FEASIBILITY STUDY REPORT

The Restoration and Conservation of Remnant Native Forest on Maraeti'a Plateau, Punaruu Valley, Tahiti, French Polynesia

TE RAU ATI ATI A
TAU A HITI NOA TU

Title: The Restoration and Conservation of Remnant Native Forest on Maraeti'a Plateau, Punaruu Valley, Tahiti, French Polynesia

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EXECUTIVE SUMMARY

The purpose of this document is to determine whether it is feasible to intervene to protect rare and threatened native plant species on the Maraeti'a plateau, Punaruu valley, Tahiti, French Polynesia.

The 20 ha Maraeti'a plateau lies at 800 m elevation, approximately 8 km from the western coast of Tahiti-nui, near the head of the Punaruu valley. It contains remnant populations of critically rare and endangered native and endemic plants, including tree species. Populations of some of these species are the only known examples in Tahiti and are of international significance.

Regeneration of these plant species is very likely severely affected by the foraging and disturbance activity of rats and wild pigs, and the detrimental effects of invasive plants. A significant influencing factor is that there is considerable uncertainty as to what affect the exclusion of ungulates and removal of rodents will have on the natural regeneration of the rare plant species.

Recommended intervention to protect the rare plant species and improve their future natural regeneration includes:

1. The erection of an ungulate-proof fence;
2. Implementation of a rodent control programme both within the proposed protection area and over an adjacent area of the plateau and accessible sidings;
3. Options for invasive plant management include:
    - A "do nothing" approach for a period of up to 3 years;
    - A "control the low-incidence and allelopathic invasive weeds and leave suspected "nursery-weed" species approach"; and
    - The second approach combined with a pro-active replanting programme of suitable native plants including the rare and endangered species.

A robust monitoring programme is recommended utilising photo-point and plot techniques both within and outside the proposed protection area.

An adaptive management process is recommended in undertaking this project. A working group needs to be formed that includes members of the two associations with land management interests within the Punaruu valley: "Association pour la protection de la vallée de Punaruu" and "Te rau ati ati a tau e a hiti noa tu". There is currently a good level of community and government support for the project, however, community groups, such as the pig hunters and orange gatherers, need to be represented and contribute to the project's adaptive management process working group. It should also include scientists with an active interest in the project and other key stakeholders.

This project also allows opportunity for conservation best-practice and values of the Tahitian natural environment to be demonstrated to school and community groups. Knowledge sharing and the groups' active participation in management of the protected area, e.g. native tree planting, weeding, monitoring programme; should be incorporated into the project.

Costs for the project are a high-level estimate made in New Zealand dollars and calculated for a five year timeframe. The estimated cost of the protection fence is $36,922 (to be constructed in year one); the cost of the rodent control programme is $124,004; the cost of the monitoring programme is $20,765 and the cost of the invasive plant management and possible native species replanting programme ranges from $0 ("do nothing") to $122,061 (the invasive plant and native species replanting option).

With additional project administration and design costs, the total cost of the project is in the order of NZ$311,300 over the projected 5-year period. This cost assumes that the invasive plant control and replanting programme is undertaken as part of the project.

The Restoration and Conservation of Remnant Native Forest on Maraeti'a Plateau, Punaruu Valley, Tahiti, French Polynesia project is feasible and should proceed once the project design has been detailed and funding is available**.**

1 INTRODUCTION

Te rau ati ati a tau e a hiti noa tu" (hereafter named Te rau ati ati) requested PII complete the Feasibility Study to assess whether it is feasible to conserve and begin the restoration of an area of unique remnant native forest in Tahiti. The area is known as Maraeti'a and is a 20 hectare plateau near the end of the Punaruu valley accessed from Tahiti's western coast. The plateau is between 780 – 800 metres elevation and contains the largest populations of the endangered forest species *Pouteria tahitensis* and *Ochrosia tahitensis*; important populations of *Polyscias tahitensis* and *Santalum insulare var insulare*; and also two examples of the endangered endemic plant *Zanthoxylum nadeaudii* (Te rau ati ati field trip document, Appendix 2). These forest species are all legally protected under French Polynesian legislation. This population of tall canopy tree species is thought to be the most pristine and best example site in Tahiti. An active management programme will help ensure its protection and regeneration. The health and regeneration of the forest species is threatened by populations of invasive animal species, including wild pigs (*Sus scrofa*) and rats (*Rattus rattus, R. norvegicus* and *R. exulans*); and invasive plants (*Tecoma stans, Psidium cattleianum, Coffea arabica, Spathodea campanulata, Miconia calvescens, Rubus rosifolius, Passiflora maliformis, Lantana camara*).

A project team tramped to the Maraeti'a plateau from 27-30 August 2012 to gather the baseline information for this report. The team consisted of members of Te rau ati ati and Association pour la protection de la vallée de Punaruu; J.-Y. MEYER from the Department of Research, French Polynesia; a representative from PII and another from New Zealand's Department of Conservation (DOC); and three members from the Hawaiian Auwahi and Leeward Haleakala Watershed Restoration Partnership.

This document is the resulting Feasibility Study Report.

The main purpose of the Feasibility Study Report is to assess the feasibility of:

1. Constructing an ungulate exclusion fence around an approximate 2 hectare area (the proposed protection area) of the Maraeti'a plateau.
2. Undertaking a rodent control programme on the entire Maraeti'a plateau.
3. Options for managing invasive plant species within the proposed protection area. Options include a possible native plants replanting programme.
4. Incorporate a monitoring programme establishing photo point and plot count methodologies within and outside the proposed protection area.

This Feasibility Study answers three main questions: Why do the project, can it be done and what will it take? The Study also presents an opportunity to record known facts about a project and environment.

This Feasibility Study report will be used as a resource to identify the most suitable design and location of the proposed exclusion fence; best-practice methodology and programme design for rodent control; assist in identifying the most suitable options for progressing invasive plant control; options for establishing a native species re-planting programme; best-practice methodology for establishing a medium to long-term monitoring programme; and recommendations on ensuring that community liaison

and partnership for the project is achieved through an adaptive management process and continues beyond the 5 year initial project timeframe.

The audience for the Feasibility Study will be Te rau ati ati, the *Association pour la protection de la vallée de Punaruu*, Government and other agencies within French Polynesia and elsewhere, CEPF and other funding bodies.

A project brief, prepared by Te rau ati ati, was used as background material, as were several research papers into French Polynesian exotic and indigenous vegetation. Papers researching exclusion fencing designs and potential biological control of weeds targets in the Pacific were also very helpful. All documents are listed in the Reference Section.

Thanks are extended to the following people and organisations for their support, help and advice in completing this Feasibility Study: Te rau ati ati a tau e a hiti noa tu, President Noella Tutavae, Honorary presidents Maxime Chan and Elie Poroi, Secretary Elizabeth Poroi, project manager Ravahere Taputuarai, Paul Moohono Niva, Christian Malinowski and fellow members; members of the *Association pour la protection de la vallée de Punaruu*; Dr Jean-Yves Meyer, Dept. of Research, Government of French Polynesia; Andrew Styche and Keith Broome, New Zealand Department of Conservation; The Auwahi and Leeward Haleakala Watershed Restoration Partnership, and in particular Dr Arthur Medeiros, Andrea Buckman and Luke McLean; Natasha Doherty, Bill Nagle and Souad Boudjelas, Pacific Invasives Initiative; Carola Warner, The University of Auckland.

The Critical Ecosystem Partnership Fund (CEPF) has provided funding to Te rau ati ati to undertake this Feasibility Study Report as part of the project: **Restoration and conservation of remnant native forests on Maraeti'a plateau, Punaruu valley, Tahiti, French Polynesia.**

Te rau ati ati is a French Polynesian environmental NGO based in Tahiti. Te rau ati ati was formed in 1987, have approximately 100 members and have completed environmental projects including the construction of tracks and cabins within the Tahitian high altitude forest.

New Zealand's Department of Conservation (DOC) manages much of the publically-owned estate, amounting to approximately one third of the land area of New Zealand. The Department's mission is to conserve the natural and historic heritage of New Zealand for the benefit of present and future generations.

The Auwahi and Leeward Haleakala Watershed Restoration Partnership was formed in 2003 and is based on Maui in the Hawaiian Islands. The partnership comprises a group of private and public landowners and supporting agencies restoring substantial areas of forest at 1,000 – 2,000 m altitude.

The 20 ha Maraeti'a plateau, with remnant native forest, is in the foreground with the jagged outline of "Te tara o Mai'ao" to the left and Mount Aorai emerging from the cloud to the right. Mount Aorai, at 2066 m high is the third highest mountain of Tahiti.

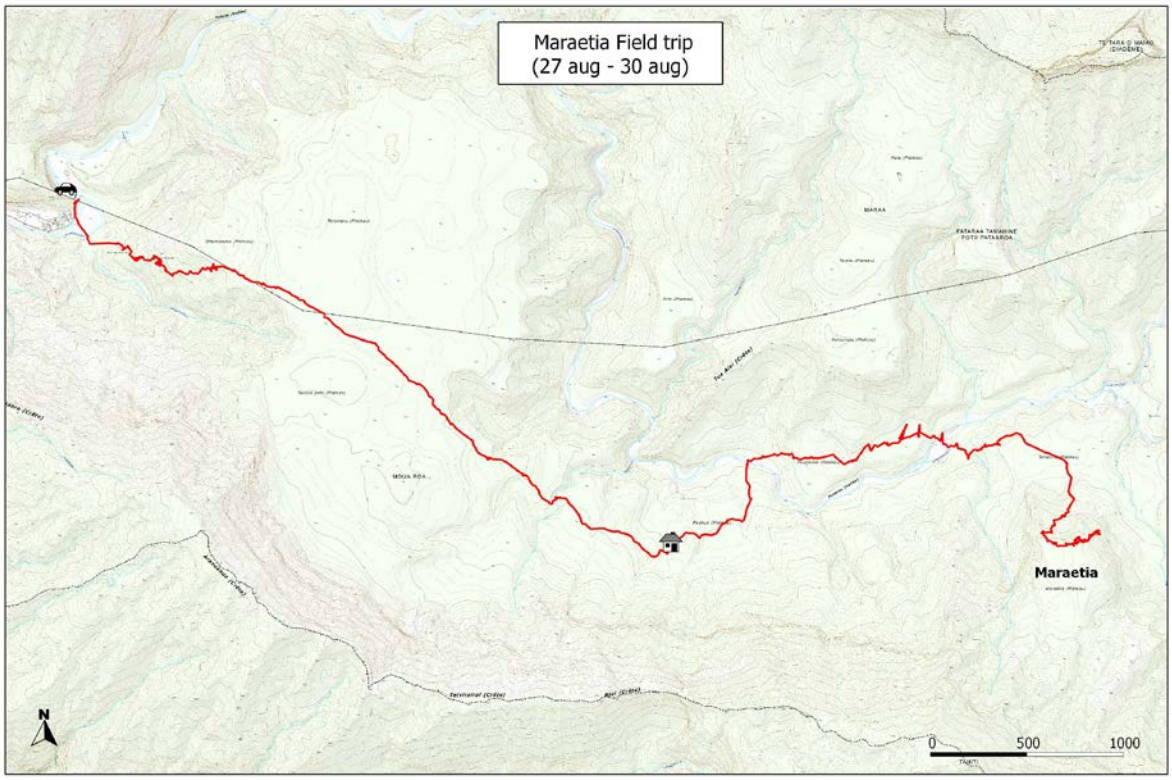
2 GOAL, OBJECTIVES AND OUTCOMES

2.1 Goal

The goal of the proposed project is to establish a protection area on the Maraeti'a plateau to enable the regeneration of threatened plant species and demonstrate the value of excluding invasive animals and plants to the well-being of the Tahitian environment.

