NPC will be the lead implementing agency on the project. NPC will be assisted by a project partner, Windward Marine Protected Area committee (WMPA). Any gaps in expertise, most notably technical experience with large scale hand-broadcasting eradications and captive bird programmes, will be met by engaging contract staff. The use of external experts will also further NPCs ongoing eradication capacity building by providing opportunities to up skill NPC staff.

The project is estimated to cost NZ$346,280. Breakdown by stage: Project Design ($20,000), Operational Planning ($112,200), Implementation ($187,680) and Sustaining the Project ($26,400). Costs for 5 years of surveillance and incursion response are included in the budget. After year 5 NPC would take responsibility for the ongoing costs of the biosecurity measures.

# 1. INTRODUCTION

*Explanation:* *Explain the purpose of this document, and set the context for the project.*

*Prompts:*

- *Include the name of the implementing agency that undertook the Feasibility Study*
- *Who has funded the work*
- *Provide details if this eradication project is part of a larger programme of work (of multiple eradications or a restoration project).*
- *Include details of any national or international programmes that this project is related to.*
- *What is the purpose of the document, ie assess the feasibility of eradicating XXXX from Island Y.*
- *How will the Feasibility Study Report be used?*
- *The expected audience of the Feasibility Study Report*
- *What documents were used as background information, for example, a project proposal. List all relevant documents in the References section.*
- *Include thanks to any people organizations that have provided support/help/advice etc to the preparation*
- *Delete this Help Box once you have completed the Feasibility Study Report*

Biodiversity International have provided funding to the National Parks and Conservation Department (NPC) Republic of Pacifica to undertake a Feasibility Study for the eradication of the Pacific rat from the Windward Islands, Republic of Pacifica. This document is the resulting Feasibility Study Report. This Feasibility Study Report will form the basis of a later proposal to Biodiversity International to fund the full eradication project.

The purpose of the Feasibility Study is to assess the feasibility of eradicating the Pacific rat from the Windward Islands. Essentially, the feasibility study asks three questions: why do it, can it be done, and what will it take? The remainder of the *Introduction Section* will explain the regional and international context of the proposed project. *Section 2* details the goal, objectives and outcomes of the proposed project. After a description of the Windward Island site in *Section 3, Section 4* will describe the Pacific rat, its impacts on the Windward Islands and the anticipated benefits to the islands if the Pacific rat were to be eradicated. *Section 5* considers seven criteria and for each asks: does the project meet this criteria? And, what issues do we need to resolve to make the project a success. *Section 6* records the final conclusion, all things considered, would the proposed project be a success?

The need for the rat eradication project is identified in the Republic of Pacifica's National Biodiversity Strategy, the country's key conservation strategy, with an action recorded as:

> '*Develop a programme for the eradication of rodents from small islands which can be used for conservation of rare species such as the ground dove*'.

For some years there have been recommendations from international scientists that rats be eliminated from the Windward Islands (e.g. Jameson *et al* 1992).

A Priority Working Goal in the Windward Marine Protected Area Management Plan 2006-2011 is:

> **"** *by the end of 2011 our offshore islands (Far and Away Islands) will have had implemented a restoration programme focusing on rat eradication, and endangered bird-life (land and sea bird) and other native wildlife conservation and overall security of these islands for heritage conservation (natural and cultural). We will have investigated and decided upon options for nature tourism development for these islands.*"

This repeats the same goal in the Management Plan for the Windward Marine Protected Area for 2002 –2006, which was not able to be acted upon during that timeframe.

These islands were also identified as one of the important conservation sites at the Polynesian Avifauna Conservation Workshop in Rarotonga in April 1999 (Aitchison & Smith 1999).

The draft Regional Invasive Species Strategy for the Pacific notes the need for advocacy measures to promote the eradication and control of invasive species threatening biodiversity (McCormack *et al* 2000). Hence this project could be a useful demonstration eradication project that can help build techniques and capacity for other Pacific Island countries. This is one reason that it has the support of regional conservation agencies such as Pacific Environment Aid (PEA) and Pacific Invasives Initiative (PII). Showing that eradication can be done successfully and safely, and bringing about positive changes in island biodiversity, will strengthen the region's ability to make more such projects happen. This in turn would do much to safeguard a significant number of threatened species, particularly birds.

As part of an internal review of project priorities, NPC reviewed all proposed eradication projects using the PII Resource Kit Project Selection Process. Using criteria defined by NPC the eradication of rats from the Windward Islands project was identified as the top priority eradication project for NPC.

This Feasibility Study Report will be made available to all relevant Republic of Pacifica Government authorities (e.g. NPC, the Windward Marine Protected Area committee (WMPA), and Ministry of Agriculture and Fisheries (MAF)) and to local villages and other key stakeholders. It will be of considerable help to these stakeholders to see the benefits of rat eradication, along with the costs, issues and commitment required to see it happen.

Initial funding to develop a Windward Island restoration project was provided from AusAID. A portion of this money was used for a preliminary survey of birds and rodents that exist on Far Island. A group of experts from New Zealand including Dr Ian McCormack (Auckland University), Belinda Turner (International Eradication Consultants Ltd ) and Rawene Parita (NZ Department of Conservation, Head Office) teamed up with Dr Graham Aitchison (then Programme Manager for Conservation and Invasive Species, PEA) and Mr Pele Lagasa and Viliamu Reed (Department of National Parks and Conservation, Republic of Pacifica) and the Windward WMPA Project Team to undertake a preliminary survey of Far and Away from 22 – 30 August 2000 to identify the species likely to benefit from the eradication of rodents and the species that may be at risk from the procedure. From this survey Turner put together a discussion document on the eradication of rats

from Far and Away Islands (Turner, 2000). A further feasibility survey, prepared by Lagasa (2001) further examined the proposal from the Republic of Pacifica perspective.

The current Feasibility Study Report builds on much of the earlier collected information. This study has been developed by collation of all current available knowledge of the islands, including several biological survey trips (see References section) and by a site visit as part of this study.

A large number of people have been involved in this project to date, either in meetings, field expeditions or in commenting on proposals. All deserve mention to show the high level of support for this project. However I hope they will allow me to specifically name those who have had specific input into this proposal and to generalise beyond that.

PII have provided support in helping find the required technical input and independent technical advisors to complete the project reviews.

Thanks then go to:

- Staff of the National Parks and Conservation Department, particularly the Director Taiaga Wilson for his support of the proposal, and Viliamu Reed and Tunia Tokoa for their generous assistance.
- Staff of the Marine Protected Areas Programme, particularly Susan Jolie, Andrew Talofa and Lalani Matenga.
- The following for specific inputs to this study and earlier technical discussions:

  Lance Denver, Rod Smith, Susan Jolie, Carl Leary, Richard Parita, Suzy Randall, Klaus Hoffman, Greg Aitchison, Ian McCormack, members of the IEAG.
- Finally to Paga Matipo and his family for sharing their love of the islands.

# 2. GOAL, OBJECTIVES and OUTCOMES

*Explanation:* *Define what the project will achieve in terms of the goal, objectives and outcomes.*

*Prompts:*

- *When defining objectives and outcomes remember that, later, as part of the Monitoring and Evaluation Plan you will need to measure indicators that will tell you if the objectives and outcomes were achieved. Consider this when deciding on objectives and outcomes as they will need to be measurable.*
- *The Goals, Objectives and Outcomes at the start of the Feasibility Study may change due to what you learn during the Stage. After writing the Can it Be Done Section and Conclusion Section return to this Section and check whether the Goals, Objectives and Outcomes need updating.*
- *Delete this Help Box when the Feasibility Study Report is complete.*

*Useful Tools:*

- *Guidelines for Project Managers – Section 3. Setting Goals, Objectives and Outcomes*

## 2.1 Goal

The goal of the proposed project is:

> "*Restoration of Far and Away Islands, Windward Group, as key sites for the conservation of Republic of Pacifica's indigenous biodiversity, through the eradication of Pacific rats*"

## 2.2 Objectives and Outcomes

The objectives that this project will achieve and the outcomes that will be seen as a result of achieving these objectives are:

| Objectives | Outcomes |
|---|---|
| 1. Eradicate Pacific rats (*Rattus exulans)* from Far Island | 1.1 No Pacific rat population on Far Island. |
| | 1.2 Increase in population size of native bird species on Far Island. |
| | 1.3 Increase in native vegetation densities on Far Island. |
| | |
| 2. Eradicate Pacific rats (*Rattus exulans)* from Away Islands | 2.1 No Pacific rat population on Away Island. |
| | 2.2 Increase in population size of native bird species on Away Island. |
| | 2.3 Increase in native vegetation densities on Away Island. |

| Objectives | Outcomes |
|---|---|
| | |
| 3. Safeguard the ground dove populations on Far and Away Islands | 3.1 Increase in population sizes of ground dove on Far and Away Islands. |
| | |
| 4. Improve the capacity of NPC to undertake larger eradication projects. | 4.1 NPC staff have skills to undertake further eradication projects of a similar size to current project. |

Research during the Feasibility Study Stage identified that the application of ground-based bait may pose a threat to the population of ground doves on Far and Away Islands. Given the national importance of this population, for this project to be considered a success, the project can not cause any long term decrease in the island population of the ground dove. To reflect their importance, an objective to safeguard the ground dove population (*Objective 3*) was added to the original project objectives. See Section 5.5: *Environmentally Acceptable* for further information on the threats to the ground dove.

# 3 THE SITE

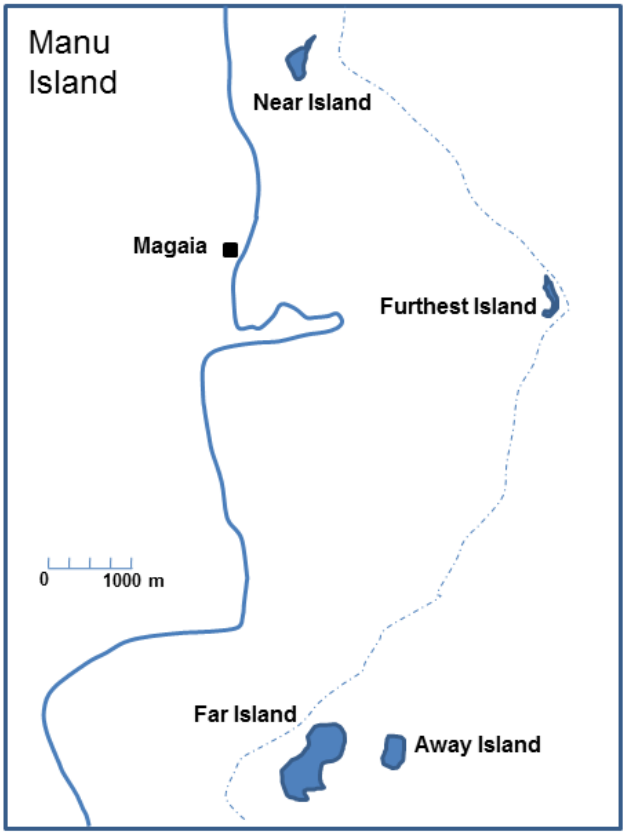
*Explanation: Describe the physical character of the eradication site.*

*Prompts:*

- *Where is it? (include country)*
- *How many islands are included?*
- *Include: Location, area of each island, type of terrain,*
- *If there are several islands, create a table with names, sizes, distances to other islands and/or mainland*
- *How big are they?*
- *How far are they from other islands or the mainland (i.e what is the swimming distance for any possible re-invasion?*
- *Who owns or has jurisdiction over them?*
- *Are they inhabited? – describe current land use and ownership*
- *Include details of location and size of villages and how the villagers use the land on the island*
- *What is the island used for? (E.g. agriculture, tourism, fishing port etc)*
- *What access is there to the island – boat, plane, are there wharves?*
- *Food sources for the target species (natural & how it varies, associated with people inc. waste)*
- *What are the typical seasonal weather pattern*
- *What is the topography and vegetation cover like? (include information on proportion of the vegetation cover is native vs exotic – gives an indication of weediness)*
- *What native and endemic species are present, when do key species breed (i.e. those of conservation interest and key food sources for the target species)*
- *A map or an aerial photo with key features is essential.*
- *Explain why the site is worth protecting*
- *Delete this Help Box when the Feasibility Study Report is complete.*

The Windward Island group lies off the east coast of Manu Island, in the Republic of Pacifica. The group is made up of four islands, namely Far, Away, Near and Furthest (see Table 1 and Map 1).

