ECOLOGICAL RESTORATION OF VAHANGA ATOLL, ACTEON GROUP, TUAMOTU ARCHIPELAGO

OPERATIONAL PLAN

15 september 2006

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Operational Summary

The following table summarises details of the proposed *Rattus exulans* eradication on Vahanga Island, French Polynesia.

Location	Vahanga Atoll: 382 ha (includes vegetated and unvegetated area) in the Acteon Group in the Tuamotu Archipelago, French Polynesia
Primary target pest species	Pacific rats (*Rattus exulans*)
Secondary target species	The invasive plant lantana (*Lantana camara*) – research, monitoring, determine feasibility for eradication
Timing	June-August 2007 (eradication of rats)
Target benefit species	Polynesian ground dove (*Gallicolumba erythroptera*) CR; Tuamotu sandpiper (*Prosobonia cancellata*) EN; atoll fruit dove (*Ptilinopus coralensis*); Murphy's petrel (*Pterodroma ultima*); Bristle thighed curlew (*Numenius tahitiensis*) VU; potentially Phoenix petrel (*Pterodroma alba*) EN.
Vegetation type	Broadleaf forest, coconut plantation
Climate characteristics	Winter-spring dry season
Community interests	Uninhabited; Catholic church, coconut plantation
Historic sites	None known
Project Coordinator	Dr. Philippe Raust, SOP MANU
Operational Manager	Anne Gouni, SOP MANU
Start and end date	Eradication planned to commence in June 2007
Methods	Hand broadcasting brodifacoum bait
Biodiversity/conservation outcomes	Recovery of threatened bird populations, plus lizard, invertebrate and plant species
Socio-economic benefits	Providing employment (eradication operation and subsequent surveillance and biosecurity)
Capacity development	• Training and skills-sharing • Develop quarantine and contingency procedures • New partnerships and initiatives in IAS management
Management history	Previous operation failed in 2000 (see Section 4 for details)

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1. Executive Summary

Vahanga atoll is located in the Acteon Group and only 7 km from Tenararo, which is one of only two mammalian pest-free islands in the entire Tuamotu Archipelago. Tenararo-Vahanga has been identified as a Key Biodiversity Area (KBA) in Conservation International's Critical Ecosystem Partnership Fund Ecosystem Profile for the Polynesia/Micronesia Hotspot (#127) and is also a proposed Important Bird Area (Birdlife International). This proposal seeks funding to eradicate Pacific rats from Vahanga which will allow the natural recolonisation and recovery of at least three threatened or near threatened bird species currently present on Tenararo, including the Polynesian ground-dove (*Gallicolumba erythroptera*) (Cr) and Tuamotu sandpiper (*Prosobonia cancellata*) (En). As well as providing safe habitat on Vahanga, the eradication of rats there will also provide increased biosecurity for the Tenararo biota. It is proposed to hand-lay brodifacoum poison baits to eradicate rats from Vahanga and put in place improved biosecurity measures for the Acteon Group as a whole. There are significant learning opportunities for the local community as well as opportunities for further pest eradication on other members of the Group.

2. Introduction

Vahanga Atoll (382 ha) is located in the northern sector of the Acteon Group in the Tuamotu Archipelago, French Polynesia. The northern sector of the Acteon Group comprises a line of three small atolls c.7-10 km apart comprising Tenararo (mammal-free), Vahanga (Pacific rats present) and Tenarunga (Pacific rats, black rats, cats, seasonal human occupation for coprah harvest). A larger atoll (Matureivavao) is present to the south-east of this line of atolls (Fig 1).

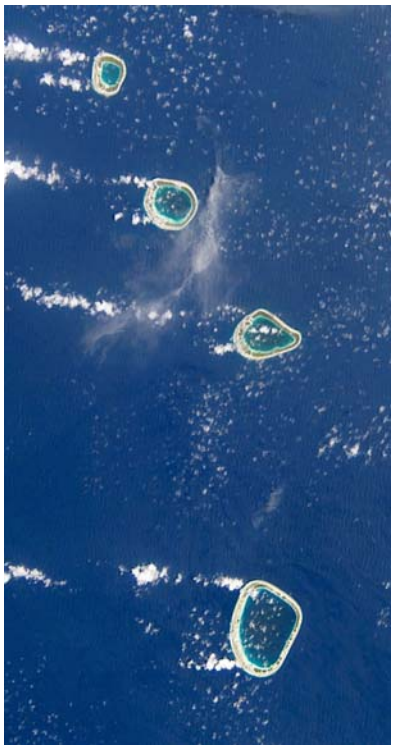

Fig 1. Northern Acteon Islands. From North to South - Tenararo, Vahanga, Tenarunga & Matureivavao - courtesy of the Image Science & Analysis Laboratory, NASA Johnson Space Center, http://eol.jsc.nasa.gov

Tenararo-Vahanga has been identified as a Key Biodiversity Area and is an Important Bird Area. This area contains many threatened endemics including two endangered birds identified as priorities for species-specific CEPF investment - the Polynesian ground dove or tutururu (*Gallicolumba erythroptera*) (CR C2a(i)) and the Tuamotu sandpiper or titi (*Prosobonia cancellata*) (EN B1ab(ii,iii,iv,v)). Tenararo contains one of the two largest populations of each of these species (Pierce et al 2003, Pierce and Blanvillain 2004) and it also supports atoll fruit dove (*Ptilinopus coralensis*) (NT) and Murphy's petrel (*Pterodroma ultima*) (NT).

Other threatened or near threatened species present in the Archipelago include Tuamotu kingfisher (*Todiramphus gambieri*) (CR D1+2) and the blue lorikeet (*Vini peruviana*) VU B1ab(ii,iv,v). Several seabird species have important, but declining populations in the Archipelago and the Phoenix petrel (*Pterodroma alba*) (EN A3bce) was previously reported to be present (Blanvillain et al 2002). Finally, this archipelago is the main wintering ground for the bristle-thighed curlew (*Numenius tahitiensis*) (VU C2a(ii)) (Birdlife 2000). In light of these values, the Société d'Ornithologie de Polynésie (SOP) MANU and the Catholic Church which owns Vahanga Atoll are committed to recovering the populations of threatened birds on the archipelago.

Pacific rats were the only mammal confirmed to be present at Vahanga in 2000-01. They were common in areas where mature coconut was present. Pre-control indices in October 2000 were c.25% captures per 100 trap nights (Pierce unpub.). They occurred at low densities in areas of bare coral rubble above MHW, including at several hundred metres from vegetation, i.e. they were present throughout the atoll.

Following a survey of parts of this Archipelago in 1999 (Blanvillain et al. 2002), it was proposed to eradicate Pacific rats (*Rattus exulans*) from Vahanga Atoll. This would enable the natural recolonisation of the atoll by dispersing birds from Tenararo. An attempt to eradicate Pacific rats in 2000-01 failed (see Section 4) (Blanvillain 2001). However, further surveys of the Tuamotu Archipelago in 2003 reaffirmed the importance of Vahanga (along with some other atolls) as a high priority atoll to restore. Not only would it provide for the recovery of threatened species, but also provide a buffer to the existing predator-free Tenararo (refer Table 1).

Table 1. Pest mammals and key avifauna observed on Tenararo, Vahanga, Tenarunga and Matureivavao 1999-2001

	Tenararo	**Vahanga**	**Tenarunga**	**Matureivavao**
Total area (reef and lagoon included) ha	700	1258	1349	2862
Land area (vegetated or not) ha	272 (39 % veg)	382 (30%)	425 (32 %)	396 (14 %)
Dist. from Vahanga (km)	7	-	8	17

Table 2. Pest mammals and key avifauna observed on Tenararo, Vahanga, Tenarunga and Matureivavao 1999-2001

	Tenararo	**Vahanga**	**Tenarunga**	**Matureivavao**
Mammals	Nil	Pacific rat	Pacific and black rat; cat (intro. c.1997)	Pacific and black rat
Polynesian ground dove	20-50	1-2 detected Nov 2000 and July 2001	0	0 (previously recorded 1974)
Atoll fruit dove	100+	1-2 recorded 2000-01	0	?
Tuamotu sandpiper	600-1000	2-3 recorded all visits	1 in 1999, 0 since then	Few
Bristle-thighed curlew	30+ Nov 00	c.20 Nov 00, c.5 July 01	?	?
Murphy's petrel	Present and breeding	Low numbers	0	?