Achieving this goal is important as the Maraeti'a plateau holds unique remnants of Tahitian native – almost pristine – mesic to wet forests containing the largest populations of the endangered forest species *Pouteria tahitensis* and *Ochrosia tahitensis*; important populations of *Polyscias tahitensis* and *Santalum insulare var insulare*; and also one specimen of the endangered and legally protected endemic plant *Zanthoxylum nadeaudii*. This population of tall forest tree species is unique on the island of Tahiti (Te rau ati ati field trip document, included at Appendix 2).

Achieving the goal is also important as the Maraeti'a plateau has substantial cultural significance to Tahitian people. For example, an annual orange gathering festival takes place each July when local people harvest fresh sweet oranges from established trees in the Punaruu Valley, including the Maraeti'a plateau. The orange gathering tradition has been the subject of a recent book "Les porteurs d'oranges, une tradition a Tahiti" with photos and text by Cecile Flipo. There are many marae within the valley dating back to early Polynesian times. The condition of some marae, visible as ancient stone structures, has been assessed through archaeological surveys. There is an annual season to hunt wild pigs in the Punaruu valley. Many local people would like to see the native vegetation thrive in the Punaruu valley, but also continue with the traditional culturally-valued activities of orange gathering and pig hunting. The Punaruu valley is also an established location for guided and non-guided treks. Well-established tracks link the lower valley to the remote upper valley which ends at the slopes of the highest mountains of Tahiti-nui. The valley and mountain range topography is spectacular.



Fond cartographique: Service de l'aménagement et de l'urbanisme

Trekking route from the car park at the road end of the Punaruu valley, to the Maraeti'a plateau. The house symbol marks the Anani refuge. (Thanks to Jean-Francois Butaud for the GPS tracks / routes used for the map).

2.2 Objectives and Outcomes

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

Table 1: Objectives and Outcomes

Objectives	Outcomes
1. Remnant native forest on the Maraeti'a plateau, Punaruu valley, French Polynesia, is conserved and regenerating.	1.1 1.1 Remnant native forest species currently established on the Maraeti'a plateau are healthy.
	1.2 1.2 Remnant native forest species are successfully re-establishing within the protection enclosure through natural regeneration or managed re-planting programme.
	1.3 The remnant native forest natural ecosystem is restored within the protection enclosure.
2 The community is supportive of the project and assisting management through an adaptive management process.	2.1 The community takes "guardianship" of the ungulate-proof structure and assists in its construction, maintenance and improvement.
	2.2 The community is actively involved in project monitoring activity.
	2.3 The community are supportive advocates for the project and champion similar projects elsewhere.
3 A suitably designed ungulate exclusion fence is erected on part of the Maraeti'a plateau.	3.1 Remnant and other native forest species are naturally regenerating and establishing within the protected area.

4	A rodent control programme is underway on the Maraeti'a plateau and accessible sidlings.	4.1	There is an increase in the germination and establishment of remnant and other native forest species on the Maraeti'a plateau.
5	Invasive plants are managed in-line with agreed actions from the adaptive management process.	5.1	There is an increase in the germination and establishment of remnant and other native forest species on the Maraeti'a plateau, not detrimentally affected by invasive plant species.
6	A monitoring programme is in place, gathering data which can be analysed to assess the effect of the project on the Maraeti'a plateau environment	6.1	Monitoring programme information will assist with reporting, enable analytical decision-making using the adaptive management process, and increase the knowledge-base for any similar future projects.

3 THE SITE

Table 2: Site Information

SITE NAME	UNIQUE ID	LATITUDE	LONGITUDE	SEARCH RADIUS (m)	MUNICIPALITY	VILLAGE	COMMUNITY	LANDOWNER	NOTES
Maraeti'a	n/a	17.6464524	149.5141289		Punaauia	Punaruu	Punaruu valley	Government of French Polynesia	The site is remote. The GPS point is within the proposed fenced area.

The project site is on the island of Tahiti-nui in French Polynesia and is located on the Maraeti'a plateau. This 20 ha plateau lies within the Punaruu valley at approximately 800 m elevation and about 8 km from the western coastline. The valley is approximately 10 km long and runs in a general west–east direction. Industry is established throughout the western 2 km near the coast. The Punaruu valley is the second biggest watershed on Tahiti-nui and is well-known for its mid elevation plateaus near the Punaruu River. The biggest plateau is known as plateau Tetamanu which is 400 ha in size and at 614 m elevation. The surface area of the entire valley is approximately 39.2 sq km. The two options proposed for a protection area, enclosed by the ungulate proof fence on the Maraeti'a plateau, are 0.8960 ha and 1.6210 ha area in size, depending on the agreed location of the perimeter fence.

Annual rainfall within the Punaruu valley varies from 1700 mm near the coast to 2400 mm at 600 m elevation. The Maraeti'a plateau receives more than 2400mm rainfall annually with November to April being the wet season, September the driest month and August usually the coolest. Temperatures in Tahiti generally vary between 20 and 30 degrees Celsius but cooler conditions can prevail on the higher elevation plateaus, such as Maraeti'a. The dominant wind direction is from the northeast.

The project site is not inhabited. The only access to the site is via an approximate 7 km walking track. Although an established track, parts of it are very steep. Visitors to the site include the orange gatherers in June each year, pig-hunters in the July pig hunting season and trampers who may traverse the plateau at any time. People may occasionally camp on the plateau. The closest inhabited site is the Anani refuge, approximately 2.5 km west of the Maraeti'a plateau at about 300 m elevation. The established walking track connects the plateau to the Anani refuge. Various minor tracks traverse the Maraeti'a plateau and are used by the pig hunters or orange gatherers. A map of the established tracks of the Maraeti'a plateau is in Appendix 7.

Although land tenure at the Maraeti'a plateau is privately-owned, there are no individual owners of defined land titles. Instead, management is undertaken by the "Association pour la protection de la vallee de la Punaruu" which has effectively regrouped the owners in order to manage the Punaruu Valley in its entirety. The Association has authorised Te rau ati ati to progress actions enabling the completion of this Feasibility Study. There is no current formal conservation status for the Maraeti'a plateau but the Association has been active in protecting the valley from further industrial development and preserving cultural values including orange gathering and pig hunting.

Numerous ancient marae exist in the Punaruu valley. They are recognised by remaining stone structures, usually rectangular in shape, sometimes with upright stones which may indicate a religious altar. Several marae were located and assessed during the Feasibility Study site visit, including one structure on the Maraeti'a plateau. A report with detail of the assessed marae is in a document (Archaeological survey of Maraeti'a and Punaruu valley) accompanying this Feasibility Study.

The vegetation within the upper Punaruu valley is a mixture of native forest and exotic invasive plant species. The Maraeti'a plateau contains the largest populations of the endangered forest species *Pouteria tahitensis* and *Ochrosia tahitensis*; important populations of *Polyscias tahitensis* and *Santalum insulare var insulare*; and also one example of the endangered and legally protected endemic plant *Zanthoxylum nadeaudii*. This remnant population of tall canopy tree species is thought to be the most pristine and best example site to be found in Tahiti (Te rau ati ati field trip document, included at Appendix 2). The most common native plant on the plateau is the small tree *Hibiscus tiliaceus*. A full plant list was made during the Feasibility Study field trip to the plateau. Te rau ati ati plan to publish the plant list at a later date.

Some tree species on the Maraeti'a plateau were valued for canoe (waka) construction in ancient times. Examples of these species still exist on the plateau and include the To'i (*Alphitonia zizyphoides*) and Mara (*Neonauclea forsteri*) (P. Moohono Niva, pers. comment).

The health and regeneration of the forest species is threatened by populations of invasive animal species, wild pigs (*Sus scrofa*) and rats (*Rattus rattus, R. norvegicus and R. exulans*); and invasive plants (*Tecoma stans, Psidium cattleianum, Coffea arabica, Spathodea campanulata, Miconia calvescens, Rubus rosifolius, Passiflora maliformis* and *Lantana camara*).

4 THE TARGET SPECIES, IMPACTS AND BENEFITS OF MANAGEMENT

4.1 Target Species

Pigs (*Sus scrofa*): Polynesians are credited with introducing pigs to French Polynesia (Shine, C., J.K. Reaser, and A.T. Gutierrez (eds.). 2003). This may have been before the first landing of Europeans in 1595. Pigs may have been deliberately released or escaped into the Tahitian environment at about this time. The wild pigs of today exhibit the characteristics of the hardy wild pig breed as distributed by Captain Cook and others – generally black in colour, hairy with a long snout.

Goats (*Capra aegagrus hircus*): Goats are thought to have been brought to French Polynesia in the period following the early European explorers, i.e. after 1769. A small population of goats in the Punaruu valley is thought to have been hunted to the last individual. There is uncertainty as to whether goats have been re-released into the upper valley area but they have not been sighted for some years now.

Rodents: The rodent species on the plateau are yet to be identified but are most likely to include black or ship rats (*R. rattus*) and Polynesian rats (*R. exulans*).

Invasive plants: Eight species (*Tecoma stans, Psidium cattleianum, Coffea arabica, Spathodea campanulata, Miconia calvescens, Rubus rosifolius, Passiflora maliformis* and *Lantana camara*) were recorded on the Maraeti'a plateau during the Feasibility Study site visit: *Tecoma stans* and *Spathodea campanulata* spread mostly via wind-borne seeds, while *Psidium cattleianum, Coffea arabica, Miconia calvescens, Rubus rosifolius, Passiflora maliformis* and *Lantana camara* spread mostly via plants fruiting and subsequent bird-borne seed dispersal. Rodents and ungulates (e.g. wild pigs) may also consume the fruit and (probably to a lesser extent than birds) distribute the seed.

Each of these invasive plant species is well-established within the general Punaruu valley area and so on-going reinvasion via wind or bird-borne seed dispersal is possible.

Further information regarding the invasive plant species is at Appendix 6 (Invasive plant database: Resource Kit for Invasive Plant Management, Pacific Invasives Initiative, 2012; Pacific Islands Ecosystems at Risk (PIER) Website, 2012; Invasive Species Compendium, 2012).