Island ownership rests with the head of individual families in the main village of the Windward coast, Magaia, but the island group forms an integral part of the Windward Marine Protected Area (WMPA), established in 1999. All claimants have endorsed the islands as being part of the WMPA and are included in the management plan for it. The WMPA is managed by a committee which includes leaders from the local villages as well as government representatives from the National Parks and Conservation Department (NPC) and Ministry of Agriculture and Fisheries (MAF).




**Map 1. Location of Windward Island Group, off Manu Island, Republic of Pacifica.**

All of the islands are uninhabited, but are sometimes used by villagers from the Windward coast villages for harvesting of coconuts and for growing of crops for village use. Coconut, banana, taro, coconut crabs, young seabirds, Pacific pigeons and flying fox are intermittently harvested from Far Island (Jameson *et al.* 1992, D. Johnson *pers. comm*. 2006). None are currently cultivated and they are all growing or living in a wild state. Both Far and Away Islands are visited very infrequently by one of the families. Away Island is visited much less frequently than Far Island (P. Matipo *pers. comm*. 2006).

Local fishermen also occasionally use the islands for sheltering and resting. Before the establishment of the marine protected area, turtles were harvested from the islands and surrounding sea. This region is not developed for tourism as yet, so the islands receive very few visitors apart from infrequent visits from scientists and conservation managers.

Two of the islands, Near and Furthest, are within the fringing reef that extends out between 1 and 4km from the mainland coast. Far and Away are outside of this reef in deeper water and their position reflects their more rugged and natural state.

None of the islands have any wharfs or permanent structures on them, though temporary shade shelters and fale (huts) from island-sourced materials (coconut palm fronds, etc) are occasionally constructed on them for use by the villagers. Landing is on the sand beaches, which occur on all four islands, but on the outer two islands safe landing can sometimes be prohibited by strong trade winds.

The inner two islands, being of relatively easy access have been used extensively for agriculture and sustainable harvesting by local villagers, and Far Island to a lesser degree has also been used for such purposes. Away Island is a rare example of a forested island that does not have coconut trees deliberately introduced to it.

**Weather Patterns and Access**

Weather patterns are typical for the region, with a wet season from October to April, and a dry season with often strong trade winds in the months June to September. (Further information is currently being sought on rainfall records). The outer two islands have limited safe access spots due to these cliffs, fringing reefs, predominant wind and wave conditions.

The outer islands especially are often difficult to access during the trade wind season and best accessed during rainy season due to generally calmer conditions and absence of trade winds.

All the islands have some cover of native forest vegetation, though Near and Furthest have had relatively significant amount of modification (clearance of forest for crops, planting of coconut and other tree crops, etc). Far and Away have a near-natural native coastal and lowland forest typical of this part of the Republic of Pacifica covering the bulk of the area of both islands.

**Table 1. Islands in the Windward Group, Republic of Pacifica.**

| ISLAND | SIZE | DISTANCE TO MAINLAND and/or NEAREST ISLAND | PEST STATUS |
|---|---|---|---|
| Far | 108 ha | 1.3km to mainland,<br>500m to Away | Rats present,<br>Pacific rat |
| Away | 25 ha | 500m to Far | Rat-free until 2003,<br>Pacific rat |
| Near | 21 ha | 700m to mainland, but within fringing reef | Rats present,<br>unknown species |
| Furthest | 7 ha | >4km to mainland | Rats present,<br>unknown species |

Comprehensive details of the vegetation and fauna of Far Island are available in Jameson *et al* 1992. Away Island has also had some survey work conducted (e.g. Johnson 2003) but literature on Near and Furthest is relatively lacking.

**Threatened Species**

A wildlife survey report (McCormack *et al* 2000) found that Far and Away Islands are home to a number of endemic and internationally threatened species. These include:

- Crimson pigeon (endemic; Endangered)
- Ground dove (regional endemic, Vulnerable)
- Pacifica broadbill *(Myiagra pacifica)* (Endemic, Vulnerable)
- Coconut crab (*Birgus latro*) (Vulnerable).

Far Island also provides habitat for a number of other locally and regionally endemic birds and the Endangered endemic Pacifican 'flying fox' bat (*Pteropus pacificus*) (Turner 2000). This island is a breeding ground for the red footed and brown boobies (*Sula sula* and *Sula leucogaster*), black terns (*Sterna sumatrana*) and white terns (*Gygis alba),* greater frigate bird (*Fregata minor)*, and other seabirds, and is the last nesting seabird colony in Republic of Pacifica (WMPA, 2002). It is also worth noting that the red footed booby has significant cultural value to the local communities, appearing prominently in local folk lore and traditional stories. These islands clearly contain species of local, national and international importance. Furthermore, Far and Away represent the only potentially secure offshore uninhabited islands in Republic of Pacifica for an endangered wildlife sanctuary.

**Far and Away Islands' Rats**

The rats present on Far and Away Islands are the Pacific rat and as the islands have no regular human habitation, the rats' principal sources of food are the natural plant and wildlife communities of the islands. No data from the islands exist, but it is suspected that, as is the case for most tropical islands, food resources allow rats to breed year-round. On Far Island, fallen coconuts and scraps of husks are targeted, and the eggs and chicks of smaller seabirds are also a prime target when they nest, the time of which can vary from year to year.

Collectively this group of islands make up approximately a third of the total number of small forested islands off the coast of the main islands of the Republic of Pacifica. Far and Away are the only two of these in relatively unmodified state and far enough offshore to provide a degree of surety against natural rat re-invasion. They therefore offer a limited and valuable potential resource for conservation of any of the Republic of Pacifica's biodiversity that is affected by the presence of rats. Eradication of the rats will bring significant benefits for the existing biodiversity of the islands. However there are also opportunities to use these rat-free sites as refuges to other species that may be threatened on the main island of Republic of Pacifica, or the Republic of Pacifica archipelago as a whole.

Far and Away Islands have been the focus of suggestions for the eradication of rats for some years now, and the development of eradication technology over the past few decades has made this a realistic option.

**Table 2. Birds recorded from Far and Away Islands**

| Common name | Scientific name | Status* |
|---|---|---|
| ***Land birds*** | | |
| Crimson pigeon | (*Didunculus strigirostris*) | EN |
| Ground dove | (*Gallicolumba stairi*) | VU |
| Many coloured fruit dove | (*Ptilinopus perousii*) | LC |
| White throated pigeon | (*Columba vitiensis*) | LC |
| Pacific pigeon | (*Ducula pacifica*) | LC |
| Crimson crowned fruit dove | (*Ptilinopus poriphyraceus*) | |
| Pacifica broadbill | (*Mylagra pacifica*) | VU |
| Flat-billed kingfisher | (*Todirhamphus recurvirostris*) | |
| White-rumped swiftlet | (*Aeroramphus spodiopygius*) | |
| Pacifican whistler | (*Pachycephala brevifrons*) | |
| Pacifican triller | (*Lalage bluntei*) | NT |
| Wattled honeyeater | (*Foulehalo carunculata*) | |
| Pacifican starling | (*Aplonis pacifica*) | |
| Scarlet robin | (*Petroica multicolor*) | |
| Pacifican fantail | (*Rhipidura pacificosa*) | |
| Banded rail | (*Rallus phillippensis*) | |
| Barn owl | (*Tyto alba*) | |
| ***Seabirds*** | | |
| White-tailed tropicbird | (*Phaethon lepturus*) | LC |
| Red-footed booby | (*Sula sula*) | LC |
| Brown booby | (*Sula leucogaster*) | LC |
| Greater frigatebird | (*Fregata minor*) | LC |
| Lesser frigatebird | (*Fregata ariel*) | LC |

| | |
|---|---|
| Reef heron | (*Egretta sacra*) |
| Golden plover | (*Pluvialis fulva*) |
| Wandering tattler | (*Tringa incana*) |
| Turnstone | (*Arenaria interpres*) |
| Common noddy | (*Anous stolidus*) |
| Black noddy | (*Anous minutus*) |
| Blue-grey noddy | (*Procesterna cerulea*) |
| White tern | (*Gygis alba*) |

List compiled from: Park *et al.* (1992), Stringer *et al.* (2003a, 2003b), Parrish *et al.* (2004).

* Threat status: Global threat status from *Threatened Birds of the World* (Birdlife International 2000) and sourced from Watling (2001): EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern.

**Reptiles**

Four skinks, two geckos and one snake species are present on the Windward Islands.

The oceanic gecko (*Gehyra oceanica*) and mourning gecko (*Lepidodactylus lugubris*) have been recorded on all four islands in the group.

Parita *et al.* (2004) comment that while the gecko fauna is likely to be the same on each island in the Windward Group, the Pacifican boa appears to be confined to Far Island. The Pacifican skink and Murphy's skink (both on Far Island) and the dusky-bellied slink (Away Is) are currently thought to be confined to single islands. None of the lizard species are threatened (McCormack *et al.* 2003b).

Hawksbill turtles (critically endangered) nest on the beaches of Far and Away, and they and green turtles (*Chelonia mydas*) are often observed in the seas around the islands (P. Matipo *pers comm.*).

**Table 3. Reptiles recorded from Far and Away Islands**

| Common name | Scientific name |
|---|---|
| White-bellied skink | (*Emoia cyanura*) |
| Dusky-bellied skink | (*E. impar*) |
| Samoan skink | (*E. pacifica*) |
| Murphy's skink | (*E. muphyii*) |

| | |
|---|---|
| Oceanic gecko | (*Gehyra oceanica*) |
| Mourning gecko | (*Lepidodactylus lugubris*) |
| Pacifican boa | (*Candoia pacifica*) |
| Hawksbill turtle | (*Eretmochelys imbricata*) |
| Green turtle | (*Chelonia mydas*) |

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**Bats**

Only one species of bat is present, the Pacifican fruit bat or 'flying fox' (*Pteropus pacificus*).

**Invertebrate fauna**

The invertebrate fauna of Far and Away has not been comprehensively studied and information on rarity and endemism levels are not known. Coconut crabs (Vulnerable), *Grapsid* crabs, hermit crabs (*Coenobita* spp.) and at least one other species of crab are common (McCormack *et al.* 2003a, 2003b).

**Other non-native animals present**

The red-vented bulbul (*Pycnonotus cafer*) was recorded as being common on Far by McCormack *et al.* (2003a), but it's status on Away Island was unclear until the site visit during this study, in which its presence there was confirmed.

**Far Island**

Far Island lies 1.3 kilometres from the Windward coast, and is only 500m from Away Island, the closest of the other Windward Islands. Eradication will be needed there concurrently because of the proximity of the two islands.

Far (108ha) is the highly eroded remains of a tuff cone (high point is 100 metres) that was originally circular in shape, but due to erosion, various portions of the rim are now gone (Singer 1983). Hence, Far has moderate slopes with some limited areas of steep to vertical terrain, which is broken by a series of small bluffs (Turner 2000). On the north and west sides of the island are low marine cliffs up to 30m high (Singer 1983). The vegetation covering the whole island is native or only partially disturbed, with a relatively open understorey, only a few vine tangles and limited ground cover (Turner 2000). However there is a small plantation area on the island (at Black Beach) supporting vegetable species and coconuts.

Jameson *et al.* (1992) recognise four plant communities: littoral forest; coastal forest; lowland forest; and managed (modified) land. The littoral forest is dominated by the canopy species tropical almond (T*erminalia catapppa*) with 'utu (*Barringtonia asiatica*) and pukaama (*Hernandia nymphaeifolia*) also common. The exposed ridges of the island are covered in a unique coastal forest composed largely of asi (*Syzgium clusiifolium*), ebony (*Diospyros elliptica*) and 'au'auli (*Diospyros pacificus*). The interior of the island on the east and west facing slopes are covered with lowland forest which

reaches 20 m in height in favourable places. Rosewood (*Dysoxylum pacifica*) is the dominant canopy species. The modified land consists mostly of the small coconut plantations at Black and Far beaches. A number of native forest tree species grow within this.

