ALEIPATA ISLANDS, SAMOA OPERATIONAL PLAN:

ERADICATION OF PACIFIC RATS

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IMPLEMENTING AGENCY
Secretariat of the Pacific Regional Environment Programme (SPREP)

Prepared by
Dave Butler (Technical Adviser – TA),
Malcolm Wylie (Aerial Drop Adviser – ADA)

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Operational Summary

Location	Nuutele (108ha) and Nuulua (25ha) Islands, Aleipata Group, 1.8km off eastern coast of Upolu, Samoa.
Primary Target Pest	Pacific Rat (*Rattus exulans*). Note: Yellow crazy ants (*Anoplolepis gracilipes*) are being targeted for control on both islands, the subject of a separate operational plan.
Target Benefit Species	Birds (tooth-billed pigeon (*Didunculus strigirostris*), friendly ground dove (*Gallicolumba stairi*), seabirds, invertebrates, reptiles and forest flora.
Vegetation Type	Coastal forest, lowland rainforest.
Climate	Wet and dry season; trade winds season.
Community Interests	Islands are uninhabited. Nuutele occasionally used by one family. District Community have given their approval to operation as part of a Marine Protected Area Management Plan.
Historic Sites	Two graves and remains of former leper colony on Nuutele.
Project Manager	Kate Brown, Action Strategy Adviser, SPREP.
Project Coordinator	At MNREM – subject of a submission to create a short-term coordinator position
Start & end Dates	August 2009 – February 2010
Methods	Aerial application of baits containing brodifacoum by helicopter guided by GPS. A total of 6 tonne (includes contingency of 1.5 tonne) of bait will be ordered. There will be 1 drops at 12kg/ha over both islands with coastal swaths and high risk areas (coconut plantings with high crab and rat numbers) being retreated at 6kg/ha followed by a second drop at 8kg/ha and re-treatments at 6kg/ha over both islands. The contingency will cover any gaps in bait spread and will allow for a complete third drop if one of the first two drops gets washed out by significant rainfall.
Biodiversity & Conservation Outcomes	o Enhanced population sizes of fauna present including birds, reptiles and invertebrates o Opportunity created to translocate species threatened on the main islands (particularly by invasive species): e.g. birds like the mao; native tree snails.
Socio-economic Benefits	o Sanctuaries for eco-tourism o Community pride through co-management of key natural assets
Capacity Development	o Government staff training o Skills-sharing with representatives of other countries o Education and awareness-raising in community o Model for community and Government co-management of nationally important sites o Increased awareness of management options in the region through use as a demonstration project.
Management	o Islands identified as key sites for biodiversity conservation

History	since 1991. o First assessment of rat management options in 2000. o Surveys of birds, reptiles and invertebrates in 2000, 2001. o Rat eradication endorsed in Marine Protected Area management plan in 2002. o Trials of rat control options in 2003. o Planning project with CEPF funding through RNHP started June 2006. o Community consultation project with CEPF funding through RNHP started February 2006

1. Introduction

The islands of Nu'utele and Nu'ulua, two of the Aleipata Island group situated off the eastern end of Upolu Island, Samoa have long been identified as key sites for conservation (Holloway & Floyd (1975), Pearsall & Whistler (1991), Park et al. (1992). They hold large populations of species currently found nowhere else in the country including threatened land-birds, seabirds and nesting turtles. They also are the only uninhabited offshore islands large enough and far enough offshore to be considered as refuges for several of the nation's species threatened on the larger islands by introduced mammalian pests. Such refuges have assumed greater importance as recent severe cyclones have reduced bird and bat numbers.

A key step towards the restoration of these islands is the eradication of the only mammalian pest known to be present, the Pacific or Polynesian Rat (*Rattus exulans*). Pacific Rats were trapped on Nu'utele in 1991 and their elimination was identified as desirable at that time (Park et al., 1992). Rats were located for the first time on Nu'ulua in 2003 (Butler, 2003).This eradication is feasible. Experience overseas has shown that removing this species would be very beneficial for the native fauna and flora occupying the islands and for other species that might be transferred there for their conservation.

The local people who use the islands have given their support to this rat eradication as part of a larger, successful marine protected areas project along that section of coast. Eradication needs to be followed by a community-led programme to prevent rats reinvading the islands.

The approved method for eradication is by distribution of baits containing the toxin brodifacoum. Both islands have areas of high cliffs which require the spreading of baits using a helicopter. However no helicopters are in the country so one will be shipped there as a significant part of the project costs.

The islands are two sites in the country where a threatened species, the Friendly or Shy Ground Dove *(Gallicolumba stairi)* is found and between them appear to hold a nationally significant population. This is likely to feed on bait fragments and be at risk of poisoning. Managing this species becomes an issue for the project.