4.2 Impacts

Pigs (*Sus scrofa*): Pigs, through their destructive feeding habits, primarily mechanical disturbance from rooting, can cause significant effects on vegetation and soil characteristics. These effects can be in the form of reduced plant cover, species richness and diversity; reduced macroinvertebrate density; increased abundance of invasive plants; changed soil compaction and moisture content; and altered C and N availability. Mechanical disturbance by pigs has an immediate impact on herbs, perennial grasses and shrubs, and longer term may affect forest tree regeneration by altering seedling spatial patterns. Large seeded trees may also be disproportionately impacted, favouring dominance by small seeded plants. The impact of pigs can vary depending on the degree of disturbance and other on-site effects, and have little predictability due to a lack of adequate research.

Wild pigs appear to be common on the Maraeti'a plateau and roam freely. There was ample evidence of pig-rooting with approximately 40% of the surface area of the plateau showing physical appearance of

having been disturbed by wild pigs. There was also evidence of foraging, with numerous seedling *Miconia calvescens* plants browsed of their growing tips and occasional feeding damage to the roots of *M. calvescens* and other plants such as *Ficus prolixa*. The pig hunters reported that the *F. prolixa* browsing resulted in a tainted taste to the wild pork. Also evident were the damaged trunks of trees, where boars had rubbed and sharpened their tusks along the tree's trunk from near ground level to approximately 60 cm high.

Wild pigs are shot and trapped during a defined hunting season spanning three weeks during July. The Punaruu valley is a popular hunting destination during the hunting season with upwards of 30 permitted hunters in the area throughout this period. Hunters are prohibited from using dogs and instead rely on ambushing pigs as they move around, using rifles or snare traps set on game trails. Several snare traps were observed during the field trip to the Maraeti'a plateau, including at least one set within or adjacent to the proposed fenced area.

Disturbance by wild pigs may have assisted the establishment of invasive weed species on the Maraeti'a plateau.

Goats (*Capra aegagrus hircus*): Goats had not been observed in the upper Punaruu valley for some years. There were no known populations of goats in the valley at the time of the field trip and no obvious sign of goat browse on vegetation on the plateau or slopes surrounding the plateau. It is possible that they may be released into the valley to establish a huntable population or naturally move in from another locality.

Rodents: Polynesian rat (*Rattus exulans*); black or ship rat (*Rattus rattus*); brown or Norway rat (*Rattus norvegicus*); mouse (*Mus musculus*): The impact of rats on the fauna and flora of island communities has been well documented. Rats are associated with and have probably directly caused the disappearance of many sea bird populations, and the extirpation of terrestrial bird species, reptiles and invertebrates. These extirpations have resulted in flow-on effects on ecosystem function, stemming from reduced nutrient deposition by sea birds, and pollination and seed dispersal. It has also been confirmed that rats have contributed to the extinction through recruitment failure of some plant species. Large seeded and fleshy-fruited species may be disproportionately affected, potentially favouring dominance by small-seeded species. Rats are associated with the recruitment depression of plant species targeted for protection on the Maraeti'a plateau, including *Ochrosia tahitensis,* and *Santalum insulare var insulare*. Rats also harbour and spread diseases, such as leptospirosis, which effect humans.

It was evident that a rodent population exists on the Maraeti'a plateau: several were observed on the plateau by members of the field trip team; a cache of seeds of *Aleurites moluccana* was located on the plateau; and physical sign of rat predation on seeds of several species was observed, including seeds of *Ochrosia tahitensis*.

Invasive plants: Each of the eight target invasive plant species is well-established within the Punaruu valley and areas of the Maraeti'a plateau. All eight species can disrupt natural plant community succession as they are transformer species ('Transformer species' are a subset of invasive plants which are species that change the character, condition, form or nature of ecosystems over substantial areas relative to the extent of that ecosystem (Richardson *et al*., 2000a); and defined in the PII Resource Kit for Invasive Plant Management as "already a habitat transformer in [your country] (includes hybridizers with endemics)). Some of the invasive plant species established within the proposed enclosure area are

recorded as having allelopathic affects e.g. *L. camara* (Sahid, 1993, p. 303-8). These affects are likely to reduce the germination and seedling growth rates of the canopy tree species.

Tecoma stans: Mature plants are established over approximately 70% of the proposed protection area and are a substantial part (approximately 50%) of the Maraeti'a plateau's vegetation. *T.stans* is known to out-compete native vegetation. Most *T.stans* plants on the plateau and within the proposed protection area are well-established mature plants, most with extending prostrate trunks and adventitious upright stems or branches. *T. stans* growth habit allows filtered sunlight to penetrate the canopy. There was little evidence of native seedling establishment beneath these mature *T. stans* but this may have been affected by the substantial amount of disturbance caused by pig rooting and rodents destroying seed.

The high prevalence of *T.stans* is having a major effect on native plant biodiversity on the Maraeti'a plateau. There is little economic effect on the Maraeti'a plateau and no known health effects. A minor positive social effect caused by the *T. stans* plants is that they are occasionally used as a climbing aid (especially the semi-prostrate branches) to assist orange gatherers in reaching the top branches of the orange trees.

Psidium cattleianum: There were no dense stands of *P. cattleianum* detected on the Maraeti'a plateau. Scattered plants occupy approximately 1% of the proposed protection area and plateau. The effect on native biodiversity values at the project site is currently minor. The fruit are probably consumed by wild pigs and rodents, which would disperse the seed. Pig hunters may value *P. cattleianum* as a food source for wild pigs in the upper Punaruu valley. Pig hunters occasionally eat the fruit if plants are growing along the trail, but they are not particularly sought out (R. Taputuarai, pers. comment). There are no detrimental human health effects caused by *P. cattleianum*.

Coffea arabica: A 20 m X 30 m patch of *C. arabica* is established near the centre of the proposed protection area. *C. arabica* is established within the upper Punaruu valley and probably established at this site through bird-borne seed dispersal. The area was shaded by adjacent *T. stans* and native tree species, but this had little effect on the shade-tolerant *C. arabica*. Birds, rats and wild pigs probably consume the fruit and spread seed. The seeds are not harvested. There are little economic, social or health effects of *C. arabica* being present on the Maraeti'a plateau. There is a minor to moderate effect on native plant biodiversity.

Spathodea campanulata: Occasional mature trees and an apparent low number of *S. campanulata* suckers (growth originating from the base or root of a tree) or true seedlings occupy the Maraeti'a plateau. *S. campanulata* plants occupy approximately 1% of the area of the proposed protection area. Plants are much more numerous in the more weather-protected valleys below the plateau. The trees that are present on the plateau do, however, occupy the tall canopy tree species habitat which the rare and endemic Tahitian tree species should occupy. *S. campanulata* has no known economic, social or health effect on the plateau or within the proposed protection area. Because the trees present on the plateau overlap the ecological niche of the endangered and rare native tree species, the effect of *S. campanulata* on native biodiversity values is moderate and options for management are recommended.

Miconia calvescens: Although *M. calvescens* prefers the damp, shady habitat of, for example, gullies and streamside areas, it comprises approximately 3% of the plateau's vegetation. Most plants were seedlings typically to 2 m high. About one third of these plants had reportedly been grazed by wild pigs, with

obvious signs of browse being the top few leaves chewed off. This is apparently common in July / August when more palatable food is scarce. A defoliating fungal pathogen, *Colletotrichum gloeosporioides* f. sp. *miconiae,* was released onto *M. calvescens* in Tahiti in 2000 (Meyer, J.-Y. and Butaud, J.-F. 2009). Leaf damage from this pathogen on *M. calvescens* in Tahiti has been estimated to effect between 6% and 36% of leaves. Damage is more evident at higher elevations where the climate is cooler and wetter. The field trip for this Feasibility Study was undertaken in the July low-rainfall period. There was no scientific analysis of the percentage of leaves which may have been affected by the fungal pathogen on the Maraeti'a plateau, but leaf damage probably caused by the pathogen was evident. *M. calvescens* had a minor to moderate effect on native plant biodiversity values on the Maraeti'a plateau at the time of the Feasibility Study field trip.

Rubus rosifolius: Much of the plant understory on the entire Mareati'a plateau, approximately 20% of the area, was dominated by *R. rosifolius.* Plants were less prevalent or absent from low-light areas beneath a shady tree or shrub canopy. Native and introduced fruit-eating birds, wild pigs and rodents are likely to feed on the fruits. People traversing the plateau may occasionally consume *R. rosifolius* fruit. The sprawling growth habit and prickly stems of *R. rosifolius* interfered with access for people traversing some areas of the plateau. *R. rosifolius* had a moderate negative effect on native plant biodiversity and minor positive and negative effects on economic, social and health values.

Passiflora maliformis: Well-established along especially the edge of the plateau in areas of full-light. There were only occasional plants growing over the central plateau. *P. maliformis* comprised approximately 3% of the vegetation on the Maraeti'a plateau. Numerous fruits were present above ground level. Wild pigs and rodents are likely to have consumed *P. maliformis* fruit. The pulpy flesh and seeds are likely to have been consumed by birds. These species are likely to vector the seed to other sites. It had a moderate negative effect on native plant biodiversity and no economic, social or health effects.

Lantana camara: *L. camara* was also well-established along the edge of the plateau in areas of full-light and often grew in association with *P. maliformis.* The *L. camara* plants were often growing to 2 to 3 m high. *L. camara* thickets of plants with prickly stems interfered with people's access to areas along or near the edge of the plateau. There were few plants within the central plateau area. Birds and rodents are likely to have consumed fruit and distributed the seed. *L. camara* is a poisonous plant. Although animals, such as cattle have died from eating *L. camara*, it is unlikely that wild pigs would consume any of the plant's stems or leaves. *L. camara* occupied approximately 3 to 4 % of the Maraeti'a plateau. It had a moderate effect on native plant biodiversity values and minor economic, social and human health effects.

4.3 Benefits of management

It is essential that the native and endemic tall canopy tree species of Tahiti are preserved from possible extinction and that this component of Tahitian biodiversity and ecosystem is protected. *Ochrosia tahitensis*, *Pouteria tahitensis*, *Zanthoxylum nadeaudii*, *Santalum insulare var insulare* and *Polyscias tahitensis* are all locally protected in regard of French Polynesia's legislation as "Espèces protégées relevant de la Catégorie A".

On the IUCN Red List (http://www.iucnredlist.org/), *Ochrosia tahitensis* is listed as extinct and *Polyscias tahitensis* as critically endangered. .

One of the best known examples of endemic tall canopy forest containing these species is present on the Maraeti'a plateau. It is preferable that this remnant is protected and able to form self-sustaining populations. Establishing an area free from the harmful environmental effects of ungulates, rodents and invasive plants is essential to allow for the opportunity of regeneration of these canopy tree species on the plateau.

If proof were to be established that the native and endemic tree species will readily re-establish in areas protected from rodents, ungulates and managed invasive plants, it may prove that other suitable areas need to be protected with similar methodology to further preserve the ecological integrity of Tahiti's natural environment.

A significant self-sustaining population of tall canopy tree species may generate further interest in nature tourism into the area. It may also be a valuable resource for school groups and others (including community groups, government department personnel) to learn about Tahiti's natural heritage, environment and best-practice management which may ensure its future re-establishment. It may also further empower NGOs to establish additional areas where critical refugia are protected and enhanced.