The vegetation of Far Island was considered by Jameson *et al.* (1992) to be of conservation significance because:

- coastal and lowland forests are rare and uncommon (respectively) in the Republic of Pacifica
- Species diversity is high, with over 160 species of plants recorded
- Several species are rare, the most significant being *Chionanthus vitiensis*, polo (*Solanum viride*) and pani (*Manilkara dissecta*)
- The vegetation is very important for the seabirds present.

**Away Island**

Away Island (25ha) is in effect a smaller version of Far. It is similar to Far in its geology, with a tuff cone (maximum height 70m) breached on the eastern side by the sea, though its cliffs are not so high. Its vegetation is also similar, though few formal surveys have been made. Nevertheless, one native plant species found on Away Island is known nowhere else in the country.

It is more difficult to land upon and is further offshore than Far Island so visits have been relatively rare.

Of note is that it is a near-natural island, and does not have any evidence of human settlement, and while it does have a few self-established coconut palms, it does not have established coconut plantations.

Rats were first discovered on Away Island, only recently, in 2003 (Johnson 2003), having not been detected in wildlife surveys in 2000 and 2001. It is probable that they were brought to the island by human means, as the species has been identified as the Pacific rat which is a poor swimmer and is very unlikely to have reached the island unaided.

Away Island contains the most intact lowland coastal forest assemblage in Republic of Pacifica and is of high conservation significance. The vegetation is practically unmodified and there are few coconut palms. It has some unique vegetation and species diversity is relatively high. One plant species is present that is found nowhere else in the country (*Suriana maritime*), a coastal shrub known from a single specimen on the beach (Jameson *et al.* 1992)) and another, *Boerhavia alba* is rare in Polynesia and has only been recorded from Away Island and Fanuatapu in Samoa. The vegetation is very similar to that of Far (Jameson *et al.* 1992). Four vegetation types are recognised: herbaceous strand, littoral forest, coastal forest and lowland forest. The herbaceous vegetation is comprised predominantly of *Lepturus repens*, *Paspalum vaginatum*, and *Fimbristylis cymosa*. Instead of being dominated by tropical almond, as on Far Island, the littoral forest of Away is dominated by pukaama (*Pisonia grandis*) which extends 100 m inland from the shore of the beach. Tropical almond, pukaama and gatae (*Erythrina variegate*) are common in the canopy and fao (*Neisosperma oppositifolium*) is a common understorey species. The coastal and *Dysoxylum* lowland forest have not been surveyed but are probably very similar to those on Far.

It is considered that Near Island (21 ha) at only 700m away from the mainland across a shallow fringing reef is highly vulnerable to re-invasion from rats. Because of its location it also receives a relatively high degree of human activity and is widely used by local villagers for growing of crops and harvesting of coconuts. The vegetation cover has been significantly altered by human activity. Rats are present but it is unclear which species, or whether more than one species occurs there.

Furthest Island (7 ha) is a significantly greater distance offshore but is still within the fringing reef of the mainland. Its small size and relatively modified nature means its potential for conservation of forest-reliant species is more limited. Its greater use for agricultural purposes also means it is of more value to local villagers for sustainable living, and as a consequence of higher visitation has a greater likelihood of re-invasion by rats. However, it is an option to eradicate rats from it in future, and may be part of the overall proposal if funding permits.

Therefore both Near and Furthest Islands are considered as lower conservation priority and have been discounted from the current proposal.

# 4 THE TARGET SPECIES, IMPACTS AND BENEFITS OF ERADICATION

## 4.1 Target Species

*Explanation:* *Describe the species to be eradicated*

*Prompts:*

- *Include details of the distribution, numbers and densities. Do they vary seasonally?*
- *When does the species breed?*
- *Collect voucher specimens/DNA samples of the target species (i.e. for confirmation of the identity of the target species and for comparison with specimens collected during incursion events. Samples can be stored for later analysis if not immediately required.*
- *Remove this Help Box when the Feasibility Study Report is complete.*

The target species for eradication is the Pacific rat (*Rattus exulans)*.

Information collected by prior surveys suggests rat numbers are generally not particularly high but Johnson (2003) found high densities of rats (10 rats in 12 trap-nights) in coconut-dominated areas near Black Beach on Far Island. Their numbers may vary slightly seasonally and in response to longer-term climatic and other factors. Densities on Away Island are unknown, but are expected to have increased since their discovery in 2003, when 1 rat was caught in 20 trap-nights (Johnson 2003).

Information is limited as to the extent of the breeding season on Far and Away, but it can be assumed (as for most tropical islands) that breeding occurs for most of the year if not all year-round.

Information is also limited on the distribution of the rats over the islands, but as the habitat is relatively uniform it can be presumed that rats occur in similar densities over much of the islands. Lower densities may occur on the small cliff areas but this has not been established.

Voucher specimens for DNA purposes have been collected during a site visit during this study.

## 4.2 Impacts

*Explanation:* *Describe the impacts of the target species at the project site*

*Prompts:*

- *Consider all impacts of the target species: economic, biodiversity, social, health*
- *Remove this Help Box when the Feasibility Study Report is complete*

Despite being the third most widely distributed species of commensal rat, and especially common in the tropical Pacific, the effects of Pacific rat on other organisms remain relatively poorly known compared to effects of the larger rat species. Almost all data available have been gathered in the warm to cool temperate environments of New Zealand (Atkinson & Towns 2005). Pacific rat on New Zealand islands have been implicated in declines and local extinctions of 15 species of forest trees and shrubs, one species of palm and one of climber; 15 species of invertebrates, two species of frogs, reptiles including 11 species of lizards and the tuatara *Sphenodon* sp.; 10 species of seabirds and eight species of forest birds (D.R. Towns, unpubl. data). Small seabirds (<300g) have been among the more severely affected species, and these include Cook's *Pterodroma cookii* and Pycroft's petrels *P. pycrofti* as well as prions *Pachyptila* spp., storm-petrels Hydrobatidae, and small shearwaters *Puffinus* spp., which have all decreased in the presence of Pacific rat. The most serious was the endemic *Puffinus spelaeus*, which declined to extinction after invasion of western South Island by Pacific rat (Worthy & Holdaway 2002).

It is almost certain that Far and Away Islands once held significant populations of burrow-nesting seabirds such as shearwaters and petrels. Areas of ideal soil and 'departure trees' are present, particularly on Far, and some burrows are present. All of the ones currently in use are occupied by coconut crabs but it is possible that seabirds were present until very recently. It is possible that small relict populations persist, or that they may recolonise after eradication of rats. Conservation agencies in New Zealand have had significant success at 'artificially' re-introducing such seabirds to previous localities. Seabirds are important not just in themselves but because their breeding stimulates local changes in invertebrate fauna and vegetation which increases the biodiversity of the islands.

While no clear information exists, anecdotal evidence of the decline in Republic of Pacifica land-bird populations suggest that it is probable that the populations of the land-birds are much lower than they would be in the absence of rats simply because of possible predation of eggs, chicks and smaller birds, while there is also overlap between the diets of rats and many birds. This means that the ecosystem is likely significantly altered from the natural state, with loss of native biodiversity and disruption to ecosystem processes as a result of the presence of the invasive species which have

contributed to the probable massive reduction in seabird numbers and their associated marine input.

Given the evidence of the effects of Pacific rat in New Zealand, it is likely that on Far and Away Islands the Pacific rat has also influenced regeneration of some forest plants, may also have been responsible for declines and the extinctions of some species of land snails and other invertebrates, and may have suppressed some cryptic species (especially invertebrates) to levels where they cannot at present be detected.

## 4.3 Benefits of eradication

*Explanation: Describe the benefits of eradicating the target species from the project site*

*Prompts:*

- *Consider all benefits: economic, biodiversity, social, health*
- *Remove this Help Box when the Feasibility Study Report is complete.*

Eradication would be easily justified in terms of the current biodiversity values of the islands alone, but there is also an opportunity to use them as predator-free refuges for safeguarding the nation's whole fauna, which makes it even more desirable. Species currently present on Far and Away include a number of internationally threatened endemics: the crimson pigeon (endemic; with IUCN ranking 'Endangered'), the ground dove (regional endemic, 'Vulnerable'), Pacifica broadbill (endemic, Vulnerable), the coconut crab (Vulnerable) and Pacifican flying fox (Endangered). The two islands also hold the only significant seabird colonies in the country including red-footed and brown boobies, black terns, white terns, and greater frigatebirds.

There are several other Republic of Pacifica birds whose status is a concern and for which rat predation may be the key threatening factor. One such is the purple lory (*Vini purpurea*) a parakeet now endemic to Republic of Pacifica after becoming extinct on neighbouring islands. It is now rare on the main islands of Republic of Pacifica, only being found at 4 sites during a major upland survey (Schweigman *et al* 1999). Others suggested in earlier reports (e.g. Turner 2000) are the island thrush (*Turdus poliocephalus*) and the Pacifican white-eye (*Zosterops pacificus*). These could be transferred to Far and Away to ensure their long-term survival. A list of possibilities needs discussion but should be developed out of recovery planning for the country's threatened species.

Research in New Zealand has shown that the eradication of Pacific rats can bring about improvements in vegetation and quite dramatic increases in reptiles, invertebrates and some birds that nest in or on the ground (the ground dove and many of the seabirds fall into this category), or in holes low in trees. Rats are likely to have been responsible for the absence of burrow-nesting seabirds on the islands – several species of shearwater and petrel should be present and possible burrows were identified in 1992 though no birds were found. Higher numbers of ground doves are likely if rats are removed.

Benefits of the New Zealand eradications of Pacific rat have included positive responses from populations of many native species of forest plants, large invertebrates, skinks, geckos, the tuatara (a large endemic reptile), and at least five species of seabirds. However, because the eradications from many of the largest islands have been undertaken in the past 10 years, longer-term benefits and more subtle changes have yet to emerge. For example, on three islands previously unrecorded species of lizards, which had presumably been present at extremely low densities during the period of rat occupation, became obvious only 10 years or more after the eradications.

Comparisons between islands invaded by rats and those un-invaded (Fukami *et al* 2006), and studies in New Zealand and elsewhere on the pathways of marine-derived nitrogen and carbon (e.g. Markwell & Daugherty 2002), indicate that seabirds have profound effects on soils and, consequently, terrestrial communities (Towns & Atkinson 2004). It is therefore reasonable to expect significant changes on Far and Away Islands if Pacific rats are removed. The ecosystem will almost certainly change from one driven by Pacific rat, to one driven by the seabirds importing huge amounts of marine-derived nutrients into the ecosystem, with effects cascading through a diversity of pathways. If seabirds increased markedly, towards the level prevailing before the arrival of rats, this would represent a return to the conditions under which Far and Away Islands biodiversity evolved in past millennia.

Based on New Zealand results, it is likely that the eradication of Pacific rat from Far and Away Islands would result in:

- Enhanced breeding success of populations of small surface-nesting seabirds
- Expansion of any undetected relict populations of petrel species, and/or recolonisation by locally extirpated species of seabirds. For example, common diving-petrels *Pelecanoides urinatrix* greatly expanded their range on Korapuki Island after the eradication of Pacific rat in 1986 (Towns & Atkinson 2004), and on Raoul Island, recolonising species included black-winged petrels *Pterodroma nigripennis* and wedge-tailed shearwaters *Puffinus pacificus*.
- Improved regeneration of those species of forest plants sought by rats because of the palatability of their fruit, attractiveness of seeds or vulnerability due to reproductive strategy (e.g. some species that are dioecious). As an example, remarkable regeneration by the understorey species of *Pisonia* was recorded in New Zealand.
- Benefits to pigeons, doves and other fruit and nectar-feeding species from enhanced abundance of fruit and flowers, and possibly to insectivorous species from enhanced invertebrate abundance. These benefits would be realised in increased population sizes of the birds.
- Reappearance of rarely seen or even unknown species of large invertebrates whose populations had been suppressed by rats.
- Opportunities to translocate threatened species (such the purple lory, thrush and white-eye) from the main islands to establish secure populations on these invasives-free islands.
- Any crops or sustainably harvested foods from the islands will not be eaten or affected by rats.
- All of the above would help to create the islands as a unique environment in the Republic of Pacifica that could with care be used to create ecotourism opportunities and local employment.