A further issue has emerged that needs to be addressed as part of the restoration programme for these islands. Within about the past three years the Yellow Crazy Ant (*Anoplolepis gracilipes*) appears to have 'irrupted' on Nu'ulua with vast numbers active throughout the forest day and night and it may have already led to significant changes in the island's ecology. It has also been detected very recently on Nu'utele where it is still confined to c.10 hectares. It is also present in parts of the main islands of Upolu and Savaii in varying densities. The control or eradication (and preventing re-invasion) of the Yellow Crazy Ant will be the subject of a separate operational plan.

Opportunities to combine rat and ant management are being investigated, not least because aerial poisoning may be the preferred option for addressing the ant problem. Eradicating the rats on the islands seems of reduced value if nothing is done about the ants there. Restoration requires both to be under control. However any combined operation will be set up to place a successful rat eradication as the priority.

This plan identifies the necessary tasks and the people or agencies to undertake them to complete the rat eradication. A draft was discussed by New Zealand's Island Eradication Advisory Group in Invercargill on 19/10/06 and this final plan has benefited greatly from their expertise.

A funding application was submitted to the Australian Regional Natural Heritage Program (RNHP) in July 2006 to fund the actual operation.

2. Outcomes & Targets

2.1 Overall Goal	Restoration of Nuutele and Nuulua Islands, Aleipata Group, as key sites for the conservation of Samoa's indigenous biodiversity, through the eradication of Pacific rats (this plan) and control of yellow crazy ants.
2.2 Conservation Outcomes	• Native species remaining on the islands increase in number following removal of pest species • The island become a potential sanctuary to which species endangered by pests on the main islands can be translocated • The project demonstrates best practice for rat and crazy ant management that can be applied elsewhere in the region. • Local staff and the community develop skills and understanding to apply to the future management of the islands
2.3 Socio-economic Outcomes	• Local community have a potential ecotourism asset, arguably the best in the country, once restoration is complete. • This asset will generate income-generating opportunities for local families working with tourism operators. • Local community take pride and experience from their involvement in a regionally-significant conservation project.
2.4 Targets	• Eradication of Pacific rats • Ecological monitoring programme established and maintained • Appropriate surveillance and contingency actions implemented

3. Consultation, Consents & Notifications

3.1 Consultation	The conservation of the islands, lagoons and reefs of Aleipata were first discussed with the District's community during a United nations Environment Programme (UNEP) project in the mid-1990s. A World Conservation Union (IUCN) funded project more recently formalised a Marine Protected Area including the Aleipata Island. In a MPA Management Plan signed by the District Community & Government in 2002 a joint commitment was made to support rat eradication. More detailed consultation has been undertaken between February and July 2006 through a small grant from the Australian government's Regional Natural Heritage Program through the Critical Ecosystem Partnership Fund. The District Committee have viewed short video footage of an aerial drop overseas and re-endorsed the operation. An EIA was conducted in August involving consultations with key Government Departments and other stakeholders. A draft has been prepared and this will be discussed with the community to obtain their final sign-off.
3.2 Consents & Notifications	Government & District Community signed-off on MPA Management Plan in 2002. Community (District Committee) and Government approve Restoration Programme in July 2006. Community sign-off on EIA – expected November/December 2006 PUMA/Cabinet sign off on EIA – expected November/December 2006. Licenses and approvals for helicopter use – under discussion. The contracted helicopter company, North Shore Helicopters, is based in New Zealand and

	has begun the arrangements necessary for approval to operate in Samoa. Consultations with the Registrar of Pesticides during the EIA confirmed that Pestoff and brodifacoum are not registered for use in Samoa but a special use permit can be applied for.

4. Methods

4.1 Summary

Eradication will be undertaken using the aerial spreading of baits from a helicopter using an under-slung bucket. A Robinson 44 will be shipped from Auckland, New Zealand to Samoa. The bait was manufactured in Wanganui, New Zealand by Animal Control Products (ACP) and has been shipped separately to Apia. Baits are grain-based and contain the toxin brodifacoum. The helicopter will be guided by a GPS system which will enable the checking of flight paths and any possible gaps in bait spread. The operation will be closely based on similar ones used to successfully eradicate rats from much larger islands in New Zealand and other countries.

4.2 Bait to be used

Pestoff Rodent Bait 20R, 10mm extruded baits containing 20ppm brodifacoum manufactured by Animal Control Products (ACP), Wanganui, New Zealand. Bait to be dyed green and contain no bitrex. The bait was to be coconut-lured but this was not added due to an error at the time of manufacturing. This is not considered to be reason enough to delay the operation. Bait is supplied in 25kg bags with 40 bags to a pellet making an overall weight of around 1050 kg per pellet. Pellets will be shrink-wrapped for transport.

4.3 Bait quantity & spreading rate

6 tonnes of bait has been calculated as the amount of bait needed for this operation. This is based on the following:

<u>Nu'utele Island (108 ha)</u>
1st drop: 12kg/ha – nominal sowing rate of 6kg/ha with 50% overlap
Coastal swaths: an additional 3kg/ha with 50% overlap (c. 90ha?)