5 CAN IT BE DONE?

5.1 Technical approach

Note that technical information and references for the described management options below are listed in the appendices section (see Appendices 3, 5, 7, 8 and 9).

5.1.1 Options for managing wild pigs and goats

Options for ungulate control include hunting and exclusion by fencing. The extent of recreational hunting in the Punaruu Valley has been sufficient to remove or greatly reduce the local goat population to the extent that their impact is undetectable. Any gains from this control may be lost if recreational hunters are able to re-introduce goats and provide partial or complete protection enabling this population to re-establish. Despite a great effort by recreational hunters during the hunting season, pig control has not been as effective and pigs remain at a density sufficient to have a visually significant impact on the Maraeti'a plateau. Investigations into the effect of pig control on disturbance showed that control can lead to reduced pig impacts, but that the control needs to be regular and to low levels to achieve any long-term benefit. Pig abundance increased rapidly with cessation of control due to local increase through breeding and from immigration. In order to achieve any sustained protection of the Maraeti'a plateau, pig control would need to be greatly increased in frequency from the currently limited hunting season and that this control would need to occur over a large area. This level of control would impact on the recreational hunters that use the valley and is unlikely to be acceptable.

Exclusion fencing has a greater initial cost and is limited to suitable terrain. However, fencing allows for long-term control of ungulate impacts, with low on-going costs of maintenance and the impact of this activity on recreational hunters is limited only to the fenced area. For this reason fencing is favoured for the protection of the tall canopy forest on the Maraeti'a plateau. Because goats are not present on the Maraeti'a plateau and are apparently effectively being controlled under the current hunting regime, the fence can be designed to more effectively exclude pigs, without the additional construction requirements and consequent cost increase to also exclude goats.

This Report recommends that fence construction begin shortly after the end of the pig hunting season. This will minimise the immediate impact on the hunters, but also takes advantage of pigs having been reduced in number and chased away from the plateau by hunters.

Ungulate proof fence:

Fences can seldom be described as pig proof. If the terrain is rough, gaps may appear under the fence through natural soil movement or from disturbance by pigs. Also, where a fence is placed over a trail regularly used by pigs they will actively seek to push through or under the fence. For these reasons a breach may occur at any time and regular inspection and maintenance is required.

A guideline for erecting pig-proof fencing is provided in Appendix 7. To enable researchers, trappers and orange gatherers to traverse the fenced area for management or to access orange trees, step-overs/styles should be placed at the most obvious access points. These should be designed to minimise impacts on the fence from people climbing in and out of the enclosure, but should also be designed to prevent pigs and goats from climbing in.

Materials for the fence can be transported to the Maraeti'a plateau by sling-load beneath a helicopter. The materials should be dropped adjacent to, but not inside, the proposed site and all care taken to minimise disturbance during construction to avoid opening the site to greater weed invasion.

5.1.2 Options for controlling rodents

There are two broad methods for controlling rats. These are: trapping, where rats are caught in some sort of device, designed to kill the animal, which is set under a cover; and poisoning.

Traps are suitable for control of rats at low to moderate densities and/or scale. Traps are suitable for sustained control and there is likely to be less public resistance to this method. A downside of trapping can be the high cost of labour to achieve knockdown when rats are at high abundance, set-up for trapping can be expensive, no long-life baits are available so bait replacement needs to be regular, and pig and ant interference can be a problem.

Poisoning can be used at all rat densities and in all types of habitat, and there are a range of products available. There are matters to be considered with any possible rodent poisoning programme, including the logistics of providing all rats with sufficient bait, legal and policy controls on the use of poisons, and community concerns about the use of poisons. There can be some risk to non-target species, such as pigs and birds. Substantial planning is required to make poisoning successful. Poisoning is not recommended as a long-term method as there is a real risk that resistance to the poison will develop in the rat population.

A combination of the two methods should be considered, with poison used to achieve an initial reduction in rat abundance, followed by traps to maintain low abundance. The option chosen will depend on rat density at the start of the operation, whether control is undertaken during all or part of each year, public attitudes towards the available methods, availability of labour to undertake the work, timing of the operation (whether all or part of the year) and extent of re-invasion.

Little is known about which rat species are present and their ecology on the Maraeti'a plateau. Important information to obtain is: what species are present, when do they breed, what density are they at and does this change during the year, and how great a factor is re-invasion. It is important to establish possible vulnerabilities in the rat population, such as periods of the year that they are least abundant, or if they are not breeding at some stage during the year, so that they can be targeted more cost effectively. During the initial stage of the project resources should be targeted towards establishing this information and once known, planning for control can begin. There have been several studies undertaken to measure presence, abundance and life history traits of the rodent species expected to be present on the Maraeti'a plateau (references to two papers published by Grant Harper and co-authors have been provided in the reference section). Development of a monitoring design based around the methods used in these studies is recommended. The design should be peer reviewed to ensure it will provide the information required to answer the questions posed.

The Maraeti'a plateau is a relatively small area (approximately 20 hectares) that is completely surrounded by rat habitat, so re-invasion is likely to be a significant factor affecting the ability to maintain low abundance for any length of time. This report recommends that rats be controlled over a larger area than the proposed fenced site. This is to manage re-invasion, which is a significant factor in smaller sites. If possible rats should be controlled over all of the Maraeti'a plateau and preferably the slopes around it.

Three options are available and selection of preferred method or combination of methods will be determined by public acceptability, ability to find labour and other resources. The adaptive management working group should ultimately decide on the preferred management option or combination of options. Timing of control and the need for seasonal or permanent suppression of the rat population should also be determined by the adaptive management working group, with support from experts on the ecology of the tree species being protected.

Additional information regarding rat control methodology is in Appendices 9 and 10.

The three options for rat control are:

1. Rat control using 1st generation anticoagulants in bait stations

- First generation anticoagulants include toxins, such as diphacinone. These toxins are less persistent than second generation anticoagulants (e.g. brodifacoum) and pose less risk to pig hunters. Risk to hunters can be minimised by ensuring toxin is not used in the lead-up to the hunting season, preferably having a gap of not less than 2 months before hunting begins.

- Because they are not as potent as second generation greater planning needs to be done to ensure a successful result. An example of best practice used by the Department of Conservation in New Zealand is included in Appendix 9. By following this best practice there is less risk of the operation failing to reduce rat abundance.

2. Rat control using kill traps

- The recommended kill trap is the Victor Professional break-back snap trap, which has proven to be effective and humane in large scale trapping operations in New Zealand. The traps are not weather proof and should be set under covers and should be dipped in paint or a vegetable-based oil to increase longevity. New traps are being investigated, such as the self-setting Goodnature trap. At the moment these traps cannot be recommended as the current research programme is not yet complete, but they could be considered in the future.

- For trapping to have any chance of success optimal frequency and timing of trap checks; and high quality of trap setting and maintenance is critical. This level of sustained trapping effort is difficult to maintain, especially in more remote sites such as this. With smaller sites prone to constant need for control due to re-invasion, sustained effort is more critical.

- An example of the Department of Conservation best practice for kill trapping is provided in Appendix 10.

3. Combination of poisoning and trapping

- A combination of poisoning using 1st generation anti-coagulant toxin and trapping may be the best compromise between public concern regarding toxins and minimising costs of control. In such situations the initial knockdown of the rat population is undertaken by poisoning. Low rat abundance is then maintained by trapping, avoiding the need for an extensive labour cost of trapping a large rat population. If rat abundance becomes too much for trapping to control then toxin can be used to reduce numbers quickly to make trapping cost-effective again. The

same network of tracks can be used for trapping and poisoning so costs and impact of the infrastructure on the environment are not increased.

- Trapping can be used to manage the rat population in the lead-up to and during the pig hunting season to minimise the real and perceived risk to hunters from the use of toxins.

The methods shown in the DOC best practice documents are largely designed to control ship rats in typical New Zealand forest habitats. Due to the likely presence of *R. exulans*, which have a smaller home range than ship rats and because little is known about ship rat home range and density in Tahiti, when planning rat control the manager should consider increasing the density of traps or bait stations, for example by using closer line spacing or bait stations/traps at closer spacing along the lines. Experience from Hawaii and New Caledonia showed trapping can be effective to maintain low abundance of ship rats and Pacific rats using a 100m x 25m grid, with traps spaced 12.5m apart around the perimeter (Lindsay Wilson pers. comm.). Closer spacing of traps in the interior or more regular checking may be required for such a small site as this. Monitoring of rat density in the lead-up to control will be important to determine trap spacing and trapping effort.

Options for monitoring rat abundance include tracking tunnels, wax-tags and chew cards. These methods have well established protocols and require minimal training. The chew card method may not prove useful at this site as it is only suited to very low rat densities. The other two methods were designed for large areas and so the methods will probably have to be modified to account for the smaller area proposed for management on the Maraeti'a plateau. In this instance placement of detection devices in a grid may be more informative and practical than random placement of lines.

Wax-tag method is best suited to Maraeti'a as wax-tags are cheaper and could be recycled using local products after each use. A modified version of the wax-tag method using peanut flavoured wax tags set on a grid specifically designed to monitor rodents is recommended.

5.1.3 Options for invasive plant management

Following the field trip to the proposed protection area, options for the management of invasive plants within the ungulate proof enclosure were discussed. Three main options emerged from that discussion. Each is presented below. The option to be implemented will be decided by the working group using the "adaptive management" decision-making process, analysing information collated from the monitoring programme described in section 5.1.7, i.e. after the ungulate-proof fence is erected and rodent control programme in place, the level of natural regeneration will be observed and recorded; the level of further invasive plant establishment, and effect on any native plants, will be similarly observed. There is expertise within Te rau ati ati to make these observations and assist in deciding the best management option. Further opinion can be sought from international experts if required.

Three possible options have been identified for invasive plant management within the ungulate-proof enclosure. They are:

5.1.4 A "do nothing" approach for a period of up to 3 years

This option is applicable if:

- After the construction of the ungulate proof fence and the rodent control programme is underway, a successful natural germination and re-establishment of native and endemic canopy tree species and other desirable native flora occurs across a substantial area of the enclosure.

- These desirable species eventually dominate the invasive plant species present.

A potential benefit of the "do nothing" approach is that the only costs incurred are the monitoring costs.

A risk of the "do nothing" approach is that the proposed protection area may be substantially further infested with invasive plant species. There could be an exponential increase in the cost of invasive plant management through more plants to control within the area. Should the invasive plants seed or spread then there could be further potential for on-going incursion through an increase of viable seed in the soil seed bank and increase in propagules through plant growth from viable stems or rhizomes.