# 5 CAN IT BE DONE?

*Explanation: By considering each of the 7 criteria below assess whether this project has a sufficiently high chance of success.*

*Prompts:*

- *The following Conclusion Section will be where you make a final decision based on the 7 individual criteria and an assessment of the net benefit and costs of the project*
- *Remove this Help Box when the Feasibility Study Report is complete.*

*Useful Tools:*

- *Guidelines on Feasibility Study*

## 5.1 Technical approach

*Explanation: Do we have a technical approach that will work? Describe the broad technical outline of the eradication project and explain why it is the preferred approach.*

*Prompts:*

- *Have you identified an effective and achievable technical approach? If not identify any trials/data gathering that is required to answer key questions relating to eradication design.*
- *Describe the toxin/bait/trapping methods that were considered. Include briefly the advantage and disadvantages for each, and the major reasons why the preferred technique(s) have been chosen.*
- *Include summary of past efforts to control the target species (i.e. info on toxins used etc, as may need to stop such usage prior to carrying out the eradication).*
- *The recommended technique and distribution methods may be different for different islands within the project.*
- *Are there any logistical challenges to overcome?*
- *Has the technique been successfully used in other similar projects?*
- *Clearly identify any issues that will need to be resolved in the later Stages.*
- *If the eradication is not considered feasible with current technology etc then identify the issues that need to be solved in the future for it to become feasible.*
- *Remove this Help Box when the Feasibility Study is complete.*

*Useful Tools:*

- *Guidelines on Feasibility Study.*
- *Guidelines on Choosing the Correct Eradication Technique.*
- *Guidelines on Cat Eradication and Monitoring Techniques.*

No prior rodent control has been undertaken on these islands, so the rats should be entirely naive to toxic baits or any other potential eradication technique.

**Management Options**

- **Do Nothing:** A 'do-nothing' approach for the islands is not considered as appropriate, as further damage to the islands' ecosystems will occur over time, with possible local or total extinctions resulting, and the potential for the islands to be developed further as refugia for the Republic of Pacifica's threatened species will be negated.

- **Control:** Control as opposed to eradication has also been considered, but judged to be extremely inefficient and of only short-term benefit. It would require a similar infrastructure (tracks, accommodation, etc) as would an eradication attempt, and it would need to be sustained over a much longer timeframe (meaning greater overall environmental effects). The many and regular visits required for control measures also bring an increased biosecurity risk to the islands. As a result, the overall benefits would be less and the long-term costs higher than an eradication.

- **Eradication:** So long as biosecurity measures are implemented to ensure as far as possible that rodents do not reinvade and recolonise the islands, eradication is seen as clearly the best option to address the goal and desired outcomes identified in Section 2 above.

The most preferred eradication option is to use pelleted cereal-based brodifacoum baits. Other options such as trapping and use of other toxins have been discounted as options as they have not been proven as reliable eradication methods.

Three proven bait delivery techniques were considered for Far and Away Islands:

1. Aerial application of bait using helicopters guided by GPS navigational systems
2. Bait stations set out on a grid pattern over the entire area of both islands
3. Hand-broadcasting bait over the entire islands along a pre-established network (grid) of tracks

- **Technique 1 - Aerial Application:** This may generally be the most often-used, reliable and efficient way of undertaking rat eradication, but the absence of a suitable helicopter in the region, and the cost and logistically challenging task of arranging shipment of the helicopter to Manu Island, make it potentially very expensive. It remains an option, but the prospect of finding sufficient funds is considered low. This option also requires the input of highly skilled technical expertise, and the potential for local involvement in the project is relatively low.

**Technique 2 - Use of Bait Stations:** This technique as been considered, and has been determined as a less suitable option. This is due to possible interference to the bait stations (and therefore rat access to bait) from land crabs. Bait station operations usually take much longer than the other options, and therefore would require staff to be based on the island for much longer, at greater cost of wages. The cost of the bait stations required to cover both islands is appreciable. The Pacific Invasives Initiative's (PII's) Guideline for 'Choosing the Right Eradication Method' recommends not using bait stations unless there is a clear reason why aerial or hand-broadcasting cannot be used.

**Technique 3 - Hand-Broadcasting:** Hand-broadcasting is considered the most appropriate option in this instance, as the cost of the operation will be significantly less than a helicopter-based operation,

and has no technical limitations such as procurement of helicopters (the technical resources required for hand-broadcasting operations are minimal). It is considered that hand-broadcasting of brodifacoum baits as a viable eradication option for islands of this size. Hand-broadcasting will take considerably less time and cost than a bait station operation, while not having the same degree of potential issue with crab bait take from stations (bait will still be taken by crabs but hand-broadcasting will alleviate the problem of concentrations of crabs likely to occur around bait stations). There is significant potential for use of local resources and therefore it will assist with development of local 'ownership' and pride in the project.

Hand-broadcasting has been used effectively and successfully in numerous operations on smaller islands around the world, including in the Falkland Islands (D. Brown *pers comm*.), in the Phoenix Islands (R. Pierce *et al* 2008), and on Christmas Is motu (Pierce & Brown 2009).

**Method and Issues with the proposed method**

The protocols established in the PII's Guidelines on 'Rodent Bait and Baiting' should be followed to give the greatest prospect for success.

Some increase in bait quantities above that normally recommended in the best practice document may be required on both islands to compensate for the uptake by hermit crabs. The field trials conducted in 2003 suggested that a special situation occurs in the areas of Far Island dominated by coconuts (Johnson 2003) where high densities of both land crabs and rats are present, and baits disappeared very rapidly. From the site visit for this study (see Appendix 3) hermit crabs occur at a maximum density of 1,000/ha in the coconut-dominated areas on Far, but occur at lesser densities (<200/ha) everywhere else on both islands. Exact rates may need to be determined by further hermit crab monitoring and trial non-toxic bait uptake rates.

A similar situation was found in the Seychelles (D. Merton *pers. comm*.) with experimental non-toxic bait plots eaten out by crabs during the first night. However during the actual aerial operations, pellets still remained in these areas after three nights, showing that when baits were spread across the whole island the short-term impacts of crabs in any one spot was much reduced.

To establish easy access for bait spreading, tracks will need to be cut across both islands, in parallel lines 25m apart. These tracks will require use of GPS navigation (GPS's suitable for use under forest canopy, (e.g. Garmin 60's) will be required) to achieve this. The best system for tracking (direction, etc) has yet to be finalised, but a site visit during this study indicated a central line would be desirable on Far Island at least. Some minor obstacles (inland cliffs) may need to be taken into account but all areas of the islands (except coastal cliffs) are considered to be suitable for tracks. Track-cutting could be done by locals but would need to be led by someone knowledgeable in GPS and with experience of successful baiting operations. This person would need to verify the accuracy and placement of the tracks is adequate, before any baiting commences. Establishment of tracks will require approval of the owners of the islands, but it is expected that this would be granted, as track-cutting on the islands is a well-established practice, and any damage will be temporary and quickly overgrown again.

Far Island has low cliffs with vegetated areas, but as they are <30m in height, bait can be delivered to such areas by throwing baits from above or from the coast or sea below to ensure there are no gaps in bait coverage. Away Island also has steep cliff areas, but of lesser extent. There are no areas of more than 30m in length or width that are inaccessible, so bait should reach every rat territory.

Coordinating a hand-broadcasting baiting operation is a specialist task. NPC will need to find an external expert that can help with this specialist task. NPC will work with PII to find a suitable contractor. This person would take responsibility for liaison with the bait supplier to ensure timely delivery, ensure the tracking is suitable for the purpose, then make decisions on when baiting should occur and to supervise this.

**Timing**

The 'dry' season from June to September is considered the ideal period to maximise the chances of dry weather necessary to ensure bait remains in good condition for as long as possible once broadcast. Weather is considered a more important factor in determining timing, rather than possible seasonal changes in the natural food supply available to rats. It is anticipated that the year-round food supply for rats will vary much less in tropical areas than in temperate climates where it is more limited in winter.

There are no well-defined breeding periods for colony-nesting seabirds on the islands, which may offer potential food for the rats. There is no clear period in which an eradication should **not** be considered because of increased risk to non-target species, or because of food resources to rats. The major timing issue is therefore ensuring bait will remain on the ground for as long as possible.

The following table summarises rainfall data obtained from Dan Tulofa of the Republic of Pacifica Meteorology Section:

**Table 4. Rainfall Data Summary**

| Month | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average rainfall* | 5.6 | 6.8 | 8.6 | 5.0 | 7.0 | 5.4 | 4.3 | 4.3 | 5.4 | 7.8 | 11.1 | 10.7 |
| Days with > 5mm Rainfall* | 5.7 | 7 | 10 | 5.3 | 6 | 7.7 | 5.7 | 3.3 | 4.7 | 5.7 | 8.3 | 6.3 |

* *Average of monthly averages, 2007-09*

It shows that July and August are the driest months, followed by June and September, and that August and September are the months with fewest days of significant rainfall, potentially a more useful variable for this work.

Wind may be a factor in reducing what appears to be 3-4 month window of opportunity based on rainfall. This period often has trade winds which may often cause delays in moving to and from the islands, but to maximise the chances for success it is considered that the wind can be worked around, in preference to planning the operation in the rainy season.

As recommended in the PII Guidelines on Rodent Bait and Baiting two bait applications will be required. The time interval between the two broadcasts is ideally 7-10 days, but would largely be determined by the weather.

**Logistics**

Getting to Far and Away Islands is relatively easy compared to many Pacific Islands. From the international airport and main centre, a reasonable road exists to the Windward villages, and temporary accommodation and a range of small boats are readily hireable from there.

Landing on the islands, particularly Away Island, can be tricky but is easily managed in good weather. It is possible some delays could occur due to rough seas, and this should be factored into the planning. Bait and sensitive equipment (such as GPS's, laptops) may also need to be protected for boat transport and landings, possibly through use of dry-bags or sealable plastic bins.

An eradication operation using hand-broadcasting of brodifacoum bait is the recommended technical approach and is considered a feasible option. There are a few issues that have arisen, but none that we do not consider can be resolved or managed. The most significant issue, the bait uptake by hermit crabs will need addressing. Further discussion can be found in the *Conclusion* section.

## 5.2 Sustainable

*Explanation: Can you prevent re-invasion of the target species and invasion of new species?*

*Assess whether the benefits of the eradication operation can be maintained afterwards.*

*Prompts:*

- *Can you prevent re-invasion of the target species and other invasive species?*
- *Identify major-risk invasive pathways.*
- *Seek expert help, if required, when assessing the risk from each species.*
- *Clearly identify any issues that will need to be resolved in the Project Design and Operational Planning Stages.*
- *Remove this Help Box when the Feasibility Study Report is complete.*

*Useful Tools:*

- *Guidelines on Biosecurity.*

**Table 5. Invasive Pathways**

| Species | Source | Pathway | Risk | Prevention Strategy |
|---|---|---|---|---|
| *Species Name* | *Where will be invasive species come from* | *How will it travel to the island?* | *How severe is the risk: Critical(C)/High(H)/ Medium(M)/ Low(L)* | *How will you prevent the species using the pathway to re-invade* |
| Norway rat | Windward or any part of mainland Republic of Pacifica | Aboard any boat calling into the islands (fishing, tourist, villagers), on the boat or in supplies loaded into it | High to critical | Education of local communities. Inspections of boats and cargo before loading<br><br>Improving 'permit' system |
| Ship rat | | | Medium | |
| Pacific rat | | | Medium | |

| Species | Source | Pathway | Risk | Prevention Strategy |
|---|---|---|---|---|
| | | | | for non-locals to include biosecurity measures<br>Provision of sealable bags or buckets to locals using the islands |
| Myna species | Deliberate introductions to Republic of Pacifica, and from there natural dispersal | Brought to Republic of Pasifica on board ships as pets (has happened in 1990's and 2005 but caged birds did not escape or establish in wild) | Medium | Public education |

**Minimising Re-Invasion Risk**

The ability to manage the risk of re-invasion is a very important criteria for determining whether an eradication should proceed or not. Both Far and Away Islands are far enough (>1.3km) from the main island of Manu Island, for rats to be quite unlikely to reach them unaided. The greater risk may come from ship rats or particularly Norway rats which are stronger swimmers than Pacific rats but this distance is at the limit of their known swimming range. Attention then turns to minimising the risks of them reaching the islands along with people. At the same time a surveillance system would need to be set up on the island to detect and hopefully deal with any arrival of animals.