3. Flora and Fauna

Vegetation and habitats

Vahanga is a typical coral atoll with an outer coral reef platform and beach c.10 km in circumference, succeeded by a shrubland and forest belt 200-400 m wide, beyond which is a large lagoon (Fig 2). Many hoa or passes dissect the atoll dividing it into discrete motu (2 main motu and ten smaller). Habitats are described in more detail below:

Fig 2. Vahanga Atoll - courtesy of the Image Science & Analysis Laboratory, NASA Johnson Space Center, ISS002-E-8872, http://eol.jsc.nasa.gov

Reef and lower beach

The outer reef is succeeded by an intertidal platform of coral and rubble-strewn foreshore of widely varying width and gradient. For example on the northern side of the island this intertidal platform can be over 100 m wide and of very gentle gradient, but on the eastern and southern sides the beach is narrow, strewn with coral rubble and is often steep.

Upper beach
The upper beach comprises infrequently inundated slopes of coral rubble of widely variable size, ranging from coarse sand to large "boulders". The shore profile is generally gentle on the north and western sides of the atoll.

Shrubland
The outer vegetation includes the prostrate bush *Scaevola sericea* which often forms extensive mats, and the more erect shrub *Pemphis* which is often found growing in the more inhospitable hoa (channels) and outer supralittoral zone. Small isolated trees, particularly *Messerschmidtia argentea,* are scattered along the foreshore. In parts of the island, shrubland is prevalent, particularly in the south-eastern sector and near hoa.

Forest
The bulk of the vegetated part of the island is forest comprising predominantly *Guettarda speciosa, Boheravia tretrandra, M. argentea* and *Pandanus tectorius.* Coconuts (*Cocos nucifera*) were planted in the 1960s and this species has begun to dominate the canopy, and in places the undergrowth. Mature and fallen coconuts are present in most of the motu, but in the south-eastern part of the main motu, there has been extensive die-off of coconut trees. Lantana (*Lantana camara*), a known invasive plant, occurs over about 2 hectares of forest/coconut in the vicinity of the deserted village (occupied during coconut planting period). Ripe fruit was scarce during visits in October-November 2000 (Pierce 2001 unpub.).

Indigenous fauna

Vertebrate fauna comprises skinks, geckos, seabirds and land birds. Evidence of green turtle (*Chelonia mydas*) activity on the upper beaches was found in 2000-01. Birds present in 2000-01 are listed in Table 2 and invertebrates and lizards are listed in Table 3.

Table 3. Avifauna present on Vahanga in two different seasons - October-November 2000 and July 2001

Species	Oct-Nov 2000	July 2001
Murphy's petrel	Present, nesting in low numbers – tens	Present in unknown (probably low) numbers
Red-footed booby	Common, nesting < 100	Common
Greater frigatebird	Common, nesting in scores	Common, nesting
Red-tailed tropicbird	Uncommon, not nesting	Uncommon, not nesting
Pacific reef heron	c.20, nesting in trees	Common
Pacific golden plover	< 5	None
Bristle-thighed curlew	c.20	c.5
Wandering tattler	Common 30+	Few
Tuamotu sandpiper	3	3
Polynesian ground dove	2+	1+
Atoll fruit dove	1-2	1-2
Long-tailed cuckoo	0	1
Brown noddy	100s nesting	Common
Black noddy	Tens nesting	Uncommon
White tern	100s, nesting in trees	Abundant, nesting on ground and in trees

Table 4. Invertebrates and lizards present on Vahanga (2000-01)

Species	
Hermit crab (*Coenobita perlatus*)	Widely distributed throughout the atoll and locally very abundant (no density data available), e.g. former village area (2-3 ha) and much of the forest/coconut area
Coconut crab	Rare, recorded on the main motu in 2000
Land crab (*Cardiosoma*) or Tupa	Locally common e.g. in the estuarine arms of the several small motu in the SW part of the atoll
Spiders, beetles, ants, Lepidoptera	Widespread and common
Lizards	Skinks, mourning gecko (*Lepidodactylus lugubris*) and probably house gecko (*Hemidactylus frenatus*)

4. Project Context

There are a number of international, regional and national strategies, policies and plans that this project will contribute to:

International

- France is a party to the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) and the World Heritage Convention, and has signed but not yet ratified the Convention on Biological Diversity (CBD) (*Article 8h*).
- There are 2 species listed under the IUCN (2004) Red List of Threatened Species – the Polynesian ground-dove (*Gallicolumba erythroptera*) is critically endangered and the Tuamotu sandpiper (*Prosobonia cancellata*) is endangered.

Regional

- French Polynesia is a member country of the South Pacific Regional Environment Programme's (SPREP) Action Strategy for Nature Conservation 2003-2007 (SPREP 2004).
- France has ratified the Convention on the Conservation of Nature in the South Pacific (the Apia Convention), is a party to the Convention for the Protection of the Natural Resources and Environment of the South Pacific (SPREP Convention),
- Conservation Internationals Critical Ecosystem Partnership Fund Ecosystem Profile for the Polynesia-Micronesia Hotspot identifies French Polynesia as an important 'Hotspot' and Tenararo-Vahanga as a Key Biodiversity Areas (#157).
- In the "French Strategy for Biodiversity: Stakes, Purposes and Directions" (February 2004) the French overseas territories were identified as important in terms of worldwide biodiversity - French Polynesia was identified as 1 of 4 priority sites.
- Tenararo-Vahanga has been identified in BirdLife International's Pacific Important Bird Areas due to its high diversity and endemism.
- Four species were identified as priority projects for species and locations in French Polynesia in Bird Conservation Priorities and a Draft Conservation Strategy for the Pacific Islands region (Sherley 2001)

A STRATEGIC APPROACH FOR THE ACTEON

As well as removing rats from Vahanga, it is also strategically important to remove Pacific and black rats (*Rattus rattus)* and cats (*Felix catus*) from the one seasonally inhabited neighbouring atoll to the south-east (Tenarunga) to ensure that these species do not get transported to Vahanga or Tenararo in the future. The habitat on Tenarunga is only moderately suitable for ground doves and fruit doves (Blanvillain

et al. 2002), but is very suitable for Tuamotu sandpipers and seabirds. Additional work is required on Tenarunga, including possibly determining the length of time black rats can stay up coconut trees (review existing information and carry out telemetry study if needed), how long ground baits are available and the feasibility of rodent eradication from this island. Vahanga will provide learning opportunities for future rat eradications on Tenarunga and elsewhere. Finally, if rats were removed from Matureivavao, the entire Northern Acteon Group would be pest free and would provide a significant habitat for the suite of threatened species listed in Table 3. Using a helicopter and charter boat could become cost-effective if 2-3 atolls were targeted for pest eradication.

PREVIOUS WORK: 2000 ERADICATION ATTEMPT

An attempt to eradicate rats using a c.50 x 50 m grid (50 x 25 m in places) in October-November 2000 was not successful (Blanvillain 2001). This was mainly due to a lack of suitable management and planning - some of the factors that may have contributed to the failure include:

- uncertain bait specifications as it was not possible to test the toxin provided by a poison bait manufacturer on Tahiti – originally intended to be brodifacoum, but believed to include chlorophacinone and bromadialone,
- insufficient bait for the size of the atoll (island size underestimated and bait quantity was less than ordered),
- too few workers and who were untrained with little or no interest in the outcome, leading to poor quality of operation, some bait being dumped in the sea, etc,
- insufficient time for set-up, poisoning and follow-up,
- gaps in coverage (intervals between lines up to c.100 m),
- rapid loss of baits from some stations (crabs),
- no supervision during follow-up period,
- some rats may not have been prepared to climb to some higher bait stations on young palm fronds, etc.