2nd drop: 8 kg/ha – sowing rate of 4kg/ha with 50% overlap
Coastal swaths – an additional 3kg/ha with 50% overlap

<u>Nu'ulua Island (25 ha)</u>
1st drop: 12kg/ha – nominal sowing rate of 6kg/ha with 50% overlap
Coastal swaths: 6kg/ha over entire island, no overlap of swaths

2nd drop: 8 kg/ha – sowing rate of 4kg/ha with 50% overlap
Coastal swaths – 6kg/ha with 50% overlap

<u>Contingency</u>
A contingency amount of 1.5 tonnes will be ordered. This will cover for any possible gaps in flight paths during the first two drops, or allow a complete third drop if either of the first two gets washed out by unforeseen rain events.

This system will mean the high-risk areas being the high cliffs on Nu'utele, and Vini and Nu'utele beaches on Nu'utele, will receive between 14 and 18 kg/ha during each drop.

If 4.5 tonne of bait is used then the average application rate will be in the order of 30-

33 kg/ha.

The gap between the two drops is proposed as a minimum of 7 days.

4.4 Timing

Funding for this operation was confirmed in late 2008. The preferred timing for the operation is between August – September 2009. Daily rainfall records from two stations in the Aleipata district will be checked for these months but frequent fine spells (allowing 3 consecutive fine nights after a drop) are likely as these are two of the four driest months. What ability there is to forecast these fine spells is being investigated. Note: there is no season equivalent to the New Zealand winter which is when such operations are carried out there as there is a relative shortage of food then and baits are at their most attractive. Rats breed year around on the two target islands. The bait arrived in Apia in mid-July after being manufactured in early June 2009. The helicopter and associated equipment is expected to be ready to operate in Samoa around the August 10th.

4.5 Contracting supply of helicopter and baits

4.5.1 Supply of helicopter

A contract to supply an appropriately equipped helicopter and a pilot experienced in such aerial drops of toxic baits was finalised in mid-July.

Three quotes were received as part of the process to find an operator although only two of these were competitive. North Shore Helicopters Ltd based in Auckland, NZ was selected by the project team as being the preferred operator and this decision was endorsed by the funding body. This company will supply a Robinson 44 helicopter, spreader bucket, GPS system and fuel necessary to undertake the operation. They specified as their lead pilot a pilot with the necessary experience to undertake this operation with the skill required.

4.5.2 Supply of bait

Baits were supplied by Animal Control Products (ACP), Wanganui, who supply all New Zealand's brodifacoum operations. The bait (Pestoff 20R 10mm) was manufactured in early June 2009 and arrived in Apia in mid-July.

Quality control and testing procedures developed by the NZ Department of Conservation and ACP over the past few years have lead to a reliably high quality bait being produced. Thus no prior testing of bait toxicity, moisture or fragmentation will be carried out. A sample of baits from each batch supplied (i.e. from a bag in the centre of each pallet) will be kept to be tested subsequently in the event of problems.

4.6 Operation

4.6.1 Shipping of baits

ACP have experience in shipping baits to tropical islands and were responsible for packing them in dry conditions and delivering them to the shipping line at Port of Auckland. They ensurec that no potential contaminants of the bait, such as fuel, or objects that could damage the bait were shipped in the same container.

4.6.2 Unloading of baits, transport to site, and storage

To be finalised. Bait has been stored in a warehouse in Apia and will stay there until immediately prior to the first bait drop. This will allow the bait condition to be checked more regularly and the consignment to be more secure. The issue of whether the remaining bait after the first drop is trucked back to Apia or left at the Marine Centre next to the loading site needs to be discussed when all the project team is in Samoa. There are advantages and disadvantages to both options.

MNRE staff need to confirm:

- whether the Marine Centre can be used
- whether a 5 tonne plus shipping container can be transported to Aleipata District and whether it can be unloaded from the truck once there.

4.6.3 Delivery of helicopter and equipment to Samoa

North Shore Helicopters are responsible to ship their helicopter and equipment to Apia where they will need to reassemble the machine and probably store it at Faleolo International Airport. Prior to each bait drop they will need to fly it to Aleipata for the operation from the Marine Centre. Any drums of helicopter fuel and the spreader bucket should probably be stored in a secure facility in Apia as they will best be transported by road to the loading site on the day of the operation or the day before.

4.6.4 Decision-making

A decision-making protocol will be developed. This will identify who will make the decision to carry out a drop on a give day (Project Manager?) and the role of the Aerial Drop Adviser (ADA) provided by the New Zealand Department of Conservation in providing them with advice. It will identify weather forecasting services to be utilised. The only likely options for making a decision on whether to fly are the Principal Terrestrial Conservation Officer from MNRE, the Technical Advisor and the Aerial Drop Adviser. There are also going to be issues needing discussion on bait dropping days. These will probably include things such as the amount of bait going out, flight paths, flying team members to the island etc. A single person with overall responsibility will be needed.