The Windward Marine Protected Area project has previously been identified as the key agency to work with the community to minimise the risks of accidental transfers and to prevent deliberate transfers. Clearly considerable trust and cooperation has been built up since the project started which has led to community support for the eradication of rats in the first place. Following the implementation of the formal WMPA project (June 2004) there are people in place to work with on preventing re-invasion, namely the Windward WMPA Incorporated Society and David Sagolo, the local WMPA manager. It is suggested that the issue is approached by 'workshopping' with the local communities the different ways that rats might reach the islands. For example, clearly each visit by people to either island poses a risk, but that risk is so much greater if building or agricultural materials are transported as well. Different boats carry different risks. Ultimately we will require individuals to take responsibility for the risk their trips pose to the biosecurity of the islands and for them to apply the recommended prevention measures.

New Zealand has well-developed rodent contingency systems for islands and many of the techniques would be transportable to the Windward situation. They would be likely to involve poison bait stations and traps set permanently alongside potential landing areas on the two islands, particularly Black Beach, and maybe similar set-ups on the mainland in areas where boats might depart from.

Based on the current knowledge we believe that sufficiently strict biosecurity measures can be put in place that will manage the risk of further invasions to the two islands. The key issue for biosecurity is that there will need to be widespread local community implementation of the biosecurity prevention measures if invasions are to be avoided. Ensuring the villages understand the importance of prevention measures and that they implement them is a key issue for the success of the project.

## 5.3 Socially acceptable

*Explanation: Is the project socially acceptable?*

*Assess whether the project is acceptable to the local and wider communities and other stakeholders. Identify any issues that need addressing to make it socially acceptable*

*Prompts:*

- *Is this project supported by all of the necessary stakeholders (including the local community)?*
- *Include details of any stakeholder consultation already undertaken.*
- *Include indication of the level of support from community and stakeholders.*
- *Describe how local community groups have been or will be involved in the project.*
- *Describe the type and level of involvement of the community groups (including women and youth) in the project.*
- *Clearly identify any issues that will need to be resolved in the Operational Planning Stage.*
- *Remove this Help Box when the Feasibility Study Report is complete.*

*Useful Tools:*

- *Guidelines on Stakeholder Engagement*

**Table 6. Key Stakeholders**

Key stakeholders identified so far:

| Name | Organization | Contact details | Notes/comments |
|---|---|---|---|
| | Windward Village elders | In person, each village on Windward coast | Support in principle given to project. Some concern about toxins, and about long-term land tenure of the islands Landowners |
| | Windward Villagers | In person | Play key role in biosecurity prevention |
| T. Wilson - Director | NPC management staff | [e-mail address] | Need to identify as soon as possible management structure and lines of reporting |
| | NPC | [e-mail address] | |

| Name | Organization | Contact details | Notes/comments |
|---|---|---|---|
| | conservation staff | | |
| D. Sagolo | WMPA | [e-mail address] | Project Partner. Will be important for 'policing' of the islands and for biosecurity prevention public awareness |
| | MAF | [e-mail address] | Government approvals required |
| | GPA | | Government approvals required |
| Souad Boudjelas | PII | [e-mail address] | Support in finding subject matter experts and advice on project methodology. |
| Aviculturalist | Auckland Zoo | [e-mail address] | Prime candidate for leading the captive dove project |
| SPREP, NZ Dept of Conservation. | Regional conservation organizations | Email | Organizations with an interest in eradication and conservation of Pacific Islands. To be kept informed of project progress and any lessons learnt. Consult these organizations for their experience of eradication projects. PII to help identify. |

**Local Villagers**

Villagers of the Windward District have already endorsed the rat eradication proposal in principle but will need to be happy with the methodology – they have informally expressed some concerns about the bait and its possible effects on fish or other wildlife, and whether it could get into food chains and affect them. They have also raised concern about long-term land tenure of the islands, and whether the project could potentially lead to limitations or restrictions on their access or local authority over them.

The local communities will also have to understand and be willing to commit to biosecurity efforts to prevent re-invasion of rodents or other invasive species (e.g. mynas) to the islands.

Fact sheets in the Pacifican language detailing the results of many rat eradication operations around the world may be one useful tool that could be developed.

It is noted that the villagers have already endorsed the islands as being part of the Windward WMPA. This proposal must have the full approval of the Windward WMPA District Committee which includes representative of all nearby villages and all island title claimants. It must effectively involve and benefit the local people. Their close involvement will also be required for logistical purposes.

It is hoped that local villagers can be employed in the project for a variety of tasks – providing accommodation and food on the mainland if required; transporting team members and supplies to the islands; assisting in track cutting; assisting in bait carrying and distribution. They may also be required for other tasks such as assisting in the capture of ground doves, helping to undertake bird surveys and counts, and trap-setting and/or monitoring for rats.

The project has the general support of the community and key stakeholders and this support will help make the project a success. The only serious issue is the concern some villagers have raised over the use of toxic bait. The villagers voice some common concerns, all of which will need to be dealt with by the project team early in the next stage of the project.

## 5.4 Politically & legally acceptable

*Explanation: Is the project likely to receive the required legal and non-legal consents?*

*Describe the political and legal considerations that have to be made to ensure the project is feasible.*

*Prompts:*

- *Indicate the likelihood this project will receive all required legal permits and consents?*
- *List all legal permits required to carry out the project.*
- *Outline all relevant laws and regulations pertaining to the site and the proposed activities. Certain activities may either be illegal or may require granting of permits or exemptions to be undertaken.*
- *Also, any permits/approvals necessary from local authorities or Government to visit the islands, or to use toxins, traps, etc.*
- *Clearly identify any issues that will need to be resolved in the Operational Planning Stage.*
- *Remove this Help Box when the Feasibility Study Report is complete.*

*Useful tools:*

- *Guidelines on Consents and Permits*

Government and community sign-off on the WMPA Management Plan was made in 1999, and this made specific recommendations for the restoration of Far and Away Islands.

**WMPA Permits**

As protected areas, permits from the WMPA will be required for staff involved in the project to:

- Land and camp on the islands
- Cut tracks to establish baiting grid
- Capture and hold native species
- Spread toxic bait

**Land Owner Permissions**

Permission will also need to be granted by the land owning families in Magaia. As they have already approved the previous site visits and continue to support the project no problems are expected in receiving access to the islands. Some doubts remain over the use of toxic bait and further consultation is required to alleviate any concerns.

**Special-Use Bait Permit**

Consultations with the Registrar of Pesticides within the Ministry of Agriculture and Fisheries confirmed that Pestoff bait and/or brodifacoum are not registered for use in Republic of Pacifica but a special use permit can be applied for. Indications were given that for a 'one-time only' operation on uninhabited islands without livestock, approval is likely, but this will have to be dealt with as part of the operational planning.

**GPA Approval**

The Republic of Pacifica Government Planning Authority (GPA) will need to approve the project from an environmental effects perspective. Historically, GPA have approved some projects based on the Project Plan or, have, also insisted on a full Environment Effects Assessment (EEA) to be conducted first. Discussions with GPA will need to be made to confirm whether an EEA is required for this project.

While there are a number of permits required to undertake the proposed project, given the discussions the project manager has had with the relevant bodies we are confident that they will be forthcoming from the relevant authorities. The most serious issue is the possible requirement to undertake an Environmental Effects Assessment from the GPA. Our current planning and budget assumes that an EEA will not be required – this is based on informal discussions with the GPA. It is important to resolve this uncertainty as quickly as possible by securing a formal decision from the GPA.

## 5.5 Environmentally acceptable

*Explanation: Will the project have a net positive effect on the islands environment?*

*Describe what measures need to be taken to ensure that the eradication does not have net negative effect on the island environment including non-target species.*

*Prompts:*

- *Identify the likely impacts to the wider island environment. What can be done to mitigate the impacts?*
- *Identify the risks to non-target species. Can you manage these risks?*
- *Consider separating out short term vs long term impacts .e.g may kill individuals however med/long term the population may improve significantly.*
- *What is likely impact of having removed the target species e.g. will weed problems develop, other invasive species populations increase?*
- *Clearly identify any issues that will need to be resolved in the Operational Planning Stage.*
- *Remove this Help Box when the Feasibility Study Report is complete.*

*Useful tools:*

- *Guidelines on Managing Environmental Effects.*

**Non-Target Species Poisoning**

Of greatest concern is the potential for some native (non-target) species to be affected by either eating the bait directly (primary poisoning) or through consuming any animal, bird, invertebrates or carcasses of such that may have consumed the toxin (secondary poisoning).

Many studies have been undertaken to identify the risks of brodifacoum use to non-target fauna. Some deaths of individual birds are likely to occur but populations of most affected species are expected to recover rapidly and then reach higher levels than they were at before in the presence of rats.

The species most likely to pick up quantities of the toxin are those that feed on the ground and include grain/seeds in their diet, those that feed on certain scavenging ground invertebrates (e.g. cockroaches) and those that would take live or dead rats. Combining the first two would place ground doves, banded rails (vea) and coconut crabs (uga) in the frame, along with reptiles that feed on insects.

**Doves and Pigeons**

Far and Away Islands are the home to two species of doves and pigeons that are internationally classified as Vulnerable or Endangered: the ground dove and the crimson pigeon. Also present are the many coloured fruit dove (*Ptilinopus perousii*) and white throated (breasted) pigeon (*Columba vitiensis*), which are of conservation concern in the Republic of Pacifica. All of these feed on foliage and fruit but some at least may also feed upon bait pellets on the ground.

For one of the at risk species, the ground dove, Far and Away hold populations that are nationally significant. The complete loss of these populations would threaten the survival of the taxon in the Republic of Pacifica. Some authors consider the Pacifican doves to be a separate race (*Gallicolumba s. pacifica*) from those elsewhere in Polynesia (Watling 2001). Outside the Republic of Pacifica, the race is only found on the small island of Ofu in American Samoa, where it is threatened. The loss of the Far and Away populations, however unlikely, could threaten the race with extinction. As a consequence it is felt that actions will need to be taken to safeguard the birds on Far and Away Islands at a population level (i.e. accepting that some individuals may be affected but ensuring that a sufficient number survive to repopulate the islands). Possible options are outlined in Appendix 2.

Due to the national importance of the ground dove, it is considered that for the eradication project to be considered a success the long term population of the dove must be protected. To reflect this, a specific objective to safeguard the population was added to the original project objectives (See section 2.2: Goal, objectives and outcomes).

The practice of removing birds or other non-target species to zoo facilities during poison application has been successfully demonstrated in New Zealand. This may not be feasible in Republic of Pacifica for a range of reasons: it is difficult to capture these species, no husbandry facilities exist, the risk that they would not survive in captivity, the risk they would not reintegrate successfully into the wild, a suitably qualified aviculturist would have to be employed and this would be a costly operation. However, some indications are that an overseas zoo could be interested in aiding the project by providing expertise and some funding to assist.

The risk of poisoning to ground nesting seabirds is negligible, as they do not feed on the ground, and the species present here (or closely-related species) have not been affected in any prior operations to date (e.g. Pierce et al 2008).

**Reptiles**

Four species of skinks and two species of geckoes are found on Far and Away Islands, but are also widespread elsewhere in Republic of Pacifica. Reptiles have generally not been affected by brodifacoum baits but there are rare instances where individuals have been killed (Fisher & Fairweather 2005). Any possible impact on these species is not likely to be of significant concern.

**Fruit Bats**

The fruit bats are almost entirely frugivorous. They are unlikely to take bait and as they very rarely feed on the ground they will not have ready access to it. They are considered unlikely to be affected.

Non-target species such as predators and scavengers are at risk of secondary poisoning. Brodifacoum can stay sub-lethally in the liver of non-targets such as invertebrates, for greater than 9 months, thereby increasing the potential of secondary poisoning for omnivorous birds (Fisher & Fairweather 2005). Rats will continue to feed on the baits as death is delayed by several days, and the excess poison in the carcasses can present a serious hazard of secondary poisoning to species such as the barn owl (*Tyto alba*). People may eat a number of the species on the island, particularly coconut crabs, the pigeons and bat species.