5.1.5 Control the low-incidence and allelopathic invasive weeds and leave suspected "nursery-weed" species approach

Some invasive plant species within the proposed protection area are in relatively low numbers, or occupy part of the protection area only e.g. *P. maliformis* is established along parts of an approximate 10 m strip running along the edge of the plateau, with very few plants occurring elsewhere. It would be relatively easy to control all *P. maliformis* plants. Other invasive plant species, e.g. *T. stans,* are known to be "early succession species" and more likely to act as nursery plants for the re-establishing canopy tree species (Bol, & Vroomen, 2008, p. 43). It may be prudent then, to control the known allelopathic (i.e. allelopathy has been proven in tropical environments) and low-incidence invasive plant species and leave species such as the well-established *T. stans,* to see whether the native canopy tree species will establish beneath them.

A possible management approach for the eight invasive plants recorded within the protection area could be: control all plants of the species: *P. cattleianum, C. arabica, S. campanulata, M. calvescens, P. maliformis,* and *L. camara.* Do not control the species: *T. stans* and *R. rosifolius.* The reason for not controlling the *R. rosifolius* is that it is well established and particularly labour-intensive to control. It is also intolerant of heavy shading, and so likely to increasingly become unthrifty and die out as the native canopy tree species re-establish at the site.

The plant species subject to control could be treated either by hand pulling, which is easily achieved for many *M. calvescens* seedlings, or by the stump treatment method; using 1 part Glyphosate 450 to 5 parts water mixture applied to the top and sides of the cut stump, which is cut horizontally and as close to ground level as possible. If any of these species (e.g. *S. campanulata*) have reached maturity then they should be controlled using the "hack and squirt" method i.e. downward cuts are made with a machete around the circumference of the tree, as close to ground level as possible, and 100% glyphosate applied with a drench gun precision applicator into the cuts to the point of run-off. Hand-pulled seedlings should be left off the ground so that they cannot take root and regrow. This is best achieved by placing the seedlings into the forked branches of any close-proximity tree or shrub. This way, they remain off the ground to completely dry out.

All stump-controlled plants should be stacked off the ground on-site. The cleared area would have to be monitored at monthly intervals for the first six months, then every two months to see if the invasive plant species re-establish within the treated area or whether native plants establish, including hopefully, the native canopy tree species. Invasive plant species should be treated at the seedling stage, either by hand-pulling or stump treatment methods described.

A risk of this approach is that the invasive plant species will re-establish within the areas that they have been treated. This is possible if there is a heavy germination of dormant seed or growth from any viable plant stems or roots and the follow-up treatment is not achieved at the required time. If follow-up treatment is not completed at the required time and to standard, then a higher density of invasive plants, than existed prior to management, may occur.

5.1.6 The second approach combined with a pro-active replanting programme of suitable native plants including the rare and endangered species:

This approach is essentially exactly the same as **5.1.5** above, excepting that seedlings of the native canopy tree species are replanted at the sites cleared of invasive plant species.

Seeds of the native tree species should be sourced from the Maraeti'a plateau. The seedlings would have to be raised within a nursery, which would have to be situated close to a regular water supply. It is possible that a nursery could be set up at the Anani refuge, and seedling plants carried to the site in root trainer containers. Biosecurity best-practice needs to be undertaken to ensure that non-native plants growing at the Anani refuge are not inadvertently taken to the Maraeti'a plateau. They can be carried in specially prepared back-packs that do not damage the seedlings. Approximately 200 seedlings can be transported by back-pack by one person. The seedlings are ready for transportation and planting when they reach approximately 150 mm height. If possible, seed of the following species should be collected, planted and raised in the nursery: *Pouteria tahitensis, Ochrosia tahitensis*, *Polyscias tahitensis, Santalum insulare var insulare* and *Zanthoxylum nadeaudii.* The plant spacing will depend upon the species, but canopy trees should be planted at approximately 4m x 4m spacing.

The native seedling replanting programme should only proceed after the ungulate proof fence is erected and rodent numbers reduced through the rodent control programme. This is likely to be approximately six months after the start of the rodent control work. The raised native seedlings should be planted into plant gaps within the ungulate proof protection area. It is likely that the seedlings will have to be released from any re-establishing native plants at about monthly intervals. The monitoring programme described below should clarify the timing of this.

The biggest risk to the success of this third approach is that the native seedlings could be smothered by any unmanaged growth of the invasive plants at the replanted sites. Regular monitoring, and control of invasive plants to protect the native seedlings, is required.

5.1.7 Monitoring programme

It is essential that changes to the ecology of the Maraeti'a plateau and within the ungulate proof protection area resulting from any work to restore and conserve the remnant native forest on the plateau is monitored and recorded. This is so that knowledge from the project can be gained, used for the adaptive management process, included in project reports and applied to any similar future projects. The

project is not going to be used for scientific research purposes and so the monitoring programme does not have to follow the replicated methodology of a scientific trial. The monitoring does, however, need to be thorough and accurate.

It is suggested that the monitoring programme should comprise regular collection of photos taken from permanently marked points, of an exact direction and perspective, preferably with the same camera, so that changes over time can be collated. The photo points should be of areas within the ungulate proof protection area, areas along the fenceline and some areas outside of the protection area. These points should be established before the area is disturbed and any construction work on the fence, or work to control invasive plants, begins. Photos should be collected at regular intervals e.g. 2-monthly for the first 12 months and reviewed as to whether 2-monthly or less frequency required thereafter.

The other monitoring technique which should be utilised is the plot monitoring technique. The National Vegetation Survey (NVS) Databank, Landcare Research, New Zealand, describes methods for establishing and monitoring permanent plots within an area of indigenous forest. A standard plot size is 20 m x 20 m. Two methods are described in detail: the permanent plot method and the recce (reconnaissance) method (Landcare Research n.d.). The recce method is suitable for recording changes over time to vegetation. At least three 20 m X 20 m permanent plots should be established at randomly selected locations within the ungulate proof protection area. Although the exact location should be randomly selected, one plot should be within the native dominant canopy and one within the exotic dominated area of the proposed protection area. Two people can record the required data using the recce method. The methodology and system for selecting plot locations is available on the NVS website (address recorded in References section). It is recommended that these plots be resurveyed at approximately 6 monthly intervals for the first two years of the project and yearly thereafter. The data needs to be entered onto a spreadsheet or database (templates available on the NVS website) and securely stored.

Casual monitoring of any invasive plant treated area also needs to be undertaken. Any invasive plant treated area needs to be observed monthly for the first six months, then two-monthly thereafter for the term of the project, to ascertain whether invasive plant species are re-establishing at the site or whether native plants are establishing; or a mixture of the two. Notes of the proportion of exotics / natives need to be recorded, the species of each and photos taken. This information should be reported to the project working group. A decision on management needs to be made as quickly as possible. The invasives may need to be weeded out, as per the recommendations at 5.1.5 above (if the 5.1.5 or 5.1.6 invasive plant management options are adopted).

5.2 Sustainable

Previous management: There has been a small attempt at rodent control, using *Brodificoum* bait to control the rat population near the area of remnant native canopy tree species. This trial was undertaken approximately three years previously. Only one application of the toxic bait was made and no monitoring of results completed. A small population of goats had been hunted out of the upper Punaruu valley and pig hunting undertaken by members of a pig hunting club, for 3 weeks in July of each year. Pig hunting reduces the pig population, but a core breeding population remains in the area.

Ungulate proof fence: The design of the ungulate proof fence is a general standard design proven to be effective at excluding wild pigs. The fence will require regular checking to ensure that it has not been

damaged by windfall trees or branches; that land movement has not damaged the fence on any sloping land and that wild pigs have not tried to push through or under the fence. Checks should be timed to coincide with other work at the site to reduce costs and after any storm event that may have resulted in windfall of vegetation. The entire fence-line must be checked, especially where the fence traverses a hollow or dip where pigs may try to push their way underneath. Equipment must be on-hand to repair damage as soon as possible.

Rodent control methods: The recommended rodent control method is commonly used in similar forest habitats in New Zealand. The rat traps have a wooden base which should be painted or preserved with a timber treatment such as linseed oil before use. This will help ensure that they remain operable for the five-year term of the project. Regular maintenance of the traps will be required. A store of spare traps should also be available to replace any lost to mechanical failure, pigs etc.

The managers of the project should keep up-to-date with trial results for the recently invented self-setting rat traps. A robust trial of the self-setting traps is currently being undertaken by the Department of Conservation in New Zealand. Results of the trial will be available in 2014. The self-setting traps are powered by a small CO2 canister and will automatically re-set 24 times before the canister requires replacement. If the self-setting traps are proven to be effective and cost-efficient then they may be suitable for the Maraeti'a project. The current cost of the self-setting traps is approximately $NZ150 plus $NZ7 for replacement gas canisters.

Invasive plant management: Recommended treatment methods for the invasive plants are effective. There should not be any regrowth from the stumps of any of the treated invasive plants or any part of the drill and inject treated tree species. All hand-pulled seedlings should effectively destroy the plant, as long as the seedling is not left on the ground and so prevented from taking root.

There will likely be re-establishment of invasive plants within the protected area, from dormant seed and the transport of bird or wind-borne seed into the site, and possibly from viable stem or root fragments. The rate of germination and recruitment of these species is currently unknown, and will be recorded as part of the monitoring programme. On-going management options will be considered during the adaptive management approach process. It is probable that more or less control work will be required once monitoring results are analysed.

Table 3: Invasive Pathways into the proposed ungulate proof protection area

Invasive Species	Source	Pathway	Risk	Prevention Strategy
Species Name	*Where will the invasive species come from*	*How will it travel to the project site?*	*How severe is the risk: Critical(C)/High(H)/ Medium(M)/ Low(L)*	*How will you prevent the species using the pathway to re-invade*
Tecoma stans	Plants on or adjacent to the Maraeti'a plateau. Dormant seed.	Wind-borne seed dispersal	M	Not possible but there should be less occurrence of this species once the site is shaded by mature native tree species
Psidium cattleianum	Uncontrolled plants on or adjacent to the Maraeti'a plateau. Dormant seed.	Bird-borne seed dispersal.	M	As above
Coffea arabica	Uncontrolled plants on	Bird-borne seed dispersal.	M	As above

	or adjacent to the Maraeti'a plateau. Dormant seed.			
Spathodea campanulata	Uncontrolled plants on or adjacent to the Maraeti'a plateau. Dormant seed.	Wind-borne seed dispersal	M	As above
Miconia calvescens	Uncontrolled plants on or adjacent to the Maraeti'a plateau. Dormant seed.	Bird-borne seed dispersal.	M	As above
Rubus rosifolius	Plants on or adjacent to the Maraeti'a plateau. Dormant seed.	Bird-borne seed dispersal.	M	As above
Passiflora maliformis	Uncontrolled plants on or adjacent to the Maraeti'a plateau. Dormant seed.	Bird-borne seed dispersal	M	As above
Lantana camara	Uncontrolled plants on or adjacent to the Maraeti'a plateau. Dormant seed.	Bird-borne seed dispersal	M	As above

5.3 Socially acceptable

There is a strong environmental protection ethic held by many members of the two associations involved in the environmental management of the Punaruu valley: Te rau ati ati and Association pour la protection de la vallée de Punaruu.