All of these factors may have contributed to the failure to varying degrees. Even the area (Village motu) that received the most intensive (50 x 25 m) and reliable poisoning and follow-up still had rats present the following July, but at lower densities than in the large motu that was less reliably covered (Pierce unpublished).

5. Consultation, Consents and Notification

Key stakeholders are SOP MANU, the project implementing agency, the Catholic Church which owns the atoll and is fully supportive of the eradication plan, and the community of and Ministry for the Environment, all of whom support the project and reaffirmed this during meetings in Papeete on 14-15 June 2006. PII partners, including ISSG, are facilitating the preparation of an operational plan for the work. Other stakeholders include DOC and other New Zealand technical experts and conservation support groups, all of whom have a high level of support for the proposal.

Consultation	Catholic Church – confirmed by phone 6 April 2006 and in meetings 14-15 June 2006
Consents and Notification	• Letter from Catholic mission (refer Appendix) • Permits from DIREN (Direction de l'Environnement) for catching and banding Tuamotu sandpiper and Polynesian ground dove • Permit for importation of bait given by SDR (Service du Développement rural)

6. Project Design Components

Goal: To restore the indigenous biodiversity of Vahanga Atoll and increase the biosecurity of the Acteon Group

It is anticipated that this project will:

- contribute to the recovery of the Polynesian ground dove and Tuamotu sandpiper on Vahanga Atoll
- provide a buffer to the predator-free Teneraro Atoll and contribute to the protection of its biodiversity.
- increase the protection of the biodiversity on Teneraro Atoll against invasions from predators by extending biosecurity measures for Vahanga Atoll to Teneraro
- lead to support from policy-makers, funders and the public for further rodent eradications on the remaining atolls (i.e. Tenarunga and Matureivavao) of the Acteon Group.

Objective: To manage invasive species on Vahanga and neighbouring atolls to allow for the restoration of biodiversity in the Acteon Group

Output 1: Pacific rat eradication on Vahanga Atoll completed by June-August 2007 or June-August 2008.

A three-phase approach will be undertaken to achieve this output. Following are the activities to be carried out under each phase:

Phase 1

1.1 Complete eradication Operational Plan (June 30 2006)
1.2 Review of critical information re crabs and rats (July-August 2006)
1.3 Specific surveys and research on Vahanga (August-September 2006)
1.4 Revise Operational Plan for rat eradication on Vahanga (October 2006)
1.5 Prepare and implement a Communication Plan – see Section 9 for components of this plan
1.6 Develop a Health and Safety Plan
1.7 Prepare and implement a Biosecurity Plan (October 2006) – see Section 10 for components.

Phase 2

1.8 Undertake surveys of non-target species and implement mitigating measures as required (for details, see Appendix 1, “Non-target species surveys June-August 2007”)
1.9 Eradicate rats on Vahanga (June-August 2007).

Phase 3

1.10 Monitor natural recovery of biota including recolonisation (2008 onward)
1.11 Evaluate feasibility of reintroducing locally extinct biota and implement accordingly (2008 onward)
1.12 Evaluate further biosecurity and restoration measures including eradication of mammalian pests from nearest atolls - Tenarunga and Matureivavao (2008 onward).

Contingency

1.13 If Phase 1 does not provide sufficient confidence for success of eradication, carry out eradication trials in June-August 2007 – involves biomarkers (refer to Operational Methodology in Appendix 1)
1.14 Eradicate rats June-August 2008.

Output 2: SOP Manu’s capacity for managing invasive species enhanced.

Activities to achieve this output are:

2.1 Identify capacity needs
2.2 In collaboration with the Pacific Invasive Initiative, develop a training/skill-sharing programme to address these needs
2.3 Train team members.

Output 3: Project stakeholders, decision-makers and the public in French Polynesia are more aware of the negative impacts of invasive species on biodiversity and livelihoods and the need for effective biosecurity measures on all atolls/islands.

To achieve this output, the following activities (which will be included in the Communication Plan) will be carried out:

3.1 Identify key stakeholders
3.2 Hold meetings with decision-makers to promote the project and IAS species management in general and lobby for their support
3.3 Play an active role in different official committees
3.4 Participate in local events (e.g. environment day, fête de la science, etc.)
3.5 Participate in relevant conferences and workshops
3.6 Prepare and disseminate (through suitable channels) awareness raising material (e.g. leaflets, articles, interviews, etc.)
3.7 Promote prevention as the best option for managing (i.e. avoiding) the negative impacts of IAS
3.8 Promote the development and consistent implementation of biosecurity measures
3.9 Engage all stakeholders in particular, the communities that have an interest in the project.

Output 4: The success of the project has led to other initiatives to manage invasive species being established in French Polynesia.

Activities for output 3 will contribute towards scaling up of this project. In addition, the following activities will be undertaken:

4.1 In collaboration with relevant agencies/departments, identify atolls/islands where there is a need for managing invasive species and prioritise them
4.2 Prepare a proposal for at least one high priority atoll/island and promote it to funding agencies.

7. Risks and Management

All risks need to be planned for well in advance and contingencies developed to deal with possible developments. These are described below.

Risks	Management	Effect	Likelihood	Responsibility
Strategic Risk				
not achieving eradication.	Ensure the operation is planned and implemented correctly, sufficient funding is obtained, the capacity of relevant stakeholders is built, and technical support is provided at critical times. Identify problems and develop contingency options. Develop a task list during 2006 that	A failed operation would harm existing political and public goodwill towards island eradication operations and make it difficult to generate	Medium	PM, OM

	identifies specific actions, dates and person responsible.	support for future efforts		
Operational Risks				
Bait transport – main single operational issue that could jeopardize this project	Bait will be transported shrink wrapped on pallets from NZ to French Polynesia. All precautions with bait during transport will be taken including checking the bait prior to leaving the factory, again at the point of departure and ongoing monitoring on the island. Use crate design that is compatible with boat, boat-cranes and long-boats to minimize bait-handling (details to be provided by ACP). A high risk period is during landing of baits at Vahanga especially if the weather is bad. The Nuku Hau would land the bait on Vahanga either on the way south or delay until the return trip north from Mangareva a few days later if the weather is bad. Use weather forecast from Mangareva to assess risks of landing on return trip. Establish good rapport with the captain of the Nuku Hau so that he understands risks and needs, e.g. avoiding contaminating cargo such as diesel. If risks of landing on southward journey are high, delay landing a few days till northward-bound from Mangareva; if risks still too high, delay 3 weeks to next round of Nuku Hau and keep baits on board the vessel	Failure to effectively implement the eradication programme	Medium	PM, OM
Bait deterioration	The best practical options for bait storage will be used to prevent deterioration from occurring. Bait will be inspected every day by the project team for condensation and pest damage and will be dried if necessary. Rodent damage to bait will be minimised by a layout of snap traps that will also be checked on a daily basis by island personnel	Failure of the efficacy of the eradication programme	Low	PM, OM
Rats not eradicated - there is a chance that not all rats on the island will come into	Ensure bait coverage over the entire island and bait is available for long enough to kill rats. Reconsider the amount of bait to be laid out in light of estimated loss of 60-70% that can occur to crabs (Bill Simmons pers. comm.) and findings elsewhere, e.g.	Failure of eradication programme	Medium	PM, OM

contact with the baits	Palmyra and Phoenix trials.			
Re-invasion by rats	The risk of re-invasion will be countered by the development of a biosecurity plan in 2006 with associated improved quarantine practices for the island, and also by following best practice in setting up an ongoing monitoring and surveillance programme. Public education and protocols put in place, resources for govt/community agencies etc.	Expected restoration of biodiversity not achieved	Low	PM, OM
Conservation impacts	Potential impacts on non-target threatened species will be managed (see Appendix 2). Any short-term negative effect on non-target species will be considerably outweighed by the long-term gains for those same species, as well as additional recolonising species and ecosystems.	Dead birds	Medium	PM
Public opposition - concerns about the toxicity and persistence of brodifacoum, non-target impacts, and cultural impacts	To counter potential public criticism, the communications plan with the public and media will emphasise the conservation benefits of eradication (a one-off only operation), and also the precautions to be taken.	Delay in implementing eradication programme	Low	PM, OM

8. Project Management Structure (Roles and Responsibilities)

SOP MANU is the project implementing agency with technical and other support coming from New Zealand, Tahiti and Tuamotu personnel. Three to four team leaders will report to the Operational Manager – Second in command (2IC), Eradication Technical Advisor (ETA), Biota Monitoring Leader (BML) and Communications Leader (CL). Depending on individual skills of persons appointed, 2IC and ETA could be one or two positions working alongside the OM. The management structure is summarized below and roles and responsibilities are detailed in the table below.