**Banded Rails**

It is considered that the chances of all the banded rails on either island dying are low. Banded rails are abundant on the adjacent main island of Manu Island, and not threatened. If necessary, birds could be re-introduced to the islands.

**Barn Owls**

The only predator of dead or dying rats that may be present is the barn owl (lulu) but at the most only a few pairs are likely to occur on the islands. Barn owls are considered regionally and globally widespread and locally common in this area, and they move easily between islands (Watling 2001), so if any birds on the islands are killed, others from Manu Island, will re-establish on Far and Away.

**Coconut Crabs**

The internationally 'Vulnerable' coconut crabs could also be affected. Coconut crabs will eat bait and will also certainly scavenge carcasses. Coconut crabs like most other invertebrates will not be killed by brodifacoum. However there is a temporary risk to people who may feed on them. Studies on Ascension Island found that brodifacoum passed quite quickly out of the bodies of land crabs there (Pain et al 2000). These results will need to be reviewed to assess their applicability to coconut crabs and to identify a period after the spreading of the toxin during which they may remain toxic. There should then be a thorough publicity programme nationally, with particular emphasis on local villages. The safest and easiest approach would be to state that all crabs on and near these islands could be toxic for a period and to ban taking of them. This period should be conservative, i.e. make it longer than perhaps strictly necessary to be sure of no harmful effects and to significantly benefit local coconut crab populations.

**Other Species**

Several other species such as the kingfisher and some insectivorous species may be at some risk. Though a few individuals may die, population level effects are not expected. Even in the very worst case scenarios, the unlikely total loss of these populations would not threaten the survival of the taxa. Populations could later be re-established by transfers from elsewhere. No management measures are therefore recommended for any of these species.

**Other Short-Term Effects**

Further unpredictable and potentially unwelcome short-term effects also include:

- Chaotic short-term fluctuations in abundance of resident species, for example explosive production of invertebrates leading to defoliation of native plants.
- Heavy production of flowers leading to over-production and then high mortality of some bird species.
- Increase in plant pests that may have been suppressed by rats consuming seeds.
- High mortality of other species that 'overshoot' food supplies as the population limitation that rats imposed is removed. Such overshoot is unlikely to result in long-term deleterious effects to the populations.

However, in New Zealand these unwelcome effects after eradication of Pacific rat have usually been experienced by exotic species in modified environments. They have included proliferations of introduced garden snails and native chafer beetles on previously farmed islands. The chafer beetles then attacked a rare species of native shrub (Towns *et al* 1997). It is considered that these negative effects would be very unlikely to occur on the relatively intact native vegetation ecosystems on Far and Away, and if they did, they would be of minor and short-term consequence only.

**Effect on People**

The potential risk from a baiting operation to the people using the islands or surrounding area is thought to be very low. The local villagers will play an integral role in any operation on the islands, and will be made aware of the potential risks to them. Outlining safety issues and outlining the nature of the toxin will be a very important part of the community consultation process.

The major issue may be their concern about when food resources from the islands would be safe to eat again. They will need to accept that a temporary ban would be necessary, and that this should have a wide safety margin factored into it, to ensure all possibility of any negative effects on humans is eliminated.

**Disposal of Waste Material**

It is likely that some toxic baits and some toxic materials (e.g. empty sacks) will be produced as waste from the ground-based operation. Safe disposal of these is an issue that will need to be addressed. Incineration and deep burial are two options listed in the brodifacoum Material Safety Data Sheet (MSDS), and this may be possible on the islands. Advice should be sought from the Republic of Pacifica Government Planning Authority (GPA) if they cannot be disposed of appropriately on the islands.

## 5.6 Capacity

*Explanation: Can you source all the required skills and expertise?*

*Assess whether the implementing agency has the skills and expertise to undertake the project.*

*Prompts:*

- *What skills are needed to undertake the project, are these skills locally available, if not where would they come from, do you need to train people in key skills, does your agency have the skills to manage the project?*
- *Do you have all the required people and skills to complete the project? Identify what training will be required.*
- *Clearly identify any issues that will need to be resolved in the Project Design and Operational Planning Stages.*
- *Remove this Help Box when the Feasibility Study Report is complete*

**NPC Project Management**

Previous eradication projects have provided NPC with sufficient project management experience to lead the proposed project. It is noted that the three previous projects completed by NPC have been smaller than the proposed project. However, as the same project manager managed all three projects it is thought that his experience will scale up to the proposed project. The independent technical reviewers (Moore and View) have confirmed that the project manager's experience is suitable for a project of the proposed size. The size of the project would make it unsuitable for a less experienced project manager.

**Specialist Input**

While the completed projects have provided NPC with some technical experience, there are several technical areas that will require specialist input. For example, a rat eradication expert knowledgeable in hand-broadcasting baiting techniques on larger islands will be needed to provide input into the operational plan and lead the implementation staff. Every effort must be taken to use the project to continue the upskilling of NPC conservation staff, most notably Eradication Officer, F. Paua (who has participated on previous NPC eradication projects).

Hand-broadcasting of bait for rat eradication is a relatively straightforward operation that requires significant labour but relatively little prior training, so long as on-site guidance from experienced personnel is available.

Track-cutting can be achieved by local labour, guided by an eradication expert, with track directions and distances apart being established using either a GPS or compass and measuring tape.

**Table 7. Key Skills NPC need to find to complete the project**

| KEY SKILL | PURPOSE | METHOD TO OBTAIN SKILLS |
|---|---|---|
| Team leadership and experience in hand-broadcasting bait | Ensuring the task is completed thoroughly and correctly | Employ specialist on contract |
| Technical leadership (capacity building) | Planning and co-ordinating implementation | NPC Eradication Officer to buddy up with specialist. |
| Trap use for rodent monitoring | Density estimates, monitoring, detection and DNA collection | Specialist to train and upskill NPC staff as part of activities. |
| Capture of ground doves | Data gathering and protection of species | Specialist to train and upskill NPC staff as part of activities. |
| Monitoring methods for hermit crabs | Determining bait rates required | Specialist to train and upskill NPC staff as part of activities. |
| GPS use | Track-cutting and navigation | GPS training for several NPC staff (funding required) |
| Compass use | Track-cutting and navigation | Practical training for several NPC staff (funding required) |
| Track-cutting, and travel over | Accessing all parts of the island | NPC staff have necessary skills |

| | | |
|---|---|---|
| rough terrain | for baiting | |
| Safe method of carrying and distributing bait | Spreading bait effectively over both islands without hazard to operators | Training in skills and techniques to be provided by specialist at start of operation |
| Computer management and storage of GPS data | Mapping of tracks to ensure total track (and bait) coverage of the islands is achieved | Some local capacity in staff likely to be involved in project, to be aided by specialist expert during actual operation. |

**Staffing**

*Project Manager*:

NPC have allocated V. Reed to be project manager. Reed has project managed the previous 3 NPC eradication projects and has the required skills to complete the project.

*Technical Co-ordinator/ Operation controller*:

A technical rat eradication expert will be required to act as the technical co-ordinator in the project team. They will provide technical expertise, guidance and take responsibility for completing the technical activities. They will assist the PM in planning the technical activities.

An experienced operator should be involved to coordinate the hand spreading of the bait, liaising with bait supplier, and organising the actual drops. There are several eradication contractors or employees of the Department of Conservation with the relevant experience in New Zealand and their involvement could be sought by PII through its association with the Department. If the selected person is an employee of the Department, salary costs may be covered, but fees would be required for private contractors. In all cases travel and accommodation would need to be budgeted for.

*NPC Eradication Officer – assistant technical co-ordinator.*

To continue to build NPC eradication skills it is recommended that the NPC Eradication Officer, F. Paua, be allocated to the role of assistant technical co-ordinator. Mr Paua has some technical eradication experience from previous NPC projects but will gain significantly by working closely with a more experienced eradication specialist. His availability will also provide much required help to the technical co-ordinator.

*Independent rat eradication Technical advisor:*

The independent expert will review project documents and conduct the operational readiness review. The advisor will not be involved with the actual completion of the project, but will remain independent so as to provide objective reviews of planning and progress. We will work with PII to source a suitable expert for this role.

*Aviculturist*:

An aviculturist will be required to lead the ground dove capture activities. It is hoped that an overseas zoo will support the project by supplying an aviculturist (as occurred in the Seychelles rat

eradication projects). Indicative support to the project has been given by Auckland Zoo in New Zealand. Further work will be required to establish what costs will be covered by which agency.

*National Parks and Conservation Department (NPC) staff*:

Four NPC staff will be required in the preparation and implementation of the project. It is recommended that the four staff members who have worked on the previous NPC eradication projects be allocated to the project. Daily allowances for work on the islands and some logistical funds will be required.

*Villager support*:

Ideally teams of eight are required for the track-cutting and bait spreading. It is hoped that four villagers will be included in the implementation. Villagers have assisted previous expeditions to the islands and it is hoped that they will continue to do so.

*WMPA involvement*

The involvement of the local WMPA manager will be a key and funding will be required for his involvement.

With the inclusion of a more experienced external expert on hand-broadcasting projects on large islands, NPC will have the required skills and experience to complete the project. The project will also provide the opportunity for NPC to increase their experience of larger eradication projects and learn from the eradication expert.

**Institutional support**

The project will require the support of relevant Government agencies. There are indications of unresolved issues in NPC senior management (e.g. regarding application of toxins) and a question whether a Project Manager in NPC will be able to focus on managing the project with many competing priorities. Declared institutional commitment to the project from the outset is critical to ensure success.

Currently the project management structure and responsibilities between agencies (e.g. WMPA and NPC) are not entirely clear, and a clear management structure and consistent support will need to be confirmed, and this will be critical to the outcome of the project.

## 5.7 Affordability

*Explanation: Will you be able to secure the required funding?*

*Provide indicative costs for the project*

*Prompt:*

- *You will only be able to provide a high-level estimate at this time as there has been no detailed planning*
- *Make sure you include some budget to cover unexpected tasks identified during the later detailed planning*
- *Add a contingency amount (as a percentage of the sub-total) to cover the risk of encountering any unexpected costs during the Stage.*
- *A default contingency of 20% is suggested but funders may have a prescribed percentage to use – check with funders how they expect the project to deal with contingency*
- *Sustaining the Project Stage will include a one off set up cost (e.g. purchase of surveillance equipment) and annual running costs. The template suggests estimating the cost of 5 years of sustaining, but this period may differ from project to project. Biosecurity prevention work will possibly need to continue indefinitely.*
- *Remove this Help Box when the Feasibility Study Report is complete.*

*Useful Tools:*

- *Guidelines for Project Managers*

Current funding covers only the Feasibility Study Stage. The budget below is to complete the Project Design Stage, Operational Planning Stage, the Implementation Stage and the Sustaining the Project Stage. The budget includes 5 year costs for the surveillance and incursion response activities. After the initial 5 years, NPC would take responsibility for finding funding to continue the biosecurity activities.