The Punaruu valley lies within the Punaauia Commune (regional area). Members of both associations attended a community meeting with the Mayor, civic leaders, members of Punaauia community and representatives of Government Departments, 31 August 2012. Also attending were the visiting experts associated with the field trip gathering information for the Feasibility Study, and a newspaper reporter. A list of the 22 attendees of the meeting and subsequent newspaper report appears in Appendix 4. The meeting viewed a PowerPoint presentation of the forest restoration project undertaken by the Leeward and Haleakala Watershed Partnership, Hawaii. Discussion followed on the need to protect the native and endemic tree species on the Maraeti'a plateau and the possibility of erecting a protection fence to help ensure their future survival. The collaborative input and purpose of this Feasibility Study was also explained to those attending.

The culturally important activities of orange fruit gathering and pig hunting on the Maraeti'a plateau were discussed. The pig hunting season had been extended by a few days and may have affected the lower than expected attendance of pig hunters to the meeting.

The reasons for using adaptive management principles were also explained to the meeting. Adaptive management will allow those coordinating any future works on the Maraeti'a plateau to involve the community and interest groups (such as the pig hunters through their membership of the Association pour la protection de la vallée de Punaruu) in decision-making and design of future invasive animal or invasive plant management works, or any future native plant replanting programme. It will also allow decisions to be made at the most appropriate time; for example, the exact effects of excluding wild pigs

and rodents on the natural regeneration rate of native and endemic forest tree species is currently unknown and so it may be best to observe the rate of natural regeneration occurring at the site with the rodents and wild pigs excluded before embarking on expensive invasive plant control works.

The collaborative, knowledge-based decision making process utilised by the adaptive management approach is dependent on the on-going input of a "working group" (Jacobson, C. *et al.* 2009). This group should comprise members of Te rau ati ati, who have initiated the project; scientists with relevant knowledge; and community members (including members of the Association pour la protection de la vallée de Punaruu) who have an interest in the site and are willing to contribute to a collaborative, shared-learning approach.

Two papers which explore the value of an adaptive management approach – one for the management of woody weeds and the other for management of forests affected by deer – are listed in the Reference section (Lowe, R. *et al.* 1999 and Jacobson, C. *et al.* 2009). Further information or mentoring may be required (to Te rau ati ati and the "working group") to ensure that the adaptive management approach is effectively utilised.

Regarding the major interest groups that visit the Maraeti'a plateau and the effect of the project on their activities:

- Orange fruit gatherers will still be able to access the citrus trees on the Maraeti'a plateau, including in any ungulate proof fenced area. The fence design should include step-overs, such as a style, allowing orange gatherers to make their way to and from the valued trees.
- The ungulate proof area is not available for hunting and, although the proposed fenced area is less than 2 hectares in size and comprises less than 0.05 % of the Punaruu Valley area, some pig hunters could feel aggrieved that this area is not available and fear that other popular hunting areas may be similarly fenced to exclude wild pigs. The project may result in more frequent visits and human activity on the plateau. It is possible that this could lead to a reduction in the wild pig population. However, the fence may also act to channel pigs making them easier to trap, which would benefit the local hunters.
- There may be concerns by pig hunters about the use of toxins and the perceived effect this will have on consumption of pig meat.
- Trampers will be able to continue to access the plateau and use the most frequently used and established tracks.

The proposed management site on the Mareati'a plateau is remote. It is essential that the project has the support of the community to ensure that any works are not adversely affected by any aggrieved user of the plateau. This is another strong reason for incorporating the adaptive management approach into the project. Users of the plateau, and especially the pig hunters, must respect the management works and support the project's objectives. They are more likely to do this if their voice is heard as part of a management "working group" from the project's earliest stage.

Most of the key stakeholders with an interest in the proposed project attended the community meeting and are recorded in the list at Appendix 4. The pig hunters not present at the meeting (because of the

extended pig hunting season) are contactable through the Association pour la protection de la vallée de Punaruu. Some of these people may want to be involved in the proposed adaptive management working group. The pig hunters are an important stakeholder group and their representation and involvement in the project is essential.

5.4 Politically and legally acceptable

Land ownership on the Maraeti'a plateau is vested in the Government of French Polynesia. The upper Punaruu valley has protection status which was passed under a government decree in 1952. There are established family links to the plateau area, but no defined individual or family ownership of property titles. The Punaauia township government administrators work with the Association pour la protection de la vallée de Punaruu to ensure that the environmental and cultural values of the valley are protected. The Association should oversee the environmental aspects of the project, working collaboratively with Te rau ati ati and the working group formed through the adaptive management process.

The Mayor of Punaauia Township, Mr Ronald Tumahai, announced at the 31 August community meeting, that administrators are writing a "White Paper" which will propose an overall management strategy for the Punaruu valley. After hearing of the project "The restoration and conservation of remnant native forest on Maraeti'a plateau" he commented that it was a welcome component of the overall management of the valley. He stated, however, that the Punaauia Municipality did not have any budget to assist with the cost of the project.

Te rau ati ati should continue to work with government and Punaauia township officials to secure legal permits and consents for the construction of the proposed ungulate proof fence on the Maraeti'a plateau. Te rau ati ati should work collaboratively with the Association pour la protection de la vallée de Punaruu and members of the working group.

The proposed rodent control programme will utilise a combination of snap traps and toxins. Any use of the recommended diphacinone toxin will have to comply with French Polynesian rules and regulations regarding the use of toxins.

The proposed methods for invasive plant control may include the use of glyphosate herbicide. Glyphosate herbicide is permitted to be used in French Polynesia. The application of herbicide must follow best-practice requirements and all health and safety precautions followed.

The monitoring programme does not include the use of any toxins or pesticides.

The location of the protection fence must not disturb the marae structure discovered during the field trip to Maraeti'a. The Marae is near the edge of the plateau and was assessed by archaeologist Paul Moohono Niva. Detail of this marae and location is in the accompanying report *Archaeological survey of Maraeti'a*.

5.5 Environmentally acceptable

The primary objective of this project is that remnant native forest on the Maraeti'a plateau is conserved and regenerating. The construction of the ungulate proof fence is necessary to prevent the land disturbance activity of wild pigs from part of the plateau where the rare and endangered native plants

grow. As observed during the field trip, successful regeneration of the valued plants does not appear to occur in areas accessible to wild pigs.

The proposed fence design and location will ensure that there is minimal disturbance to land at Maraeti'a. Although the fenceline may go over the edge of the plateau to ensure that some of the valued trees are protected, the fence line follows an existing even contour – no earthworks are required. The steel stakes securing the fence can be driven into the ground by sledge-hammer. The stakes will not cause any significant ground damage. If any future management decision requires the removal of the fence, then it will be possible to remove the entire construction without damage to the environment or evidence that it existed on-site.

A possible location for the ungulate proof enclosure was identified during the field trip to the Maraeti'a plateau. A map of the location is at Appendix 3. The map illustrates a smaller enclosure, 8960 m², with a fence line contained to the plateau; and a possible larger enclosure, 16,210 m², with the fence line extending over the edge of the plateau to enclose a mature stand of remnant forest species. The fence line for the possible larger enclosure follows an even contour and straight lines. The larger enclosure includes the green shaded area and the smaller just the red-shaded zone. Note that the indicative costs table (Section 5.7, Table 5) estimates the cost for the larger fenced area with an estimated fenceline length of 600 m.

The edge of the Maraeti'a plateau is dominated by invasive plant species. The proposed fence line will mostly pass through areas of invasive plants, especially *Tecoma stans, Lantana camara* and *Passiflora maliformis.* The fence line should affect as few native plants as possible.

The recommended rodent control methods are considered humane, though may not be agreeable to all parties. Presence of toxin residues in non-target animals is possible. It is recommended that use of toxins is timed to avoid the pig hunting season.

The recommended invasive plant treatment methods; stump treatment, and drill and inject herbicide for the larger invasive tree species do not involve any motorised spray equipment and therefore less risk of spray drift affecting any desirable plant species. Herbicide can be applied by knapsack sprayer, trigger bottle sprayer or drench-gun injector. All health and safety requirements must be followed.

All of the invasive plant treatment should be achieved with glyphosate herbicide. Glyphosate has very low mammalian toxicity and if used as recommended will not result in any residual effects.

5.6 Capacity

There is a very high level of environmental management expertise within Te Rau ati ati, who are the lead agency in undertaking this project. Plant identification skills for native and exotic plants are excellent. Practical construction and maintenance skills are very high with Te rau ati ati members having built and maintained tramping huts in remote forest locations of Tahiti. Members have also controlled most of the Maraeti'a invasive plant species at other locations. There has also been some experience of replanting native tree species at biodiversity restoration sites. Expert advice may be required for the initial rodent control trap layout and monitoring programme. A suggested rodent trapping methodology is in the appendices section.

Table 4: Key Skills needed to complete the project

KEY SKILL	PURPOSE	METHOD TO OBTAIN SKILLS
Research	To finalise best-practice monitoring programme methodology; collect and store information from the photo-point, casual observation and plot count actions.	Skills are currently present in the Te rau ati ati group. Advice and peer review of methodology is available from Pacific invasive species management agencies.
Planning	To seek funding for the project; finalise a timeline of activity to implement actions; establish a working group as part of the adaptive management process; ensure that any works and monitoring programme occurs when required with minimal disruption to cultural activity; ensure that schools and the community have opportunity to observe and, where possible, participate in project activity.	As above.
Report writing	To prepare and submit reports to funders and government agencies; and ensure that the community continues to be fully informed of the progression of the project. Complete newsletters. Keep other Tahitian and Pacific agencies informed of progress and lessons learnt from the project.	As above. Te rau ati ati currently maintain an excellent informative website.
GIS	To ensure that any works such as the ungulate proof fence is located correctly; monitoring points accurately located and identified; data collected and stored.	As above. Excellent skills currently present with Te rau ati ati and Tahitian government department collaborators.
Planting	That seedlings of native plants are successfully raised, planted, establish and maintained in good health.	Members of Te rau ati ati have raised plants within a nursery and undertaken replanting programmes. Advice is available from other Pacific agencies should specialist advice be required.
Invasive plant identification	To correctly identify invasive plant species at the earliest stage of growth that is practically possible.	Excellent skills in this area are currently held by Te rau ati ati.
Health and safety	To ensure that health and safety best-practice is undertaken in all aspects of the project; that all risks associated with the project are identified; action is taken to eliminate, isolate or minimise the risk. Hazards include the steep trek, in parts, to the site; use of sharp tools, heavy equipment, contractor use of chainsaw to clear the fenceline, use of toxins, inclement weather conditions.	Refer to health and safety best-practice procedures e.g. www.osh.govt.nz Te rau ati ati have a very good track record in complying with H&S best practice. Further advice may be required for ensuring that school and community groups apply best-practice. Ensure appropriate certification obtained for use of chemicals including toxins. Ensure that World Bank Guidelines for the Use of Pesticides is complied with.
Invasive plant treatment methods	That methods are effective and present the least harm to the environment; where practically possible the methods should be organic (e.g. hand pulling weeds); herbicide application should be via injector applicator or low-pressure knapsack application. Glyphosate herbicide should be used where effective. Triclopyr herbicide used only for knapsack application to invasive plant regrowth or seedlings that are proven to be poorly managed by Glyphosate.	If required, seek expert advice from other Pacific or world agencies undertaking management of the targeted invasive plant species or have experience with similar plants and situations. Ensure appropriate certification obtained for use of chemicals including toxins. Ensure that World Bank Guidelines for the Use of Pesticides is complied with.
Rodent control trap layout and monitoring programme	To ensure that traps are located in appropriate locations, at correct spacing and baited effectively. That the monitoring programme uses best methodology and equipment.	Seek further advice from New Zealand DOC, including U tube clips and Standard Operating Procedure publications.