IMPLEMENTING AGENCY: SOP MANU
Programme Manager (PM): Philippe Raust
Operational Manager (OM): Anne Gouni
Second in Command (2IC): To be announced
Eradication technical advisor (ETA): probably DOC staff NZ
Biota Monitoring Leader (BML): Ray Pierce

Stakeholders	Roles	Responsibilities
Programme Manager (PM) – Philippe Raust SOP MANU	Overall management and implementation of the project Secure necessary authorisations Coordinate team leaders, plan & manage work (including eradication, monitoring and experimental work)	• Recruit staff and student workers • Coordinate with Operational Manager • Financial management - payment of expenses/wages etc • Liaison point • Political matters • Public spokesperson & handling media and other enquiries • Authorizations (Church, Dept Agriculture etc), permits (bait, bird capture etc). • Implementation of island biosecurity, quarantine etc. • Reporting
Operational Manager (OM) – Anne Gouni	Coordinate eradication team Logistics Eradicate target animals Support from 2IC and ETA Manage shipping timetables Papeete-Managareva-Vahanga Daily communications Provide expedition supplies, - food, water equipment etc Emergency procedures	• Training and logistics provided for 2006 research team and finalise questions to be addressed (refer Appendix 1) • Train and manage 2007 eradication team members • Order bait, bait quality, ensure packaging ideal, coordinate transport and storage of bait, monitoring quality throughout • Supply and equipment list including personal items required by team members – tents, hammocks, sleeping bags, reef footwear, helmets, sunglasses, type of clothing, day packs etc. • Arrange purchase and delivery of supplies and equipment via Nuku Hau to Vahanga accompanying each party • Rat control contingencies in place • Coordinate biosecurity of operation • Set up transect lines, bait supply logistics for baiting operation • Facilitating daily debriefs/think-tanks • Ensure all work targets are completed • Record data and provide progress updates to PM • Confirm shipping timetables Papeete-Mangareva-Vahanga for June- August 2007 • Communications plan • Health and Safety Plan and Emergency plan
2IC Understudy to OM and could take on operational management role if required – to be appointed	Reports to Operational Manager Monitor rat and crab status and density Monitor bait take/ availability to rats	• Support to OM as required including several specific tasks allocated to OM above • Train and manage operational monitoring team members • Set up monitoring regime of rodents pre, during and post eradication • Set up pre-operational crab quadrants to determine areas of different crab densities (2006) • Monitoring bait spread & bait take
Eradication	Technical support and advice	• Advises on all tasks of OM and 2IC and

Technical Advisor (ETA) – probably from NZ	Reports to OM	undertakes key roles in several tasks identified for OM above
Biota monitoring leader (BML) Ray Pierce	Reports to Operational Manager Avoidance and/or research of non-target impacts Baseline data for biota	• Train and manage outcome monitoring team members • Carry out pre-poison surveys of non-targets at risk – curlews, ground-doves, fruit-doves, Tuamotu sandpiper, long-tailed cuckoo • Capture ground-doves, relocate to cages on Vahanga – monitor for ongoing presence at Vahanga • Survey and if possible or appropriate capture and attach colour bands and radio-transmitters to carry out radio-telemetry monitoring of Tuamotu sandpiper during poison operation • Determine fruit-dove and curlew status and monitor survival of individuals by observation • Necropsies of dead non-targets • Establish baseline data (transects, quadrants) for key biota - seabirds landbirds, lizards, plants • Map distribution and abundance of lantana and develop an operational plan for eradication
PII	Assist Operational Manager	• Help prepare the Operational Plan • Provide advice for the implementation of the project
Catholic Church	Provide permission for project to proceed, use of church etc.	

Preliminary training is required in Tahiti in the use of equipment for the operation and gaining an understanding of the field conditions. During the three Vahanga phases of the operation (Preliminary research, Operational set-up, Eradication period), training will take place on the initial day(s) of the phases. This will generally involve a technically skilled person and an island-skilled person working in pairs.

Personnel on Vahanga during the three Vahanga phases of the operation.

1. Phase 1 Preliminary research Aug-Sept 2006 ➢ 2-3 people for crab and rat assessments and specific questions (refer to Appendix 1) – ideally OM, 2IC, ETA or BML	Phase 2a. Operational set-up ➢ Operational Manager ➢ Operational Monitoring Leader ➢ Rat and crab assessors (2 people; 1 specialist, 1 local) ➢ Transect lines (4 people; 2 pairs each comprising 1 experienced, 1 local) ➢ Biota Monitoring Leader ➢ Biota monitoring assistants (2 people; 1 experienced, 1 local)	Phase 2b. Eradication period ➢ Operational Manager ➢ Operational Monitoring leader ➢ Poison baiters (10 people; 5 experienced, 5 local professional people, e.g. SOP staff). Note 3 days of bait laying by 10 people per hand spread ➢ Biota monitoring team (2 people; 1 experienced, 1 professional local)

There are significant opportunities for local people from Tahiti and Tuamotu to participate in the operation, from Programme Manager level to paired field operators involved with rat and non-target surveys, bait spread, monitoring and follow-up work and biosecurity. The participation of local professional people (e.g. SOP members and Dept Agriculture staff) will ensure a high degree of training is provided, which will make for more efficient planning and execution of similar projects in the future.

9. Communication Plan

A communication plan will be developed to address communication requirements. Key elements of this plan will include:

- Planning communications pre-operation, Tahiti, New Zealand
- Communication between Project Manager and Operational Manager
- Communication between Operational Manager and field leaders
- Communication between field teams
- Communication within field teams
- Communication between OM and field team
- Communication between OM and team members on lagoon boat
- Communication between PM and stakeholders
- Communication between PM and public/media

10. Biosecurity Plan

A Biosecurity plan will be developed to address biosecurity requirements both during the field operation and post-operational:

- Biosecurity of the field operations, i.e.
  - Commercial vessels (bait transport) are free of rodents
  - Landing vessels are clean and free of rodents, ants, seeds
  - Clean and sealed poison containers
  - Clean and sealed food and equipment containers
  - Personal gear and clothing checked for ants and seeds
- Post operational biosecurity, i.e.
  - As for biosecurity during field operation, plus:
  - Landing restricted to authorized parties that have passed quarantine inspection
  - “No landing” signs erected at landing site on Vahanga and Tenararo
  - Ensure rat bait stations are being maintained on commercial shipping
  - Remove rats and cats from Tenarunga
  - Interpretation panels erected at Tenarunga
  - Work with local people to do follow-up biosecurity e.g. training of some people for ongoing biosecurity and restoration projects
  - Advocacy of values of Vahanga and Tenararo throughout Tuamotu, Gambier and sea-faring public generally
  - Advocate value of rat removal and defense of islands and benefits to economic needs, e.g. coconuts
  - General advocacy of future risks, e.g. increased mice risks following rat removal; risks of other pests, e.g. ants; explain difficulty of removing rats from restored islands where food is now abundant necessitating a wait of many years for depletion of food before rat removal is viable – so key message is to ensure prevention of rat dispersal from source islands. All general facts, but advocated locally via site champions

- Alternatives provided for ornithologists and birders, e.g. Tahanea and Rangiroa, and the biosecurity precautions implemented – will need preparation of local people in authority for overseeing this aspect

11. Monitoring and Evaluation

Monitoring will include operational and outcome monitoring, socio-economic benefits and evaluation of the project.