4.6.5 Transport of helicopter, equipment & personnel to loading site

A decision to plan to go ahead with a drop will be made by 12pm on the day before. Once a decision has been made then arrangements will be made to inform all team

members and to get all required people and equipment over to Aleipata that afternoon/evening (accommodation to be organised). MNRE staff will be responsible for making these arrangements. Morning weather conditions will generally provide better flying conditions than in afternoons as wind and cloud generally increase as the day progresses. Based on the number of bucket loads per drop (~9-10) it is estimated that the total operational time (including refuelling, downloading flight info) will take 4-5 hours. The Marine Centre is roughly an hour's drive from Apia where the MNRE base is located.

Helicopter

The helicopter may be stored at Faleolo Airport which is approximately three quarters of an hour's drive from Apia. There is nowhere suitable to store a helicopter in the Aleipata District although it can land directly outside the Marine Centre and therefore it could be flown down the day before any bait drop. The Marine Centre is roughly 100 -120 km from the airport in a direct flight path. This path however would take the helicopter directly over the main hill range on Upolu Island which is often covered in cloud and therefore the flight path is not likely to be direct. Therefore 1 – 1.5 hours would be allowed for the machine to fly to the Marine Centre. The helicopter would be able to carry a maximum of 3 passengers if required. If flying with the spreader bucket underneath then this would increase the flight time considerably from the airport to the Marine Centre. Therefore, the spreader bucket may be best transported by road.

Prior to the first drop the helicopter will need to fly the coast of each island and load this on the GPS and check against digital images.

This reconnaissance(s) flight may provide an opportunity for others to go up in the helicopter or to get dropped off on the islands as no passengers will be taken when dropping baits as the pilot needs no additional distractions at that time – and extra weight reduces the possible bait load. A video camera operator would be one to be taken to obtain aerial footage for a video on the project. Senior staff, politicians or community leaders may be other possibilities.

The flight will also provide an opportunity to assess the risk posed by seabirds and develop procedures to minimise any risk present.

Equipment

The equipment needed will be the spreader bucket, drums of helicopter fuel, personal protective equipment (PPE), washing gear, site clean up gear and food and water for the team members if this is to be provided. There will also need to be some means of transporting the empty bait bags such as bulk bags or fadges. The Marine Centre is not really a suitable site for storing the fuel or spreader buckets unless a staff member is based there to look after the bait. PPE and cleaning gear could however be left at the centre. The spreader bucket could be transported on one large tandem trailer to the marine centre on the day of the bait drop. The fuel could also be transported on a trailer (discussions with the pilot will determine how many drums of fuel are needed at the loading site).

A portable generator will also be obtained in case of power outages.

Personnel

There will be at least 3 members in the loading team plus the Principal Terrestrial Conservation Officer, TA and ADA. Therefore transport will be required for at least 6 people.

4.6.6 Loading of bait into spreader buckets

Detailed protocols will be developed for unpacking baits and loading spreader buckets based on those used in New Zealand. The loading team itself is likely to include one or two staff members from the MNRE at most and the remainder will be community members. The Aerial Drop Adviser has recommended that 3 people in the loading team will be sufficient. This will allow two people to tip bags into the bucket and one to hold onto the empty bags and one person to dispose of the empty bags between helicopter loads. Safety measures would include the following identified in the draft EIA:

- Baits will only be handled by experienced staff or those under the direction of experienced staff.
- All workers shall receive a safety briefing from the project Adviser. (This will include the helicopter shutting down on site and the pilot providing a briefing on safety around helicopters)
- Pesticide label instructions shall be followed at all times.
- Washing facilities and a supply of clean water shall be available during the operation.
- Protective clothing and equipment shall be removed and hands/arms/face thoroughly washed before eating, drinking, smoking or using the toilet.
- Appropriate personal protective equipment (PPE) shall be worn by all people handling baits during the operation.
- The boundaries of the helicopter loading area shall be marked and signs erected.
- No person who is not assisting in the operation shall remain in the vicinity of the operation.
- All equipment used to handle, dispense or carry pesticides shall be fit for the purpose and be free of defects.

Only baits in good condition will be spread. Any damaged bags, e.g. any that have allowed moisture in, will be set aside for later disposal (see below).

Baits will be hand spread under the two buildings on Nuutele and around the temporary aviaries used to house ground doves.

4.6.7 Clean-up

- The loading area shall be thoroughly inspected for spilled baits and cleaned down following the operation.
- The helicopter, spreader bucket and loading equipment shall be thoroughly washed

before leaving the area.

- Contaminated safety equipment, vehicles and any other equipment that has been in contact with baits shall be thoroughly washed.
- Surplus pesticide should be stored in its original packaging with manufacturers label attached and MSDS available.

4.6.8 Accidents

- Procedures shall be put in place for accidents, pesticide spillage and poisoning (protective clothing, first aid supplies, and emergency service phone numbers shall be readily available).
- The appropriate authorities shall be notified in the event of accidental spill.