**Table 8. Indicative Costs for Rat Eradication from Far and Away Islands**

**Estimated costs per Stage**

| Item | Details | Cost (NZ$) |
|---|---|---|
| | | |
| **Project Design Stage** | | |
| Salary: Project Manager | Planning and writing Project Plan | 5,000 |
| Contractors | Planning and writing Project Plan | 5,000 |
| | Project Design Stage, sub-total | 10,000 |
| **Project Design Stage, Expected cost** | | **20,000** |
| | | |

| Item | Details | Cost (NZ$) |
|---|---|---|
| **Operational Planning Stage:** | | |
| Contractors | Planning costs – development of biosecurity, monitoring, and operational plans | 15,000 |
| Meeting costs | Food, gifts, travel costs etc for meeting with local communities, Government agencies, etc | 5,000 |
| Salary: project manager/administrator | Part-time for one year. Covers all stages of project | 40,000* |
| Salary: assistant technical co-ordinator | NPC Eradication Officer. Part-time for one year. Covers all stages of project | 20,000* |
| Field trip(s) for crab densities, ground dove trials, rodent monitoring and DNA, etc | Contract eradication expert, plus local staff | 20,000 |
| Publication of pamphlets etc on project, and biosecurity | 500 pamphlets in English and Pacifican | 1,000 |
| GPS and compass training | 4 NPC staff involved in project | 1,000 |
| Operational Planning Stage, Sub-total | | 102,000 |
| Operational Planning Stage, Contingency (10%) | | 10,200 |
| **Operational Planning Stage, Expected cost** | | **112,200** |
| | | |
| **Implementation Stage:** | | |
| Bait purchase in NZ, transport to port | At least 2.5 to 3 tonnes (2,500-3,000kg). Bait rates suggested at 12kg/ha for a total of 133 ha, plus additional needed for extra-high baiting areas and for contingency) | 10,000 |
| Shipment, NZ to Port Pacifica | Up to 3 tonnes of bait on pallets | 2,000 |
| Local storage and transport | Storage costs in Port Pacifica or Windward, and road transport from port to Windward coast | 2,000 |
| Contracted baiting specialist | 2 months | 15,000 |
| Airfares, accommodation, taxi, etc for NZ expert | Return flights from NZ, motel accommodation | 5,000 |
| Waterproof/rat-proof containers for bait and electronic equipment | 20 large dry bags @ $50 ea and 20 x 20-litre sealed pails @$20 each | 1,200 |
| Track-cutting staff | Estimated 50km of track, at 300m/track per | 18,000 |

| Item | Details | Cost (NZ$) |
|---|---|---|
| | person per day = 170 person days, plus equipment | |
| Food and consumables for trackcutters | 170 person days @ $10/day | 1,700 |
| 8 baiting staff | 2 baitings a week apart, each taking estimated 20 person days each, plus allowances. | 32,000* |
| Food and other consumables (batteries for GPS's, kerosene for lighting etc) for baiting staff | 40 person days @$12/day | 500 |
| Local boat transport to islands | 20 return trips @ $200 each | 4,000 |
| Technical, camping & safety equipment | incl. GPS's, sat. phone, computer, GPS software, VHF radios, tents, cooking utensils, protective clothing, marking tape and pens, notebooks | 12,000 |
| Captive holding facility for ground doves. | 2 person team – airfares, transport, food, camping equipment, aviary materials, | 20,000^ |
| Post-operational bird monitoring.<br><br>Part of this cost will be spent in Sustaining the Project Stage | Transport, labour costs.<br><br>(may be covered in government department budgets?) | 15,000 |
| Post-operational rat monitoring<br>Part of this cost will be spent in Sustaining the Project Stage | Transport, labour costs<br>(could be combined with bird monitoring above to save costs) | 15,000 |
| Operational review | Contractor, with local input, for 2 weeks | 3,000 |
| Implementation Stage, Sub-total | | 156,400 |
| Implementation Stage, Contingency (20%) | | 31,280 |
| **Implementation Stage, Expected cost** | | **187,680** |
| | | |
| **Sustaining the Project Stage:** | | |
| Biosecurity – Set up | Equipment: Traps, bait stations, tracking tunnels. | 2,000 |

| Item | Details | Cost (NZ$) |
|---|---|---|
| Biosecurity – annual running costs | Bait replacement, wages for monitoring costs. | 4,000 per annum* |
| Post-operational bird monitoring.<br>Included in Implementation Stage budget | Transport, labour costs.<br>(may be covered in government department budgets?) | |
| Post-operational rat monitoring<br>Included in Implementation Stage budget | Transport, labour costs<br>(could be combined with bird monitoring above to save costs) | |
| Sustaining the Project Stage running costs for 5 years (A) | | 20,000 |
| Sustaining the Project Stage Set up costs (B) | | 2,000 |
| Sustaining the Project Stage sub-total(C=A+B) | | 22,000 |
| Sustaining the Project Stage Contingency (D=20% of C) | | 4,400 |
| **Sustaining the Project Stage, Expected 5-year cost** | | **26,400** |
| | | |
| | | |
| **PROJECT TOTAL** | | **346,280** |

*[NB some may be salaried Govt staff and their salaries will be covered elsewhere].

^ indicates zoo may cover wages and some other costs

# 6. CONCLUSION

*Explanation: Does this project have a high chance of succeeding?*
*Prompts*

- *Include a clear statement of whether the proposed project is feasible or not*
- *If the project is considered NOT feasible, clearly describe why this conclusion was arrived at*
- *Explain the conclusion based on the findings of Can It Be Done Section*
- *Highlight any key issues that have been identified and will require addressing in later stage to make the project a success*
- *Base your conclusion on the:*
  *i) 7 criteria of the Can It Be Done Section*
  *ii) What will it take to overcome any issues*
  *iii) Net benefits and costs of the project.*

The hand-broadcasting technique has achieved success in the past on other similar islands that are comparably remote and, in some cases much larger. There is nothing about the terrain of Far and Away Islands to pose an unsolvable problem to thorough bait broadcast. Fewer eradication projects have occurred in the sub-tropical or tropical climate zones as opposed to temperate climates, but enough to suggest there is a very high chance for success.

Given this history of success using the same bait on larger and difficult islands, and on islands with similar climate and latitude, the eradication of Pacific rats from Far and Away should be technically feasible.

Since Far and Away are uninhabited and without livestock an eradication project would not pose a health hazard to resident people and their domestic animals. The absence of people and livestock also makes for a simpler operation, with no need for complex safety and community-awareness plans.

While there is much consultation and clarification of methods and management structure to be undertaken yet, there are no obvious social, legal or political obstacles apparent. There is general support for the project, and no apparent opposition. Some concerns and issues have been identified in this study, but all seem to have a range of possible solutions.

Before it commences there is a need to firmly establish the management structure and to obtain key stakeholder commitment to the project, especially from relevant government agencies, otherwise it should not proceed.

Biosecurity will be a very important aspect in protecting the natural biodiversity of the islands, and again, key stakeholders, especially local communities, will need to 'buy in' to the need for changes for procedures for visiting the islands. Without effective long-term biosecurity it is unlikely the benefits of rat eradication would last long.

There are also some issues relating to non-target species, but it is felt that these should be able to be overcome with some further field investigations in the next year.

While some technical expertise will have to be sought from overseas, much of the work can be done by NPC with support from WMPA and the local communities. The local 'ownership' of the project will be very important in sustaining any conservation gains made.

The only obvious shortcoming is cost. It is beyond the local agencies to fund this project to completion, so external funding will need to be sought. The budget is relatively modest compared to the potential conservation gains that can be made.

In conclusion, this project, if carried out professionally and in adherence to recommended best practice, has a very high chance of success. The key issues that would need addressing are:

| **Issue** | **Recommendation** |
|---|---|
| Technical approach: effect of hermit crab bait uptake | Further advice from rat eradication experts.<br>Hermit crab uptake trials<br>Hermit crab population survey |
| Sustainable: need for local communities to implement biosecurity prevention measures | Extensive community consultation and public awareness campaign |
| Socially acceptable: community reservations to application of toxic bait | Extensive community consultation to alleviate concerns |
| Legally acceptable: One-off MAF permit required for use of brodifacoum | Early application to MAF |
| Legally acceptable: Possible requirement for EEA from GPA | Early discussions with GPA |
| Legally acceptable: Need approval from WMPA to land on islands, cut tracks etc | Early application to WMPA. |
| Environmentally acceptable: Threat to ground dove from bait | Ground dove capture program implemented |
| Environmentally acceptable: Threat to people from toxin-contaminated food | Public awareness campaign |
| Need to build capacity of NPC | Inclusion of NPC Eradication Officer as project assistant technical co-ordinator. |
| Unclear division on responsibility between WMPA and NPC | Agree and clearly communicate the responsibilities of WMPA in the project |

# 7. REFERENCES

*Explanation: Use this section to record other documents that have been used and referred to in preparing the Feasibility Study Report*

*Prompts*

- *List the references alphabetically*
- *Remove this Help Box when the Feasibility Study Report is complete.*

**NB. For the purposes of this example document some references have been invented and some are real. The real documents are shaded like this and some are valuable references for developing projects. The others in the example reference list do not exist!**

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# APPENDICES

*Explanation: Use this section to record background information and information that does not fit into any of the other sections but may be of use in later project phases.*

## Appendix 1 Proposed Work plan

**1: Pre-eradication field programme:**

- Conduct pre-eradication bird counts
- Trial netting of ground doves and finalising preferred protective options
- Hermit crab density counts in different habitat types
- Monitor density of rats on Away Island and DNA sampling from rats on both islands

**2: Progressing the proposal and implementing the rat eradication programme**

This requires (approximately in this order):

- Securing additional funding, including fees for a project manager and technical advisor.
- Developing a detailed Project Plan for the field project.
- Consultations to obtain community and stakeholder approval of the project. (Not to be done in detail until funding is confirmed so as not to raise community expectations and then disappoint them, though this proposal could be used for preliminary discussions.) Ensure that the community are willing to take all the steps needed to prevent re-invasion.
- The Government Planning Authority (GPA) of the Government of Republic of Pacifica need to approve Project Plan from an environmental impact assessment viewpoint.
- Final sign-off on Project Plan by National Parks and Conservation Department, Windward WMPA Incorporated Society, PEA, and other funding agencies.
- Develop a detailed Operational Plan, along with associated documents necessary for the project to proceed – Biosecurity and Monitoring plans, Task Schedule, etc.
- Repeat stakeholder consultation and approvals from Government agencies, and gain approval for plans.
- Finalising staffing (including observers from other countries)
- Approaching NZ Department of Conservation or associated contractor for an operations coordinator and the zoo industry for avicultural support.
- Undertaking any staff training required
- Finalising contracts for supply, delivery and storage of poison baits
- Advertise that the operation is coming up, including identification of the importance of not eating crabs from the area.
- Track-cutting and establishment of the grid system
- Carry out the operation
- Debrief, review operation, write-up
- Monitor for success, and for biodiversity responses

- Spread the word about the operation as a successful (we hope and expect!) demonstration project.

# Appendix 2 Safeguarding the ground dove

Taxonomic Situation

The conservation status of the Windward Island ground dove population is uncertain. Any genetic differences are also unclear. The ground dove has been identified as potentially at risk from the bait operation. These risks will need to be further assessed and appropriate strategies put in place to ensure there is no risk of extirpation or extinction stemming from this operation.

- Complete DNA analyses to determine the genetic status of the Windward ground dove population.
- Refine and obtain support for an appropriate risk management strategy for the species.

Vulnerability to brodifacoum baits:

The ground dove's diet is recorded as seeds, fruit, buds and young leaves and shoots (Watling 2001). It is likely that the ground dove would be at risk of direct poisoning through feeding on bait fragments. This view is endorsed by Klaus Hoffman who has had considerable experience with holding the species in captivity (see Annex 1 below). Laboratory and field studies have tested the impacts of brodifacoum on several birds that can be used as indicators of the likely effects on ground doves. In captivity, 60% of 20 bobwhite quails (*Colnus virginianus*) and ring-necked pheasants (*Phasianus colchicus*) died after exposure to 0.005% brodifacoum pellets for 14 days, and LD50s for 100g non-passerines were about 2.6 0.2g pellets and for 1000g birds 26 pellets (Erickson & Urban 2002). Aerial applications of 0.002% brodifacoum baits on two New Zealand islands reduced the weka *(Gallirallus australis)* population by 98% and the pukeko (purple gallinule) (*Porphyrio porphyrio)* population by 90% (Fisher & Fairweather 2005).

Baits will be dyed green which has been shown by research in New Zealand to reduce their attractiveness to birds. Every effort will be made to minimise bait fragmentation prior to delivery. Investigations suggest that no ground doves are available in captivity in the region to conduct any bait acceptability trials. Attempts to watch or video their reaction to baits were not successful during the Johnson (2003) expedition to the islands due to technical problems and the low densities of birds. It must therefore be currently assumed that they will be at risk from feeding on any bait fragments on the ground.

Significant mortality of the barred ground dove (*Geopelia striata*) was observed during similar operations in the Seychelles (between 40-80% of individuals on different islands) suggesting that ground doves as a group are particularly vulnerable (Merton *et al* 2002). One overseas expert suggests that it should be assumed that the operation will kill most of the doves (J. Tuttle *pers. comm*.).

Distribution:

Some assessment of the distribution of ground doves has been undertaken to determine if they are concentrated in certain habitats on the islands that could be treated differently. They have been

observed widely on both islands though not apparently in the Black Beach flat on Far. On Ofu, the only island in American Samoa where they still persist (but are threatened), they occupy steep talus area of well-developed native forest with comparatively open understorey and patches of bare ground (Engbring & Ramsay 1989). It seems that all forested parts of the islands including those on steep slopes can be considered the birds' habitat.