Table 5: Human Resource Skills Register

SKILLS REQUIRED	STAFF Role: Project leader	STAFF Role: Project team member
Research	Yes	Yes, field skills
Planning	Yes	Yes, especially programme implementation
Report writing	Yes	Yes, gathering data
GIS	Yes	Yes
Coordinate the adaptive management process	Yes	Understand and assist
Coordinate rodent management programme	Yes	Assist with trap layout, oversee trapping programme
Coordinate ungulate proof fence construction	Yes, oversee	Assist in coordination and construction process
Coordinate the monitoring programme: photo-point, casual observation and plot monitoring techniques	Yes, oversee	Assist in ensuring that data collected; analyses undertaken; data stored
Invasive plant identification	Yes	Yes
Invasive plant treatment methods	Yes	Yes; certified herbicide applicator
Develop a small nursery for the replanting programme	Yes	Yes, oversee
Biosecurity	Yes	Yes
Planting	Yes, knowledgeable of best-practice	Yes, oversee
Releasing planted seedlings	Yes, knowledgeable of best-practice	Yes, oversee
Communications (website, newsletter, media, etc)	Yes, oversee	Yes, assist in gathering info and developing material
School and community education outreach	Yes, oversee	Yes, assist
Health and safety	Yes, overall responsibility for ensuring all H&S requirements are followed	Yes, assist in risk identification and ensuring all H&S requirements followed
EXPERIENCE (YEARS)	Five years including invasive species management. Preferably native plant management experience	Three years, preferably including invasive plant and animal management
HIGHEST EDUCATION	Tertiary qualification	Preferably a tertiary technical qualification

5.7 Affordability

The below costs are a high-level estimate of project costs over a 5 year timeframe. Costs have been estimated in New Zealand dollars. Note that one NZ dollar = 0.83 US dollars. One NZ dollar = 75.67 French Pacific Francs (XPF).

Table 6: Indicative Costs: The Restoration and Conservation of Remnant Native Forest on Maraeti'a Plateau project

Item	Details	Cost (NZ$)
Project Design Stage		
Project planning report	Include project actions; team member's tasks, timeline, detailed budget. 80 hours labour @ $40 per hour.	3,200
Extend awareness of the adaptive management process approach to project key scientists and community representatives	Formation of the adaptive management process working group to result from this awareness / consultation. 60 hours @ $40 per hour.	2,400

	Project Design Stage, Expected cost	5,600
Operational Planning Stage:		
Price and arrange purchase of materials. Estimated prices for 5 years of the project duration:	Rat control materials: Set-up	
	• Victor rat traps: x 236 @ $7.50 each	1,770
	• Philproof rodent bait stations: x 76 @ $12.05 each	915
	• Timber rat trap covers: x 236 @ $10 each	2,360
	• Nails: 2 x 25kg box (60mm x 2.8mm flat head galvanised) @ $100 each	200
	• Small (120mm x 90mm) triangle plastic track markers (pink): x 1000 @ $0.20 each	200
	• Small (120mm x 90mm) triangle plastic track markers (yellow): x 500 @ $0.20 each	100
	Rat control materials: Maintenance (annual cost)	
	• Victor rat traps: x 236 (20% replacement per year) @ $7.50 each	1,770
	• Diphacinone rodent baits (pellets): 456 kg @ $4.10/kg	1,870
	• lure (peanut butter): x 10kg @ $10/kg	100
	Rat control materials: Monitoring (wax tag method)	
	• peanut waxtags: x 500 @ $1.10 each	550
	Rat control materials: Monitoring (tracking tunnel method)	
	• Tracking tunnels: x 100 @ $8.50 each	850
	• Ink cards: x 500 @ $0.85 each	425
	• lure (peanut butter): x 1kg @ $10/kg	10
	Fencing materials (assuming a 600 m length of fence):	
	• Posts: 165 cm x 120 @ $11 each	1,320
	• Strainer posts: 12 @ $20 each	240
	• Struts: 24 @ $12 each	288
	• Staples: 1 x 5 kg box @ $50	50
	• Wire incl. barbed: 2.5 mm HT 650 m x 4 @ $95 each	380
	• netting: 800 mm high HT 100 m x 6 @ $200 each	1,200
	Invasive plant treatment materials:	
	• injector applicator: x 2 @ $60 each	120
	• Glyphosate herbicide: 3 x 20 l @ $160 each	480
	Plant raising materials:	
	• potting mix: 100 kg @ $20/20 kg	100
	• seed trays: x 10 @ $5 each	50
	• long root trainers and wire frames: x 10 @ $30 each	300
	• battery operated watering system x 1	50
	• frame pack for seedlings: x 2 @ $80 each	160
	• crowbar to assist planting x 1	30
	• spade for planting and weeding: x 2 @ $30 each	60
	Digital camera x 1	400
	25 m tape measure x 1	10
	Small waterproof notebooks: x 10 @ $10.50 each	105
	pencils: x 2 boxes @ $10 each	20
	GPS x 1	800

Transport and shipping cost of materials	Ship rodent control materials, herbicide applicators - Auckland to Papeete (fencing materials, herbicide to be obtained in Papeete).	200
Meeting room hire, catering	Adaptive management working group meets every two months i.e. 30 times over 5 years @ $60 per meeting room hire and catering	1,800
	Operational Planning Stage, Sub-total	19,283
	Operational Planning Stage, Contingency (10%)	1,928
	Operational Planning Stage, Expected cost	21,211
Implementation Stage:		
Transport of fencing and rodent control materials to the site (via helicopter)	1.5 hours @ $1,800 per hour	2,700
Fencing contractor + Fencing contractor to clear the fence-line in preparation for the fence construction (under supervision of the project leader)	• 40 hours @ $90 per hour (2 person team) • Walk in / out from site 16 hours x $60 per hour (2 person team) or fly via helicopter in / out from the site for similar cost. • Clear an approximate 5m x 600m fence line (if practically possible ensuring minimal harm to established native plants). 16 hours @ $90/hour (2 person team). Contractor to supply chainsaw and fuel.	3,600 960 1,440
Rodent control: initial monitoring	• Initial trapping to estimate rat numbers, species, life history etc: 12 x 5 nights trapping (6 days) + 12 x 2 days travel to and from site: 96 hours @ $60/hour (2 person team).	5,760
Rodent control: rat trap tunnel construction	• Construction of 236 wooden trap tunnels @ 50/day: 40 hours @ $60/hour (2 person team).	2,400
Rodent control: infrastructure set-up Costs based on 100m x 50m grid. Increasing intensity will increase costs, e.g. 75m x 50m = increase of 25%.	• Cutting and marking 1.6km of tracks and placing traps and bait stations + 2 days travel to and from site: 56 hours @ $90/hour (3 person team). • Transport of rodent control materials to site covered under helicopter costs above.	5,040 0
Rodent control: population reduction using toxic baiting	• Fill 76 bait stations and refill with bait as required for following 5 days + 2 days travel to and from site: 72 hours @ $60/hour (2 person team).	4,320
Rodent control: population reduction using trapping	• Check 236 traps daily for 14 days + 2 days travel to and from site: 136 hours @ $60/hour (2 person team).	8,160
Rodent control: maintenance using trapping	• 1 day/week for 10 weeks + 20 days travel to and from site (10 visits): 240 hours @ $60/hour (2 person team). • 1 day track maintenance: 8 hours @ $60/hour (2 person team).	14,400 480
Rodent control: rodent monitoring	• 3 monitors @ 2 days per monitor (1 day to place detection devices and another to retrieve) undertaken alongside control: 48 hours @ $30/hour (1 person).	1,440
Rodent control: data entry, analysis and reporting	• 2 days per year data entry (hours combined from small sums over several days): 16 hours @ $30/hour (1 person). • 5 days analysis and report writing: 40 hours @ $30/hour	480 1,200
Initial invasive plant control	• Control low-incidence and allelopathic invasive plants as per section 5.1.3.2 recommendations: initial control (stump	

	treat plants): 96 hours @ $60/hour (2 person team). • Additional time to get to the site: 5 tramps + use of "local labour" based at Anani refuge: 80 hours @ $60/hour (2 person team).	5,760 4,800
Establish photo-point and plot count locations. Complete initial monitoring including casual observations.	Establish photo-points and plots: • 4 plots@ 1/day: 32 hours @ $90/hour (3 person team). • Photo-points: undertaken alongside plot monitor. • Casual observation "as you go". • 2 days travel to and from site: 16 hours @ $90/hour.	2,880 0 0 1,440
	Implementation Stage, Sub-total	67,260
	Implementation Stage, Contingency (20%)	13,452
	Implementation Stage, Expected cost	80,712
Sustaining the Project Stage:		
Maintaining the ungulate proof fence	2 person team: 8 hours per month x 59 months = 472 hours @ $40 per hour (for two people)	18,880
Rodent control (maintenance following initial control)	• 2 person team: 16 hours /month for 57 months = 912 hours @ $ 40 / hour (for 2 people) • Additional time to get to the site: 5 tramps / year + use of "local labour" = 320 hours x $40 / hour	36,480 12,800
Invasive plant follow-up surveillance and hand weed / herbicide application control	• 2 person team; 32 hours per month x 35 months + 16 hours per month x 24 months = 1,120 + 384 hours = 1,504 hours @ $40 per hour (for 2 people) • Additional time to get to the site (when possible combine with rodent control work) plus 5 tramps / year + use of "local labour" = 320 hours x $40 / hour	60,160 12,800
Establish a nursery and raise plants	16 hours + 16 hours/month for 18 months = 304 hours @ $20 per hour	6,080
Native planting and release programme	• 2 person team: 16 hours planting + 16 hours / month releasing for 24 months + 8 hours month releasing for 18 months = 544 hours x $20 per hour • Time to get to the site (allowed for in the above hours)	10,880 0
Continue photo-point and plot monitoring	• 2 person team: Photo-point monitoring 10 locations x 1 hour per location = 40 hours x $60 per hour for first 2 years + 30 hours x $60 per hour following 3 years = $2,400 + $1,800 • 2 person team: Plot counts 3 locations x 6 hours per location = 72 hours x $60 per hour for first 2 years + 54 hours x $60 per hour following 3 years = $4,320 + $3,240	4,200 7,560
	Sustaining the Project Stage running costs	169,840
	Sustaining the Project Stage Contingency (20%)	33,968
	Sustaining the Project Stage, Expected cost	203,808
PROJECT TOTAL (Project design stage + operational planning stage + implementation stage +		$311,331

sustaining the project stage) over 5 years	

The above costs are a high-level estimate of project costs over a 5 year timeframe.