4.6.9 Disposal of bait bags & spoilt bait

The EIA has identified that there are no facilities available to safely dispose of this in Samoa so it will be packed and shipped to another destination for disposal, probably New Zealand.

4.6.10 Un-used bait

It is not going to be an option to store unused bait in Samoa or to dispose of it there. Such bait will breakdown relatively rapidly when exposed to the humid air there and it is not suitable for contingency purposes (i.e. placing in bait stations at wharfs or on the islands).

The operation should be carried out in way that all baits are spread on Nuutele and Nuulua. Any left over would be shipped overseas for disposal along with bags, spoilt bait, contaminated safety clothing, etc.

[The possibility of dropping unused bait on Fanuatapu could be investigated].

4.6.11 Dropping of baits

The helicopter used to discharge the baits shall be guided by a global positioning system (GPS) to reduce the likelihood of baits falling into the sea surrounding the islands. The flight paths of the helicopter used to discharge the baits shall be recorded by the GPS and shall be checked for any possible gaps which will be addressed (by a further aerial run or ground baiting) prior to the completion of each drop.

- The helicopter pilot shall:
    - have appropriate experience sowing bait aerially from a helicopter with an underslung spreader bucket using GPS.
    - hold appropriate aviation, chemical and agricultural ratings to undertake the aerial sowing.

- upload a digital copy of the treatment boundary. Discussions will need to be held with the pilot, once confirmed, as to in which format the digital boundary map should be provided.
- have flown the boundaries around the islands with the project Adviser to confirm that the electronic boundary is correct.
- received copies of all consents and approvals
- shut down the spreading bucket before leaving the operational area.

- The spreader bucket shall, as far as practicable:
  - be of an appropriate capacity to match the helicopter and loading equipment
  - have a spinner that is designed for distributing cereal pellets of the size being sown (brodifacoum operation only)
  - have a proven reliable system for the pilot to stop bait sowing, such as a bucket on/off switch
  - be of a design that is easy to clean

A test drop will be carried out over Nuutele to check the working of the bucket.

During the operation itself a check will be made part way through to ensure that the bait is being spread at the planned rate. One option might be to do Nuulua first, knowing how much bait is calculated as needed, and assess how many bags were used. An alternative would be to drop two buckets on Nuutele and then check with the GPS what lengths of swaths have been covered.

4.7 Monitoring

4.7.1 Monitoring of rats

Rats will be monitored from the first poison drop onwards for two purposes: operational: to determine details of subsequent drop(s), and result: to determine the success of the eradication.

Operational monitoring:

Two possible areas have been identified where there could theoretically be problems making enough baits available to eliminate all rats. One of these is the cliffs of both islands which cannot be accessed for monitoring. The second is the areas of coconuts behind Vini and Nuutele beaches on Nuutele. It is proposed as a minimum to monitor baits at Vini Beach. If baits disappear rapidly after the first drop, then this area and Nuutele Beach will be covered more heavily in the second drop.

Additional monitoring of rats may be undertaken using lines of snap traps baited with roasted coconut or tracking tunnels. The effectiveness of tracking tunnels will be evaluated beforehand.

Monitoring may be influenced by proposed research to assess crab densities and determine their relative bait take.

Result monitoring:

In New Zealand the standard practice is to wait 2 years (i.e. 2 breeding seasons) following the operation, to allow rat numbers to build up to levels that are more likely to be detected by any monitoring. However rats breed year round on Samoan islands and food is available year round. So an initial monitoring effort using a range of detection equipment spread as widely as possible will be mounted on each island one year after the operation.

In addition there will be periodic checks of bait or tracking stations on the islands as part of ongoing biosecurity to detect any possible re-invasions as early as possible.

Samples of rats will be stored frozen from each island. This will allow future comparisons of the DNA with any animals

4.7.2 Monitoring of baits

The spread of baits will be determined using GPS print-outs and the results shown on these.

The take of bait will be monitored by observation. Fixed plots may be used at Vini Beach alongside the rat trapping in relation to the proposed crab research.

4.7.3 Monitoring of bait breakdown

Baits will be monitored to determine when they are fully broken down and no longer toxic and when friendly ground doves can be re-released onto the islands. At the time of the operation several plots of baits will be placed on the ground (to allow soil decomposers to access them) in mesh enclosures established in a range of habitats, elevations, aspects and exposures. The condition of the baits will be monitored until they have completely disappeared or only a few separated bait particles remain. Enclosures will prevent baits being eaten by rats, crabs and other non-target species.

An opportunity may be taken to test de-composition of non-toxic baits.

4.7.4 Monitoring of non-target impacts of the operation (see 5 below)

The impact of the operation on birds will be checked by some searching for carcasses following each drop. If any individual friendly ground doves elude capture it may be possible to determine whether they survived the operation by subsequent visits to the area they were seen.