Operational monitoring

Operational monitoring is the responsibility of the Operational Manager and will include the following components:

Pre-operational

- Review of past information particularly on crab/rat eradication scenarios – working closely with PII on this aspect
- Pre-operational assessment of rats – confirm species present, hot spots, low density areas
- Pre-operational assessment of crabs – transects counted in representative areas and rest of island calibrated against these as high, medium, low densities of crabs. Assess viability of reducing crab impact, e.g. collecting in drums
- Pre-operational assessment of non-targets – consistent with 2000-01.

During operation

- Bait spread – all baited areas checked on day of baitspread to ensure complete coverage
- Bait survival – high density crab areas and other representative baited areas checked on days1-3 after bait spread to determine availability of baits
- Rat survival 10-20 days post-poisoning– detection of surviving rats is very difficult and should ideally involve the use of dogs (but tough going for dogs throughout island on coral rubble); spotlighting probably the best option to determine where follow-up control is needed.

Post-operational

- Return to island in following autumn and repeat trapping, luring and spotlighting.

Outcome Monitoring

Outcome monitoring is the responsibility of the Biota Monitoring Leader and it will have the purpose of a) establishing baseline population levels for ongoing monitoring of key biota and b) help determine side-effects on these biota. Key facets of this monitoring are described in the table below.

Table 4 – Summary of Vahanga outcome monitoring

Indicator	Approx baseline level	Data needed	Method	Timing*	Ongoing responsibility.	Data storage
Tuamotu sandpiper	< 5 on island in 2000-01	Numbers present and age structure	Survey atoll, count and age birds, map	Annually initially then biennially	SOP	SOP and PII in XL format
Polynesian ground-dove	< 5 on island in 2000-01	Numbers present and demographics	Survey atoll, count and photograph birds, map	Annually initially then biennially	SOP	SOP and PII in XL format, digital photoshop
Atoll fruit-dove	< 5 on island in	Numbers present	Survey atoll, count birds	Annually initially then	SOP	SOP and PII in XL format

	2000-01			biennially		
Seabirds and waders	Known species diversity	Numbers present and breeding status	Survey atoll, count each species, colony data, map	Annually initially then biennially, November best timing	SOP	SOP and PII in XL format
Reptiles	Few data	Species diversity and response	Survey, identify, index numbers on transects	Annually initially then biennially	SOP	SOP and PII in XL format
Plants	Species list	Response	Photopoints, quadrants	Annually then biennially	SOP	SOP and PII in XL format, photoshop

* Note that data collection could be coordinated with biosecurity work. Overall work should be completed in winter or spring (November ideal because of migrant wader presence), but winter monitoring would also be OK for the main species of conservation interest and the potential for long-tailed cuckoo to be present also. SOP MANU is committed to finding funding for this work.

Project evaluation

Hold a debrief on one or two occasions post-eradication (first within 3 months of eradication) to determine biodiversity gains, design issues (can it be done better), capacity building, training and further ways of moving forward with biodiversity recovery in French Polynesia.

Socioeconomic benefits

Community health – rat eradication will prevent water contamination in tanks, food spoilage and rat-borne diseases e.g. leptospirosis.
Economic – rat eradication will achieve higher coprah productivity.
These aspects will be evaluated with local communities.

12. Acknowledgements

This project is supported by the Australian government's Regional Natural Heritage Program through the Critical Ecosystem Partnership Fund

The Critical Ecosystem Partnership Fund is a joint initiative of Conservation International, the Global Environment Facility, the Government of Japan, the MacArthur Foundation and the World Bank. A fundamental goal is to ensure civil society is engaged in biodiversity conservation.

Thanks to the PII team for project liaison and support. These are Alan Saunders, Bill Nagle and Steven Bavin.
Thanks to the New Zealand Department of Conservation for allowing input via the Islands Eradication Advisory Group (IEAG) and other DOC advice (Mike Thorsen).
Thanks to Bill Simmons (Animal Control Products, Wanganui) and Gideon Climo for baiting advice.
Thanks to Graham Wragg, Skipper of the RV Bounty Bay for advice regarding bait transport.
Thanks to Beth Flint at the United States Fish and Wildlife Service (USFWS), Hawaii for information regarding Palmyra eradications.
Thanks to Father Joel Aumeran of the Catholic Church, Tahiti Archbishop Hubert Coppenrath, and to Minister of Sustainable Development Georges Handerson and his staff (especially Claude Serra) for their support of this project.

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APPENDIX 1. Operational Methodology

Summary
For the rat eradication, brodifacoum will be used as the toxin. It is a second-generation anticoagulant toxin that works by stopping the normal blood clotting processes of the body. Brodifacoum is toxic to animals with haemoglobin based blood systems (e.g. mammals, and birds) but is non toxic to invertebrates (but may rarely affect some lizards).

HAND BROADCASTING
Hand broadcasting bait will be used subject to review questions and final research visit to Vahanga in September 2006. Hand-laying brodifacoum at the specified rate, manner and timeframe poses minimal environmental risk.

Target pest	• Pacific rats
General approach	• Two hand-spreads of baits along transects throughout the atoll. The second hand-spread will aim for the period 10-14 days after the first.
Pesticide use	• Pestoff 20R, containing the toxin brodifacoum manufactured by Animal Control Products, Wanganui, New Zealand. • The smaller 10 mm size baits will be used as they are easier to hand spread and more individual baits will be available for rats. • No need for adding coconut essence or wax.
Timing	• June 2006 - Costed operational plan for eradicating rats • July-Aug 2006 – Review of existing information on rat operations, i.e. species of rat targeted, bait sowing rate, crab species and densities and success of operation. Assumption is hermit crab numbers not limited by food so much as shells, but can ask question of e.g. Graham Wragg re Pitcairn operations and whether significant changes in hermit crab abundance since 1990s (see Review details below). • Aug-Sep 2006 - Targeted research visit (late winter/spring 2006 ideal) primarily to answer key outstanding questions (see Research Trip below). • June 2007- Either 1. Advance party prior to eradication or 2. Rat-bait trial depending on outcome of review above – precise dates of either to be determined by timetable of the freighter Nuku Hau. • July-August 2007 – Rat poisoning if review answers questions adequately – precise dates to be determined as above. This timing is considered optimal as it is the dry time of year and precedes arrival period of most curlews, however some winter fruiting is still likely to be occurring at this time and rats breeding (Pierce unpublished). Based on 2000 information, September would also be suitable.
Review of existing information July-August 2006	• Note that at McKean Island (Phoenix Islands) baits in a simulated 40 kg/ha hand spread of non-toxic baits resulted in c.81% bait consumption the first night and 100% after the second night - but 2nd night compromised by heavy rain and bait went to mush. Hermit crab (mainly *C. perlatus*) densities were c. 5000/ha and *Rattus*