Detailed surveys on Far and Away including colour-banding were approved for funding several years ago as part of a PEA avifauna programme but never took place. Casual observations during recent expeditions have been unable to provide any realistic estimates of the population present on each island but they appear to be at relatively low densities.

Options:

Several options for minimising the risks to the ground dove can be considered. One is to treat the two islands separately – using rat eradication on one to assess the risk to the species before deciding how to go about the other island. The idea is that if significant dove mortality occurred on the first island this could be re-stocked from the second island before it was treated. If no significant mortality was detected then the second operation could go ahead using the same methodology. This option is not considered ideal because of the additional expense involved in co-ordinating and funding two separate operations.

Conducting feeding trials with non-toxic baits was considered. However, even if birds did not appear to take baits under experimental conditions there was no guarantee that they would not do so during the drop. Covering part of the area with ground stations was also looked at, but not enough is known about the birds' home ranges to be sure that they would not also use cliff areas which would have to have hand-broadcasted bait.

The option of holding birds in captivity so that they are not exposed to bait appears most feasible. Within this option there are two possible approaches. One would involve holding birds in temporary aviaries that would exclude baits on the islands or adjoining mainland, then releasing them immediately that the risk of poisoning had passed. This would presumably be taken as the point that any remaining baits had broken down so completely that they would be unavailable to doves. The trials conducted in 2003 suggested baits to still be partly intact after seven days so a significantly longer period than this would be needed. Temporary aviaries have been used frequently in New Zealand bird conservation programmes and designs are available. It would be feasible to build aviaries in sections on the main island Manu Island, in Republic of Pacifica and ship them to the Windward Islands for erection there.

The second approach would be to hold birds in a more permanent situation to allow them to breed and then return an increased number to the islands at a later date. Such captive breeding is very important for conservation in many countries and clearly can work in the South Pacific. The Tongan Bird Park provides an example of a facility that has been sustained for many years becoming both a tourist attraction and a source of significant conservation outcomes at times (see Annex). It is also worth noting that the Republic of Pacifica's National Biodiversity Strategy contains two relevant actions: '2.1.3. Explore the feasibility of establishing captive breeding/spawning programmes as a security from the Impacts of natural disasters and invasive species introductions' and '2.1.5. Explore and assess the feasibility of setting up an aquarium/zoo for conservation of indigenous species' so

any initiative would contribute to wider goals than just the eradication. The obvious site for any captive locality would be the Port Pacifica Botanic Gardens which already houses the headquarters of the country's National Parks and Conservation staff. Such an option could perhaps obtain its own funding and support, maybe from an Australasian zoo.

The temporary holding approach was favoured by most experts who commented on this issue. However, some experts questioned whether enough birds can be caught. The proposed timetable allows time for further assessments to be done on the islands. An expedition could be organised to net birds and colour-band those caught. This would identify the effectiveness of the technique and allow it to be improved, as well as providing a means to estimate the total population by subsequent observations of banded vs. unbanded birds.

**Annex 1: Capture and Husbandry of Ground Doves**

The following notes were prepared by Klaus Hoffman, formerly in charge of the Tongan Bird Park and now Conservation Director, Egerton Bird Park, England as advice to a programme for the Tuamotu ground dove in Tahiti.

*"The doves are easy to keep on a simple small seed mix, which is available for small doves such as diamond dove etc. (all these small Australians). I also offered fruit of various kinds, cut into small cubes. A vitamin and mineral powder is added to the fruit mix on three days per week. I captured approximately 60 ground doves (Gallicolumba stairii) in Tonga to start a captive breeding programme, 20 of which were taken from a remote island to a breeding centre on Tongatapu, the remaining were measured and released.*

*Ground doves are extremely nervous, and they injure the fronts above the beak, when trying to escape through wire. The transport boxes should be all wood with small holes around the tops of the sides of the box. It should be dark inside, so that they do not move much. The boxes should be small, perhaps 20 by 30 cm, and 15 cm high. Each bird needs a separate compartment, because they can be rather aggressive. Birds can be kept in such boxes up to 24 hours.*

*The capture cages should be made from sack-cloth in order to prevent any injuries. Sack-cloth normally gives them enough light to find water and food. The ground doves from Tonga easily ate any mix of small seeds (ideally a prepared mix for small doves), a dried food mix for insectivorous birds, and small berries. Again, I had difficulties to keep birds together in small enclosures, so separate cages should be provided. I had several birds not getting enough food when several where kept together in one box or cage.*

*The aviaries should be well planted, giving them places to hide, and should not be too high (2 to 2.2 metres only), because when frightened, they fly straight up and often hit the roof of the aviary. Some artificial horizontal branches (diameter 2 to 4 cm) should be provided, because the birds prefer thicker branches to sit on. Wire mesh size is approx. 16 mm. The back and one third of the sides of the aviaries should be closed walls (I used thin sheets of timber), and the back third of the aviary should have a roof (I used corrugated iron or plastic), so that the birds have some shelter.*

*Whenever I approached the cages and aviaries, I "talked to them", so that they were prepared that someone approaches the aviary. The doves should be kept in pairs only.*

*They easily started breeding. I used halved whole coconuts (including the fibres), taking out the shell and the copra. The birds could nest in the cups of soft fibre then. Several of these "artificial nests" were put at various places and different heights within each cage. Very important: the aviaries must be absolutely safe to prevent rats and mice from penetrating the enclosures.*

*In Tonga, I reared 64 young doves in three years from six pairs. Most of the offspring were released on remote Tongan islands - but I never had a chance to check whether the releases were successful.*

*Capture cages are those, which I used in the field to keep the birds in during the time between capture and transportation. As far as I remember, these cages were approximately 80 cm by 50 cm and 50 cm high. The Tongan ground doves are also very tame and can be approached very closely. However, they can easily be frightened, especially after capture, when they have been in human hands, and if one surprises them when approaching. Ground doves in general have the habit to fly up very fast and straight once they are frightened. We used mist nets, which we placed close to the ground. I had no hand nets, but if the birds are very tame, this method could be successful. If the first attempt fails, however, the use of hand nets may not be possible any more. The birds can remain in the transport box for some time, perhaps up to 48 hours, if food and water are provided. Food is easy, because you can spray seeds on the ground of the box. For water, we use plastic cups, which we nail into one corner of the box, put in a sponge, and fill it up with water. You can also give finely cut fruit, but these get bad very fast, so you would need to replace it during transfer. This is not good for the birds."*

## Appendix 3 Site Visits

*Explanation: Use this section to record details of each Site visit.*

*Prompts*
*For each site visit include:*

- *Date of visit*
- *Who was in team*
- *What activities were undertaken*
- *Who you talked to (e.g. in local communities) and key points/key information gained from the meetings*
- *The biosecurity prevention measures that were implemented.*
-

*Useful Tools*
- *Guidelines on Stakeholder Engagement*
- *Guidelines on Biosecurity.*
- *Guidelines on Feasibility Study.*

A range of field trips have taken place to the Far and Away Islands, including those of Johnson (2003), Parita *et al* (2003), Turner (2000) and McCormack *et al* (2000, 2001). These trips have already investigated many of the issues. However, some issues are outstanding and there is also a need to ensure the information they gathered is still current.

For the purpose of this Feasibility Study, a field trip of 5 days was made from 25-30 June 2009. Personnel involved were D.Ratta (contractor), with Rodney Suleosi and Karl Umaga from NPC and Lance Denver from PEA. Transport to and from the islands from Windward wharf was in a dinghy with outboard motor operated by Paga and Tonu Matipo from the Magaia village, and they also spent time ashore with us during the days but returned to their village each night.

**Biosecurity measures undertaken:** All equipment was thoroughly inspected for the presence of invasive species before packing and loading onto the boat. Plastic boxes with sealable tops or tied bags were used where possible to pack equipment. Before loading the dinghy was emptied and washed down with salt water. A careful inspection was made of the dinghy looking for any invasive species. Individuals in the team inspected their clothing, footwear and personal belongings as part of packing. No invasive species were found in the pre-loading inspections. The pre-loading inspections were repeated just before leaving each of the two islands to ensure no invasive species were transported off the islands.

The goals for this field trip were:

- Assess best and alternate landing options (with respect to getting bait, personnel and gear safely ashore)
- Determine best options for camping sites
- Assess best options for layout of a track network on both islands
- Briefly survey the current populations of ground dove especially (with respect to numbers present and potentially available for captive holding), and other threatened species.
- Conduct a series of five-minute bird counts to bring previous survey information up to date (all forest birds, ground dove, crimson pigeon).
- Examine seabird colonies, map locations of these, and estimate breeding numbers if possible and/or develop a method to monitor these (red footed booby and black tern).
- Conduct transect counts of hermit crab densities in various habitats on both islands, to assist in determination of baiting rates
- Confirm rat species, relative population densities and take DNA from captured animals through a series of kill-traps established for two nights on each island.

Landings were made on both islands and two nights spent ashore on each. Before landing at each island, it was also circumnavigated close to shore to assess cliffs and other areas that may be difficult to access from land. Away Island was visited first as weather was good, and access there is often more difficult.

Ground doves were surveyed during morning walks. As walking tracks on both islands are currently limited we could not do a full coverage of the islands in the time available but recorded everywhere a dove was seen. At least 17 individual dove sightings were made on Far, and 6 on Away, and as much of both islands could not be covered thoroughly, the results suggest that there are sufficient to enable capture of a reasonable number for captive holding if necessary.

Hermit crabs were counted on ten pre-established 100m transect lines on Far Island, and on 6 similar lines on Away Island. All crabs within a metre to either side of the line were counted to get a count over a 200m$^2$ area (0.02 hectare) in total. Each line was counted once per night commencing one hour after dusk. Maximum densities were near Black Beach on Far Island where the line through the coconut plantation, and this resulted in counts of 21 and 17 over the two nights, representing a density of approximately 1,000 crabs per hectare. The counts on all other lines ranged from 1-4 per transect, representing an approximate density of 60-200 crabs per hectare.

A series of 20 rat traps were set out on Far Island, and 10 on Away. Traps were left out for two nights, but checked each morning. All had to be tied to sloping tree trunks at least 30cm off the ground to prevent access by crabs. They were baited with toasted chunks of coconut sourced from Far Island. Seven rats were caught on Far, and 3 on Away. All were confirmed as *Rattus exulans*. Of the 4 females examined, only one showed signs of breeding recently (distended nipples with bare skin around) while one other mature animal had no signs of breeding and the other two were young

of the year. DNA samples of all 10 rats (the tips of tails) were labelled and stored separately in preserving alcohol. These samples are currently held by R. Suleosi at NPC.

Bird count stations were established on Far Island, and 20 x 5-minute counts were made. Bird counts were completed for all forest birds, crimson pigeon and ground dove on Far Island only. Time constraints meant the bird counts were not completed on Away Island.

The site of seabird colonies was visited on Far Island. Valuable information was gained about the locations of nesting areas for the various species, and some further discussion with seabird experts is required to formulate the best option for monitoring of these species.

Other sightings of note were a juvenile boa seen on the western slope of Far Island on the 29th, and a hawksbill turtle ashore on Away Island on the night of the 26th, with tracks in the sand indicating several others had visited recently.

Unfortunately, red-vented bulbuls were recorded for the first time on Away Island. Two birds were seen and several others were heard during our visit.

The boat operators (Paga and Tonu Matipo) were extremely helpful in passing on their local knowledge of the islands, and as a result sped up the investigations considerably. Landing and camping sites were rapidly selected, and were able to assist greatly in surveying for the ground doves and other tasks. They are very happy for the rat eradication to proceed, and their only issue is when it will be safe to start harvesting resources from the island again.

The elders from the Magaia village were briefly called upon as a courtesy prior to heading to the islands, and the intentions of the visit and purpose of the feasibility study explained. They have previously indicated their support in principle of the project, and endorsed that again during our visit. They would like to see further details once an Operational Plan is being developed, and had some questions about the toxin in the bait and its possible effects on fish in the area. One also expressed concern that the islands 'might be taken away from us' if they became too important for conservation. Some further discussions and consultations will be required to ease the identified concerns.