4.7.5 Outcome monitoring

Forest bird 5-minute counts:

A transect of nine stations has been established by MNREM and DJB on Nuutele and 5-minute counts have been undertaken periodically (using the established New Zealand protocol). Further counts will be conducted by MNREM staff prior to the operation.

Friendly ground doves:
Birds temporarily held in captivity during the operation as a mitigation measure (see 5. 1 below) will be banded. Thus when they are released it should mean that most of the population will be marked. Observations of the proportion of banded and un-banded birds seen after the operation will identify approximately how many un-captured birds survived the operation. The population will then be able to be monitored annually to assess productivity (new unbanded birds) and mortality (of banded birds).

Other birds:

Casual observations (including some counts of seabirds) have been made by several observers in the past few years. These should be replicable to some degree as a way of assessing coarse changes in bird populations.

Photopoints:

Photopoints were established by MNREM and DJB at the bird count stations on Nuutele in 2005. Six further photopoints (4 photos each) were established on Nuulua

in September 2006.

Reptiles and Invertebrates:

New Zealand scientists conducted three surveys of lizards and invertebrates (along with birds and weeds) on the two islands in 2000 (Stringer et al, 2000), June 2001 (Stringer et al., 2001) and June 2003 (Parrish et al, 2003). These could be repeated to indicate changes though they are not very quantified.

Other invertebrate monitoring using baits and pitfall traps has been carried out on Nuulua in July 2006 and on both islands in September 2006.

5. Effects on Non-Target Native Species

5.1 Friendly Ground Dove or tuaimeo

This small dove feeds mostly on the ground and is considered at risk of taking the baits and being poisoned. A species with similar ecology, the barred ground dove (*Geopelia striata*) had estimated mortality of 40 to 80% from aerial drops of brodifacoum to eradicate rodents in the Seychelles (Merton et al., 2002). The islands of Nuutele and Nuulua are considered the stronghold of friendly ground doves in Samoa though they are also present on the main islands of Samoa (Upolu and Savaii) apparently in small numbers.

An expedition to Nuutele in September 2005 set out to test whether doves could be caught and held in temporary captivity on the island as a means of protecting them from the poison drop. However despite a considerable effort only on long-distance sighting of a bird was obtained. A repeat effort to the same island using a smaller team in August 2006 located an estimated 6-7 pairs and netted two birds, so this approach is now considered viable (see 5.1.1 below).

A study of the genetic variation within the species is currently being undertaken by the Department of Marine & Wildlife Resources, American Samoa. A sample from the dead bird found on Upolu and the birds caught on Nuutele are to be compared to samples from Ofu/Olesega, and eventually from Fiji and Tonga. The dove found in Samoa and American Samoa is considered by some to be a different sub-species (*Gallicolumba s. stairii*) from that found in Fiji and Tonga (*G. s. vitiensis*). The former is smaller but the differences are considered minimal (Watling 2001). If the Samoan's bird's DNA is considered the same as that from American Samoa, or the other islands, then there is a potential to re-introduce this taxon from one of the other populations should too few birds survive on Nuutele and Nuulua to re-establish naturally and not enough remain on Upolu or Savaii.

It is proposed to capture as many ground doves as possible on Nuutele and Nuulua, hold them temporarily on Nuutele and release them when baits from the second drop are no longer toxic. This is based a demonstrated ability to catch birds and overseas (Tonga) experience showing that they could readily be kept alive in captivity.

Parrish (2006) has recommended that the capture of birds needs to commence one

week before the drop occurs. Determining the exact date to capture birds will be difficult, as the aerial drop will be determined by weather forecasts. In addition, the birds need to be held for a minimum of two weeks until the baits decay. This means some birds will be held for up to 3 weeks, but this will be longer if the drop is delayed by bad weather. Provision must be made for suitably qualified husbandry personnel to remain at Vini for the entire period (a minimum of three weeks).

He suggests using three teams to capture the birds: one based at Vini, one at Nu'utele Beach and one on Nu'ulua Island. Each team needs to consist of two people. Each team requires a minimum of two mist nets 12 m long. The mist net mesh size should be 60 mm. The nets should be set in sites where birds have been seen e.g. within a pair's territory. The nets should be set before first light, and if necessary they can be left set overnight. A clap trap could also be useful if the team know there is a bird present but are having trouble capturing it.

Enough temporary cages will be available to accommodate 15 or so birds.

5.2 Other birds

An analysis conducted as part of the EIA (reproduced here as annex 1) identifies two other species at significant risk, the barn owl (lulu) (from eating poisoned rats) and banded rail (vea) (from eating baits or scavenging poisoned rats). Barn owls were identified as regionally and globally widespread and locally common and they move easily between islands (Watling 2004), so if birds on the islands are killed, others from Upolu will re-establish on Nu'utele and Nu'ulua. It was also concluded that the chances of all the banded rails on either island dying are low and banded rails are abundant on the adjacent main island of Upolu and not threatened. If necessary, birds could be re-introduced to the islands.