	tanezumi was present. Extra bait was applied to the outer perimeter of the grid to (successfully) intercept incoming crabs. This finding contradicts the apparently successful eradications using low densities of baits, but does not allow interpretation of whether eradication would actually work). • In light of this apparent dichotomy and Palmyra recommendations for high (80+ kg/ha) bait densities in crab scenarios, there is a need to formally review past operations where rat eradication has been attempted with known bait densities and crab diversity and densities were measured – Palmyra, Pitcairn, Gambier, Seychelles, Cooks. If no crab density information is available data will need to be collected from some of these islands. • The above data together with knowledge of the success or failure of past operations will help answer questions of whether rats got enough toxic bait in different crab densities and baiting scenarios. This approach may be sufficient to answering the Vahanga question without having to trial biomarkers to measure bait uptake by rats from known bait densities, or determining how long non-toxic baits last in different crab densities. • Compare review findings with Vahanga crab species and density in August-September 2006 and evaluate options for the bait sowing density. Identify optimal approaches for different crab scenarios, and any further questions that need testing (some of this testing could be done at Vahanga if a trial was still deemed necessary there in 2007 and eradication postponed 1 year). However, it is equally likely that sufficient information will be available from the formal review and the eradication can proceed as planned in 2007. • If necessary, evaluate findings of review and apparent sowing recommendations against costs and constraints of other options, e.g. bait stations with potentially 4000+ stations would take longer, risk of neophobic tendencies, and cost c.$240k (Appendix 4).	
Research trip Aug-Sept 2006	Determine the following aspects: • Set up camp at abandoned village and consider atoll logistics, camp, cistern, rat exclusion from cistern and church. • Measure church interior. Check roof for leakages and fix these and door and window shutters of church if needed (boards, silicon, nails, hammer needed). • Crab density – Determine crab species and abundance i.e. hermit crab (10+ mm size) densities in many transects in all habitats on the village motu and parts of large motu and several of the smallest motu - (2 x 20 m transects ideal). For each transect also assign an index of “low”, ”medium”, “high”, “very high” density for known crab densities and then use this index to gauge and map relative abundance of crabs on the entire atoll (including bare rubble areas) using grid map. Outcome = semi-quantified map of atoll with low, medium, etc densities marked, which together with rat data, can then be used for planning different bait sowing rates. (Note that crab	

	densities at Palmyra were 2500/ha (or 10 per 2x20 m quadrant) where 80-90 kg bait/ha achieved eradication). (is there crab seasonality? No data – numbers seemed lower at Vahanga in July c.f. Oct-Nov but not quantified. • Examine behaviour of crabs, e.g. whether ocean and lagoon are used for brachial saturation. Consider whether significant numbers can be captured in baited drums (fish and coconut), so potentially temporarily removed from bait poisoning areas (could be placed in saturated bags and tied in shaded spots). • Ground-truth vegetation with what appears on the aerial photo. • Determine and map distribution and relative abundance of rats – based primarily on spotlighting which proved the best density estimator in Phoenix Islands; also trapping, and rat sign (gnawing and droppings). Use map and transect lines to map rat relative densities. • Ground-truth the alternatives for lines – radial lines and wedges currently preferred. Use map and GPS to determine appropriate lines – use natural features especially coconut lines to orientate the workers to ensure full coverage. • Determine optimal landing site for getting bait ashore (close to church storage vs safety of landing). Evaluate a route along upper beach for using wheelbarrows or quad. • Cut transects and determine time taken in simulated bait spreading along transect lines. Is 25 m adequate for bait spread? • Check out *Pandanus* and dense coconut areas for finding route through – consider whether trial scrub bar would work for lines. • Check out lagoon edge for safe skiff access – looks suitable from aerial photograph but needs verification. • Determine and map extent of lantana.	
Advance party June 07	Planning poison operation – some of these aspects will have been reconnoitred in 2006 • Lay out transect lines at right angles to coast. Lines to be c.25 m apart (c.12.5 m is the maximum throwing distance in dense vegetation). Lines must run parallel to each other. Set angle of lines constant for each motu or section of motu to ensure lines are parallel – potential for using the apparently parallel lines of planted coconuts but would need to check that they are indeed parallel. Where the lines need to change compass angle, insert a wedge of lines at orientation appropriate to the lay of vegetation, etc. Kick coconuts out of the way for easier access for bait spreaders (need not be neat and tidy as only two bait applications will be completed). • Flag transect lines with tape using a separate colour for alternate lines to avoid confusion and allow good visual location for workers; mark each 25 m gridpoint with distance, 0, 25, 50 m etc. • Use Sprayline dye in open rubble areas instead of flagging tape • Will need good quality machetes and/or bill-hook slashers for some of the denser areas especially on the main motu	

	• If review is inconclusive, advice is to determine rat uptake of non-toxic bait as measured by biomarker (rodamine, pyranine and other – check with Elaine Murphy) in non-toxic baits (also check for 1080 residue which would impact on trial) in order to measure bait uptake at prescribed bait density and crab scenarios. Need 50 rats caught to test bait marker. Test 10, 20, 30 kg loadings ideally in the small motu of the southern part of Vahanga – all of these small motu would be needed for a three-way trial of optimal bait sowing. • Measure extent of lantana, determine reproductive status and dispersal to assist with determining feasibility of eradication.	
Poisoning Methodology	• Provisionally 10 tonnes of bait required, but this could be increased. • 2 x 10 kg/ha = 20 kg/ha +20% contingency for loss in boat (lower layers – Op Manager to calculate what this is and that it is adequately covered by the 10 tonnes), landing, fungi etc. (Note 10-90 kg/ha has been used elsewhere, and it is likely that more than 20 kg/ha may be needed in high crab density areas – from Seychelles experience Gideon Climo suggests 12+ kg/ha and consider 3 bait applications). • Apply in two hand-applications c. 2 weeks apart (a minimum of 2 weeks allows for juvenile rats which are likely to be present). But consider the weather here – may be better to aim for a little earlier in case rain at 2 weeks pushes interval out significantly, increasing time on island, etc. Needs to be weighed up with risk of juvenile rats surviving. • Each hand-application involves 10 kg/ha, adjusted for variations in rat and crab density as determined previously. • Start poisoning from natural barrier (hoa/channel) and work in one direction away from this, e.g. start at hoa immediately north of village and work in one direction away from the village. • It is expected to take 4-5 days to cover the island (80-100 ha to be covered each day, but note that an individual person may cover only 7 ha/day – this will be tested during the first visit). • Preferable to do the large motu in one day (start on a Monday to avoid the Sabbath). • Each day's end of poisoning should also be at a natural barrier where possible, or overlap the ends next day. • Option of carrying out baiting in afternoon only so that there is less exposure of baits to crabs before rats emerge in late afternoon-evening (crabs, although primarily late afternoon and nocturnal foragers, will also consume many baits during day especially overcast days). This would give better survival of baits on Day 1 at least, but needs to be weighed against how long it takes to get around daily quota of lines. • Transport bait around the lagoon via skiff/boat each morning (earlier the better to beat wind and waves) and cache in shade at many sites at convenient intervals for bait layers. Need two people - one driver, one reef	

	spotter, both carry bait on and off skiff. • Bait spreaders work in pairs - one bait layer lays baits along first flagged transect line, and buddy does same on the adjacent line - keep in voice contact and meet up at end of the two lines and walk together to start of new pair of lines. • Keep a record of who spread bait on each line and ensure they do not cover the same line on the second spread as they did on the first spread i.e. people do not cover the same line twice. • Each of the bait-layers will be following one flagging colour and his/her buddy will be following a different flagging colour on his/her line. • Ensure each line is covered by removing a numbered flagging tape once the baiting is completed on that line. • 625 grams baits should be spread from every 25m (double flagged grid point) along transects. • Measure the precise amount of bait being spread at each station (use a scoop and level this off before each throw). • Bait should be cast to either side and in front and behind - thrown out as evenly as possible to mid way (12.5 m) to next transect line which is 25 m away, and same distance ahead and behind. • Bait-layers to practise throwing well in advance. Always throw to the left hand side (if right handed). This ensures bait is thrown in an even manner, i.e. at each broadcast station, throw to left, then rotate 90^{o} and repeat, etc. • Where bait needs to be increased consistently, state these clearly in field instructions, e.g. within x m of high tide and in areas of rubble (where baits can be lost). • An accurate bait tally is required and should be checked at the end of each day. • Each day's broadcast should be checked that same day by an operational monitoring team person who is familiar with island and rat ecology (i.e. person staying on from advance party) to check baits are present. • Each day's broadcast should also be sampled 1, 2, 3 and 4 days after the hand-spread to ensure baits are still available, and any gaps (over expected loss) after 1-2 days can be filled with contingency baits. • At the start of each day, after the first day, ensure there is a 60-75 m overlap from the previous day. Need to have a overlap contingency in the event of wet weather. • Daily debriefs/think-tanks to evaluate progress, new ideas, anticipate and deal with potential problems including individual attitudes. • Avoid times of heavy rain, continual drizzle, or when the ground is wet (baits will be damaged by excess moisture and will begin to break down, possibly becoming less palatable to rats) check which baits are best suited to showers and hardening again without setting like concrete (but also ensure retains palatability). • Spare bait leftover from the first application should be then used in areas considered to be highest risk, e.g. higher rat densities, higher crab takes, dense vegetation, problems with one or more members of the spreading	