The analysis identified several other species such as the kingfisher and some insectivorous species, e.g. broadbills at some risk. Though a few individuals may die, population level effects are not expected. These species are all relatively abundant on the mainland and could be reintroduced in the unlikely event of population loss. No management measures are thus proposed for any of these species.

5.3 Reptiles

The EIA concluded that the risk to lizards is low. None of the species are expected to be affected at the population level and the benefits of eradicating Pacific rats and releasing lizards from rat predation should outweigh any losses as a result of brodifacoum poisoning. The Pacific boa also fits in this category.

5.4 Invertebrates

Invertebrates are generally not considered to be at risk from brodifacoum poisoning as they have a different blood clotting system to vertebrates.

5.5 Crustacea

Crabs are likely to consume eat baits and scavenge poisoned rat carcasses. However, no adverse impacts on crabs and other crustaceans are expected as a result of the brodifacoum operation. Like invertebrates, crustaceans have a different blood clotting system and are not considered to be at risk from brodifacoum poisoning.

7. Tasks, actions, responsibilities and timeframes

Tasks	Actions	Responsibility	Date
7.1 Finalise staffing	• Finalise project management structure	MNREM assisted by the ADA and TA	

	• Finalise team for friendly ground dove management • Finalise team for operation – loading team, monitoring teams on islands		
7.2 Complete planning	• Complete detailed work plan for the operation	MNREM assisted by the ADA and TA	
7.3 Obtain all necessary approvals	• Obtain special use permit for Brodifacoum and Pestoff™ • Obtain approvals for helicopter operation in Samoa	MNREM MNREM & Manulele Aviation	15 December 15 December
7.4 Develop necessary protocols	• Develop a decision-making protocol to determine when a drop will proceed • Identify sources of weather forecasts that can be used within protocol	MNREM assisted by the ADA and TA	
7.5 Organise GPS maps, computer equipment, etc.	• Provide GPS maps of islands • Load GPS maps on to computer and on to helicopter system • Set up a laptop and printer and means to download maps from helicopter	MNREM Coordinator assisted by ADA & technical expert*	
7.6 Organise supply of bait and return of waste	• Order baits • Arrange quality control system and appropriate testing • Organise permits and paperwork for export from NZ and import to Samoa • Organise permits and paperwork for export from Samoa of 'toxic waste' and import to New Zealand. • Finalise bait transport/shipping arrangements to Samoa • Finalise transport of waste bait, bags etc back to NZ and disposal there	SPREP? TA/ADA MNREM MNREM & TA/ADA TA/ADA MNREM & TA/ADA	
7.7 Organise helicopter, pilot, spreader buckets.	• Confirm viability of working with Manulele Aviation • Confirm and contract NZ company and pilot • Develop a work plan for shipping of equipment, receipt in Samoa, set-up and testing of this in the machine, flight to Samoa, flight to Aleipata	Peter Garden SPREP, TA, ADA & PII NZ company, MNREM, ADA & TA	15 Nov 15 Dec

	• Organise permits and paperwork for export from NZ and import to Samoa • Ship equipment	Manulele Aviation and MNREM NZ company	
7.8 Organise other equipment	• Personal Protective Equipment • Loading site cleaning gear • Hand washing gear • Trailers for transporting buckets, fuel • Bulk bags for empty bait bags • Pallets to be used as loading site platform	TA MNREM MNREM MNREM MNREM MNREM	
7.9 Complete all pre-operational monitoring	• Including trying to collect rat samples for any possible future DNA requirements	TA, MNREM	
7.10 Organise friendly ground dove programme	• Finalise team • Organise transport of cages and food to Samoa • Organise trapping equipment (nets, banding gear)		
7.11 Train staff required for operation	• Get pilot and ADA to brief all loading team members on their responsibilities, use of PPE gear, helicopter safety etc • Show film footage of previous operations		
7.12 Put required notifications in place	• Place radio and TV adverts • Place signs around loading zone • Organise someone to stand at gate and explain operation to passers by.		
7.13 Establish programme to prevent re-invasion	• Identify potential routes of reinvasion • Run community awareness programme • Provide bait stations, bait for local fishing boats? • Install monitoring tools on Nu'utele in particular		
7.14 Evaluate & report on operation		TA, ADA & MNREM	
7.15 Disseminate reports,			

lessons learned.			

* Expert input will be needed to train one of the team to upload flight path information into the computer so that gaps can be identified.

8. Risks and Mitigation Measures

Risk	**Mitigation measures**
Public opposition; lack of support by the local community.	• Great deal of consultation undertaken • Sign-off on EIA is the final approval step • Close liaison maintained with District Committee informing them of progress during each meeting they have with the MPA MNREM team • Community members recruited to assist the operation
Government opposition	• Sign-off on EIA is the final approval step
Time delays	• Allocation of necessary staff and consultants times • Thorough work planning • Regular review against milestones
Negative conservation impact – e.g. on non-target species	• Long history of use of brodifacoum allows non-target risks to be identified with some certainty • Significant effort put in to mitigate risks to friendly ground dove [finish]
Failure to eradicate	• Operation 'over-engineered' – more than enough bait; • thorough planning and testing of GPS mapping system to ensure good coverage • protocol in place to maximise chance of choosing to drop in a period of fine weather • monitoring of impact of drop on key at-risk areas • potential to do three drops if required.
Risks to staff	• Staff selected for their ability to undertake tasks within safety margins (e.g. lifting of bait bags) • Training and safety briefings by helicopter pilot and aerial drop Adviser • Detailed individual work plans

	• Appropriate safety clothing
Operational risks: o Helicopter – mechanical failure, bird strike o Spreader bucket – mechanical or hydraulic failure o Helicopter fuel contaminated or not to standard. o Bait – arrives in poor condition o Weather – preventing use of helicopter; causing rapid deterioration of baits	• Aerial Drop Adviser, and possibly the helicopter pilot, make a reconnaissance visit to Samoa before the operation • Full complement of spare parts taken to island; oil, hydraulic fluids, etc. • Plans in place for engineering support; possible replacement machine [Am Sam?] • [birdstrike – see discussion Seychelles] • Two aerial buckets taken to Samoa plus spare parts • Helicopter company maintain close supervision on procurement and storage of fuel • Bait packed in dry conditions in NZ • No contamination in container ensured • Research undertaken to identify possible sources of weather forecasting and likely patterns at that time of year • Detailed decision-making protocol written to allow project staff to decide on dates to drop, with advice from Aerial Drop Adviser.
Financial o Insufficient budget o Going over budget	o Careful budgeting including some contingency funding o Thorough management of budgets; accounting procedures; regular reporting.
Re-invasions by Pacific rats or invasions by other rat species	o Detailed contingency plan agreed o Staff and local community provided training o Traps and bait stations ready to be set-up once operation completed.

9. Budget

Annex 1: Risk Assessment for Impacts of Aerial Baiting on Land Birds (Source: Hooson 2006)

Land birds – simple risk assessment of primary and secondary poisoning threat

Common name	Scientific name	Diet	Feeding stratum	Risk*	Conseq. †	Score
Tooth-billed pigeon	(*Didunculus strigirostris*)	Frugivorous	Ground/canopy	0	6	6
Friendly ground dove	***(Gallicolumba stairi)***	**Seeds, fruit, buds, leaves**	**Ground/sub can**	**5**	**5**	**10**
Many coloured fruit dove	(*Ptilinopus perousii*)	Frugivorous	Canopy	0	2	2
White throated pigeon	(*Columba vitiensis*)	Fruits, berries, seeds, shoots	Sub-can/ground	4	2	6
Pacific pigeon	(*Ducula pacifica*)	Frugivorous	Occ. ground	2	1	3
Crimson crowned fruit dove	(*Ptilinopus poriphyraceus*)	Frugivorous	Sub canopy	0	0	0
Samoan broadbill	**(*Mylagra albiventris*)**	**Insectivorous**	**Sub/canopy**	**3**	**5**	**8**
Flat-billed kingfisher	(*Todirhamphus recurvirostris*)	Large insects, crabs, lizards	Ground	4	0	4
White-rumped swiftlet	(*Aeroramphus spodiopygius*)	Exclusively insectivorous	Aerial	0	0	0
Samoan whistler	(*Pachycephala flavifrons*)	? Insectivorous, fruits	Any level	4	0	4
Polynesian triller	(*Lalaga maculosa*)	Insects, caterpillars, fruit	Incl. ground	4	0	4
Samoan triller	***(Lalage sharpei)***	**Caterpillars, other insects**	**Incl. ground**	**4**	**3**	**7**
Wattled honeyeater	(*Foulehalo carunculata*)	Nectivorous, fruit, insects, lizards	Sub-/canopy	2	0	2
Polynesian starling	(*Aplonis tabuensis*)	Fruit, berries, insects	Sub-/canopy -	2	0	2
Samoan starling	(*Aplonis atrifusca*)	Fruit, insects	Sub-/canopy	2	0	2
Scarlet robin	(*Petroica multicolor*)	Insectivorous	Incl. ground	4	0	4
Samoan fantail	(*Rhipidura nebulosa*)	Insectivorous	Aerial	0	0	0
Blue-crowned lory	(*Vini australis*)	Nectar, pollen, fruit	Sub-/canopy -	0	1	1
Banded rail	(*Rallus phillippensis*)	Insects, snails, crustaceans, fruit	Ground	5	0	5
Barn owl	(*Tyto alba*)	Exclusively rats, insects	Ground	5	0	5

* Risk score: 1-5 (5 = high risk) based on diet and feeding behaviour and hence risk of primary and secondary poisoning.

† Consequence: Highest of international or national threat ranking. 1-7: None = 0, LC = 1, CC = 2, NT = 3, AR = 4, VU = 5, EN = 6, CR = 7.