	team, poor weather, etc. These areas will be identified by good daily record keeping and end of day debriefs. • When the second application is made each transect should be approached in the opposite direction and each transect done by a different team member. This team mixing helps to reduce the chance of gaps occurring in bait coverage. • The second application on the larger motu should begin from a different point to that used for the beginning of the first application (to ensure "end of day" transects are in different locations).	
Sowing rate	• 10 kg/ha x 2 spreads = 20 kg/ha – may need to reconsider this	
Bait transport and storage	• Consider space requirements, weight limits of all loading equipment and craft used between factory and the most distant lines from the church. • Packed in 25 kg packages shrink wrapped (check that this is OK for tropics, barrels = alternative, but too bulky to unload etc – dry-bags better, but time-consuming; alternatively, large dry-box in skiff into which baits loaded). • Can bait be provided in smaller packages from factory, e.g. 10-12.5 kg that can be placed directly in carry bag of the hand spreaders – need to specify this to ACP. • Land-freighted on pallets Wanganui-Auckland • Sea-freighted on same pallets in containers NZ-Papeete • Papeete-Vahanga ➢ Preferred option- sea-freighted on same pallets Papeete-Vahanga via Nuku Hau (Nuku Hau once per month - no timetable available yet for 2007). Land en route south via Nuku Hau long-boats, or if weather bad defer a few days to northern trip ex-Mangareva. If weather still bad, defer till 2.5. weeks later and leave baits on Nuku Hau. ➢ Examine other possibilities. • Bait carried across lower beach/reef, wheel-barrowed or quad/trailer-transport to Vahanga Church Avoid human-chain options. • Check dimensions of the church (c.12-15 m long x 8-10 m wide x 3+ m high). • At Vahanga baits to be kept on pallets in the church – windows and door open during the day to maximize ventilation (permission needed from Church - should be no problem – to be asked at our next meeting). Unwrap bait to stop sweating and when handling the bait everyone should be careful not to crush or damage the bait. • This poison must not be used, stored or prepared, with any, bait or attractant which is likely to lead any person to believe it is intended for human consumption. • Consider transport to lagoon – quadable.	
Non-target surveys June-Aug 2007	• For details refer Appendix 2 • Survey for ground-dove, fruit-dove, Tuamotu sandpiper	

	and bristle-thighed curlew. • Catch all ground-doves found (mist nets as used for tutururu in Rangiroa, hand-nets also likely to be effective), release into rat-proof enclosures where food and water and shelter are provided. Monitor for further presence on Vahanga. • Catch sandpipers (hand nets, passerine nets), attach transmitter (n = 5 needed), release for monitoring through poison operation. Colour-band with individual colour-codes any additional birds present. • Observe feeding routine of curlews, note individual plumage characteristics. • Record details of fruit doves – locations, diet, timing, etc. • Build enclosure for ground-doves (contingency for any returning tx (define) birds from Tenararo or bad weather preventing relocation to Tenararo etc). • Grain required for ground-doves (provide supplementary feed – details to come).	
Safety issues	• Develop a health and safety plan • All workers to wear helmets (coconut protection), gloves, good gripping footwear and overalls? • Use masks when working inside the Church • Vitamin K1 to be available for accidental poisoning • Be alert when fording deep channels – shark bites • Basic first aid kit carried in field; comprehensive kit kept at church	

APPENDIX 2. Effects on Non-Target Native Species

Target benefit species	The main species to benefit from this work is the Polynesian ground dove (*Gallicolumba erythroptera*) and Tuamotu sandpiper (*Prosobonia cancellata*). Other species that are also likely to benefit are listed in Tables 2 & 3.
Effect of operation on native species	Invertebrates, including crabs, will not be affected due to their blood clotting mechanisms. Individuals of some bird species will be at risk from either eating baits directly or, by eating crabs, other invertebrates/lizards, or dead rats that may have consumed the baits. These are discussed below. Polynesian ground dove It is possible that ground-doves could eat poison baits. This species is critically endangered (20-50 at Tenararo, 20-30 at Morane) and all precautions will be taken to avoid poisoning them. Intensive surveys will be undertaken on Vahanga and any individuals (potentially up to c.5) found will be captured and placed in temporary enclosures on Vahanga, and released again when all sign of poison baits have gone. Fruits and cereal will be provided to these captive birds. Tuamotu sandpiper It is expected that few birds will be present (all past visits have recorded fewer than 5 individuals). They are unlikely to consume baits or crabs, but could consume other invertebrates attracted to baits, so there is a risk of mortality. Because there are other situations where these birds occur in the presence of kiore (Pierce et al. 2003) it is important to determine whether

	they are at risk during standard rat eradication operations. Therefore these few birds will be radio-tagged if possible, and monitored throughout the operation to determine their fate. Any additional birds caught could be colour-banded. In the event of fatalities occurring, the loss will not be significant given 600+ present on neighbouring Tenararo and the potential for recovery on Vahanga. Any fatalities would however allow methodology for other atolls, e.g. Reitoru, Tahanea, to be refined. Bristle-thighed curlew Curlews prey on crabs which are attracted to and scavenge on poison baits, so there is a high chance of secondary poisoning of any individuals present. Dead bristle-thighed curlews and whimbrels (closely related) have been found following bait operations in Palmyra and Seychelles respectively. Bristle-thighed curlews migrate from Alaska to the Tuamotu Archipelago, arriving in late September and departing in March-April, so the period of curlew presence will be avoided. However small numbers (<10) of sub-adults could be present on Vahanga in winter. As at Palmyra it is proposed to minimize curlew exposure to winter months and monitor impacts (Buckelew et al 2005). Because curlews are likely to occur on nearly all other atolls in the Tuamotu (and central Pacific) on which rats will be targeted, it is important to determine survival of these resident birds. Individuals will be observed to determine survival rates – based on plumage characteristics, bodies found and subsequent necropsy. Any birds caught while spotlighting at night to be colour-banded – check with Alaskans re suitable band combinations. Atoll fruit dove Very few atoll fruit doves have been recorded at Vahanga (0-2 per trip). If any are present during poisoning they could be at risk of primary poisoning given there frugivorous diet and sometimes feeding on the ground (R. Pierce pers. obs.). If any individuals are lost this is not likely to be significant given the presence of a population on neighbouring rat-free Tenararo and the potential for recovery of a population on Vahanga. However, any fruit-doves found will be monitored as per curlews, i.e. noting plumage characteristics and feeding areas – the latter likely to include the lantana site. Long-tailed cuckoo This species has been recorded once (one bird in July) on Vahanga and a very few birds could be present during the winter poisoning period. They could be at risk of eating lizards that have previously consumed poison bait. If any were lost, it is unlikely to have a significant impact on the species' population. Other birds present are seabirds and inter-tidal foraging wandering tattlers and are unlikely to consume baits or contaminated crabs.

APPENDIX 3. Tasks, Actions, Responsibilities and Timeframes

Tasks	Actions	Responsibility	Date
Planning meeting	• Meet in Auckland	DOC, MANU, PII, R. Pierce	1-2 March 06
Draft operational plan	• Consult technical experts • Complete first draft	R. Pierce with support from C Denny, P. Raust	10 April 06
Specific questions	• Phoenix Islands trials – bait longevity, palatability to crabs • Crab life cycles	Mike Thorsen (DOC) R. Pierce R. Pierce	April-May 06
Review Draft Plan	• Review, discuss	PII, IEAG (DOC)	9-10 May 06
Meet Tahiti	• Social and technical meeting • Agree on representatives, team leaders and participants where possible	MANU, PII, Pierce, DOC	12-16 June 06
Revise Operational Plan	• Discuss, review	Pierce	23 June 06
Submit Final Operational Plan to CEPF	• Submit to CEPF	MANU	30 June 06
Funding	• Seek funding for Research trip • See funding for Review of other operations • Seek funding for eradication	PII/MANU	July-Aug 06
Appoint Op Manager	• Advertise for manager • Select OM	PII/ MANU	31 August 06
Research Trip	• Visit Vahanga with specific research questions re crab densities, baiting, etc – refer Appendix 1	ETA, BML?	Aug - Sept 2006
Finalise Op Plan	• Revisit outstanding issues, questions • Confirm other team leaders – 2IC, Eradication Technical Advisor (ETA), Biota monitoring leader (BML), Communications leader (CL) • Teams, tasks (including task list), timetables confirmed • Communications plan • Biosecurity Plan	OM, PM	1 Sept 06
Final order for baits	• Order from ACP, Wanganui	OM	28 Feb 07
Final travel bookings	• Bait, personnel	PM, OM	31 March 07
Advance party	• Island set up • Survey, monitoring	PM, OM, 2IC	June 07
Bait freighted	• Arrange safe transport to Mangareva	OM, 2IC	To be determined
Poison party	• Bait spread • Monitoring baits etc • Monitoring biota	OM 2IC, ETA BML	July-Aug 07
Follow-up	• Rat monitoring • Quarantine/biosecurity • Outcome monitoring	2IC PM BML	To be determined
Report	• Individual reports to PM for final collation	OM, 2IC, BML	

APPENDIX 4. Budget

Total budget US $275,000. This assumes a bait spread of 20 kg x 2. Depending on outcome of research and review, it is possible that this amount of bait and cost could be revised downward (or upward). See attached spreadsheet for full breakdown of budget scenarios.

Additional funding for a research visit in September 2006 is being sought from other providers.

Vahanga Budget (US$$)	Cost	Qnty	10 t	20 t	40 t	5 t station
FLIGHTS						
Experts to Tahiti @1000 each	1000	3	3000	3000	3000	3000
Internal travel in Tahiti (flights/boats)	600	8	4800	4800	4800	4800
ACCOMMODATION						
Papeete meeting/layover ($100 night) for 3 people for 5 days (max)	100	15	1500	1500	1500	1500
Accommodation on Mangareva	150	48	7200	7200	7200	7200
BOAT COSTS						
Freight of equipment (Tahiti-Mangareva)	1000	1	1000	1000	1000	1000
Freight of bait (Tahiti-Mangareva)	6000	1	6000	12000	24000	3000
LABOUR COSTS						
Programme manager - Philippe Raust	150	60	9000	9000	9000	9000
Operational Manager – Anne Gouni	150	90	13500	13500	13500	13500
Operational 2IC	150	45	6750	6750	6750	6750
Eradication Technical Advisor (ETA - DOC)	0	30	0	0	0	0
Biota Monitoring Leader (BML) - Ray Pierce	150	50	7500	7500	7500	7500
Post-operational operating monitoring + transport/annum	150	20	3000	3000	3000	3000
Communication leader	150	10	1500	1500	1500	1500
Local Workers (daily rate in FP is $65day)	65	30	15600	23400	35100	62400
FOOD						
Cooking gear (gas, plates, pans, etc)	1000	1	1000	1000	1000	1000
Generator	1500	1	1500	1500	1500	1500
Food (30 days) Work on $20/day/person	20	30	9600	12000	15600	24000
ERADICATION INFRASTRUCTURE						
Mapping - aerial photo, GPS and map production	3000	1	3000	3000	3000	3000
Machetes, knives and safety gear for clearing tracks	4000	1	4000	4000	4000	4000
Permanent track markers	300	1	300	300	300	300
Wheelbarrow	225	2	450	450	450	450
Dingy and 2 outboards	13000	1	13000	13000	13000	13000
Fuel containers	55	4	220	220	220	220

Island notice board	100	1	100	100	100	100
Construction of tutururu cage 10x5 m + roof; (150 m hex 13 mm chicken netting)	150	3	450	450	450	450
Wirecutters, staples, hammers, nails, boards to rat proof church	300	1	300	300	300	300
Fuel for dingies	300	6	1800	1800	1800	1800
RAT ERADICATION						
10 tonnes Pestoff Rodent Bait 20R in 25 kg bags on 1 tonne pallets @ NZD3,300 per tonne (20 kg/ha @382 ha = 7640 kg + 20% loss = 1528 kg = 9168kg)	3300	10	33000	66000	132000	19800
Road Freight to Auckland including container lifts and movements	1800	1	1800	3600	7200	1080
Ocean freight Auckland to Tahiti	5000	1	5000	10000	20000	5000
NZ Customs and security clearances and shipping documents	180	1	180	180	180	180
Import taxes, freight forwarder, statistic taxes, port taxes	16000	1	16000	32000	64000	9600
Air freight (Air Tahiti)	500	1	500	500	500	500
Development of a biosecurity protocol	500	1	500	500	500	500
Containers for storing/carrying bait	10	20	200	400	800	200
Rubber gloves (for bait handling)	5	30	150	150	150	150
Biodegradable tape, marker pens	30	10	300	300	300	300
Vitamin K1, 20mg oral doses (in case of accidental poisoning)	10	10	100	100	100	100
30m tape measure	60	4	240	240	240	240
Compass	20	5	100	100	100	100
Roll of baling twine (for hanging bait stations)	5	4	20	20	20	20
Waterproof notebooks	10	10	100	100	100	100
MONITORING						
Rat traps	5	50	250	250	250	250
Transmitters (5 sandpiper)	350	5	1750	1750	1750	1750
Telemetry gear	1200	1	1200	1200	1200	1200
MISCELLANEOUS ITEMS						
Administration costs (photocopying, phone & fax costs etc.)	1500	1	1500	1500	1500	1500
Project presentation to the local population before the operation and a restitution after the operation	3000	1	3000	3000	3000	3000
Translation services (20hr for 40 hrs)	20	40	800	800	800	800
Satellite phone, hand-held radios	2500	1	2500	2500	2500	2500
First aid kits, field guides, torches, spotlight, batteries, tents, etc	4000	1	4000	4000	4000	4000
bait stations	6400	5				32000
SUBTOTAL A			189260	261460	400760	259140
5% MANU OVERHEADS			9463	13073	20038	12957
GRAND TOTAL			**198723**	**274533**	**420798**	**272097**

			10 t	20t	40	6t bs
number of workers for 30 days			8	12	18	32

APPENDIX 5. Letter of support

ARCHIDIOCESE DE PAPEETE

Secrétariat - rue de l'Evêché - B.P 94 - 98713 Papeete - Tahiti (Polynésie Française)
Tél. (689) 50.23.51 - Fax (689) 42.40.32 - E-mail : catholic@mail.pf

Autorisation

Je, soussigné, Hubert COPPENRATH, archevêque de Papeete et Président de la Société Agricole des Acteon, autorise la Société d'Ornithologie « Manu » à procéder à la dératisation de l'atoll de Vahaga.

Cette opération se fera sous la responsabilité de la Société « Manu » qui s'entourera de toutes les précautions pour ne pas nuire à la faune terrestre et marine.

Fait à Papeete, le 30 juin 2006.

+ Hubert Coppenrath,
Archevêque de Papeete