Costs have been estimated in New Zealand dollars. Over an initial five-year period, the estimated cost of the protection fence is $36,922. The cost of the rodent control programme is $124,004. The cost of the monitoring programme is $20,765 and the cost of the invasive plant management and possible native species replanting programme ranges from $0 to $122,061, depending on the option implemented. With additional project administration and design costs, the total cost of the project is in the order of NZ$311,331 over the projected 5-year period.

6 CONCLUSION

The nature of any project which includes the construction of an animal-proof fence and subsequent maintenance, invasive animal and plant management and native plant species replanting programmes is that the project could become relatively costly and labour intensive. This project has the added obstacle of a relatively remote location accessed by a track which is, in parts, both flat and very steep.

The Maraeti'a plateau does, however, contain an environmentally outstanding remnant population of rare French Polynesian native and endemic tree species. Regeneration of these plant species appears to have been severely affected by the disturbance activity of especially rats and wild pigs, and the detrimental effects of invasive plants.

The ungulate proof fence can be easily erected once the materials have been transported to the site. The design is simple and robust. Maintenance should be relatively easily achieved.

The rodent control programme is based on best-practice as undertaken by New Zealand's Department of Conservation. It involves a simple grid layout of traps, baiting and monitoring protocol.

Although there are eight species of invasive plants infesting the plateau, most of the species recommended for control occupy the edge of the proposed protection area. They are easily treated using, for the most part, a stump treatment herbicide application method. This is a simple and reliable invasive plant management technique. The follow-up management should be achieved as long as the required work is completed within the recommended timeframes.

The project monitoring programme includes simple techniques, such as photo-points and casual observation of "what's coming up". The plot counting task can take three hours per plot to complete thoroughly, but is not too onerous.

Therefore, most prescribed project actions are relatively easily achieved. A major factor to ensuring success, however, is that the project has the support of key stakeholders especially within the local community. Active participation of the pig hunters and orange gatherers will help ensure that the ungulate proof fence is not damaged by any disaffected person. Collaboration, cooperation and active assistance is best achieved by including representatives in the working group through the adaptive management process. There is a good level of current support within the pig hunting and orange gathering groups for the project, and so their cooperation and assistance should be achieved.

There is tremendous potential to extend awareness of Tahiti's natural environment and environmental restoration best-practice through this project. School and community groups would benefit from participation and knowledge of the project. There is also potential to increase eco-tourism, especially through increased nature trekking in the Punaruu valley.

The cost of the project, at up to NZ$311,300 over 5 years, is not excessive for a project involving the erection of an animal proof fence in a remote location, animal and plant management, native species replanting programme and incorporating a thorough monitoring programme so that knowledge from the project can be used to assist any future similar projects. This cost will help ensure the protection and expected regeneration of the rare and endangered plant species.

The Restoration and Conservation of Remnant Native Forest on the Maraeti'a Plateau, Punaruu Valley, Tahiti, French Polynesia project can be successfully achieved.

Table 7: Key Issues

Issue	Recommendation
Remote location.	Heavy materials to be taken by helicopter to the site. It is noted that community members regularly visit the site currently and so the location is not a significant factor for the project's success.
Construction of the ungulate proof fence in an area valued for hunting and orange gathering.	Include the pig hunters and orange gatherers and other key stakeholders on the adaptive management process working group.
Rodent control required to be undertaken over an extended area.	The rodent population on the 20 ha plateau, plus accessible sidings, is relatively easily managed through a well thought-out programme. Main issue is large labour resource required to implement this control successfully. Additional training or mentoring in effective techniques is available and is recommended.
Invasive plant and other project management actions to be decided through the adaptive management process rather than a prescribed work programme.	Most appropriate decisions are easily achieved through good information being provided to the working group and decisions made through the scientists and community members adopting a collaborative, consider options and decide action through a consensus decision-making approach.
That knowledge gained through the project is extended to the community, school groups, other NGOs and government agencies.	Ensure that adequate information is collected through the recommended monitoring programme and regularly disseminated to the identified groups.

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8 APPENDICES

Appendix 1: Site Visit to Maraeti'a; 27-30 August 2012

A team of 22 people completed a field trip to the Maraeti'a plateau, 27-30 August 2012. The objectives and programme for the field trip is recorded in Appendix 2. The team consisted of members of Te rau ati ati and the Association pour la protection de la vallee de Punaruu, visiting invasive species experts / scientists and officials from French Polynesian government agencies.

The field trip was successfully completed. Two days were spent on the Maraeti'a plateau assessing the vegetation, topography and possible fence location, ungulate and rodent populations and their environmental effects, monitoring programme methodology and evidence of early Polynesian habitation through an archaeological assessment of an ancient marae structure.

Full discussion of possible management options was undertaken in the field and following the Maraeti'a field trip.

The field trip was undertaken during the pig hunting season and shortly after the orange gathering festival. People from each of these groups were either part of the team or encountered on the plateau. Aspects of the project were discussed with at least one pig hunter and several orange gatherers. A number of hunters either trapping or using rifles were met on the trek to and from the plateau. The visiting experts were able to gain a good insight into aspects of Tahitian culture and tradition.

Biosecurity measures were implemented to ensure that the visiting experts and other members of the field trip team did not inadvertently carry invasive pests to or from the site. All tasks in the Biosecurity Checklist at Appendix 12 were completed.

Appendix 2: Field trip document (prepared by Te rau ati ati)

Feasibility study on the restoration and conservation of remnant native forests on Maraeti'a plateau, Punaruu valley, Tahiti, French Polynesia.

August, 25th - September, 01st

Association Te rau ati ati a tau a hiti no atu

Objective

Maraeti'a is a small 20 ha plateau located at the end of the Punaruu valley, between 750-800 m elevation, with unique remnants of native –almost pristine- mesic to wet forests. The plateau includes the two largest known populations of the two endangered species Pouteria tahitensis and *Ochrosia tahitensis* of French Polynesia, but also important populations of the endangered species *Polyscias tahitensis* and *Santalum insulare var insulare*. These forest structure (tall canopy) and species composition is unique in the island of Tahiti.

In order to protect Maraeti'a's natural areas, the association "Te rau ati ati a tau e a hiti noa tu", in collaboration with the "Association pour la protection de la vallée de Punaruu", is implementing a study on the feasibility of restoring the native forest, more particularly on the possibility of fencing a patch of forest, controlling rats' populations and managing invasive plants.

To do so, Te rau ati ati invited several scientists recognized as experts in their domains to assist it on the project. The local organization would benefit from the share of experience with the experts, and, pending conclusive results, could implement the restoration project in the near future.

General Programme

Day	Time table	
Saturday, 25 Aug.	9:15 PM	Arrival of John MATHER and Andrew STYCHE
	10:30 PM	Arrival of Andrea BUCKMAN, Luke MCLEAN and Arthur MEDEIROS
Sunday, 26 Aug.	Morning off	-
	11:00 AM - 01:00 PM	Lunch with Te rau ati ati
Monday,27 Aug.	All - day	Field trip
Tuesday, 28 Aug.		Field trip
Wednesday, 29 Aug.		Field trip
Thursday, 30 Aug.		Field trip
Friday, 31 Aug.	9:00 AM - 12:00 AM	Meeting with the stake holders and the authorities
Saturday, 01 Sept.	Day off	Activities to be planned
	12:30 AM	Departure of Andrea BUCKMAN, Luke MCLEAN and Arthur MEDEIROS
Sunday, 02 Sept.	06:15 PM	Departure of John MATHER and Andrew STYCHE

Field trip detailed schedule

The field trip to Maraeti'a plateau will take place on Monday the 27th of august and will last 4 days -3 nights.

The first night - Monday the 27th - will be spent at "Te tiare anani" refuge, a group of cabins located at 448 m and shelter of the orange gatherers and hunters. The place is equipped with toilets, showers and running water.

We'll reach Maraeti'a on the second day only - Tuesday the 28th - where a base camp will be set up. The second and third nights will be spent on the plateau - Tuesday, the 28th, and Wednesday, the

29th. We will sleep under tarps; for more intimacy, please feel free to bring a tent. There's no water on the plateau; water to drink will be brought.

Finally, we'll hike down on Thursday, the 30th, in order to be back to Papeete before 6 PM.

Day 1 (Mon 27 Aug.)

Distance: ca. 6 km Altitude difference: ca. 596 m Time: ca. 4 h

Time table *	Stages of the hike (in capitals = Toponyms)	Elevation (m)	Difficulty	Miscellaneous
7:30 - 7:45 AM	Departure from hotel	-	-	-
9:00 AM	Beginning of the hike	0	-	Three river fords to cross to access the trail
10:30 AM	VAIRAAAITO	370	Difficult - Steep	View on the low valley
10:45 AM	VAIPUNA	470	Difficult - Steep	-
11:00 AM	Plateau TETAMANU - border	493	Difficult - Steep	-
11:45 AM	Plateau TETAMANU	513	Easy - on plateau	View on the ocean
12:30 PM	MOUAROA	585	Easy - on plateau	Panoramic view on the center of the island
1 PM	TE TIARE ANANI cabins	448	Easy - on plateau	-

* : Timetables given here are purely indicative, it might actually be longer.

Day 2 (Tues 28 Aug.)

Distance: ca. 4 km Altitude difference: ca. 476 m Time: ca. 3h30

Time table *	Stages of the hike	Elevation (m)	Difficulty	Miscellaneous
8:00 AM	Departure from TE TIARE ANANI cabins	448	-	-
-	PURAU plateau	401	Easy - close to the cabins	Cultural sites relics - Marae and Paepae ; Ofa'i Puna ; relics of the old refuge (1927) ; orange tree plantations
8:20 AM	TOIROA	324	Easy	Ford to cross - Punaruu river
9:00 AM	PAUPAUTIA	404	Easy	Plateau crossing + climbing up a stream ; Cultural relics - Marae
10:00 AM	TEHARURU plateau	517	Easy	Two fords to cross - Teaana and Punaruu river
11:30AM	MARAETIA plateau	800	Difficult - steep	-
12:00 PM	Lunch - Setting up the camp			
2:00 - 4:30 PM	MARAETIA plateau - first exploration	800	-	-

: Timetables given here are purely indicative, it might be longer.

Day 3 (Wed 29 Aug.) will be a full work day on the plateau; we will be leaving Maraeti'a on Day 4 (Thur 30 Aug), shortly before 12 PM in order to be back at the beginning of the trail before 5 PM.

A total of about 20 persons will join the field trip, including members of Te rau ati ati, members of the "Association pour la protection de la vallée de Punaruu" and local scientists.

Food and water will be brought prior to the field trip on camp site. You will need to carry only your water and food for the first part of the hike, ie from the parking lot to the cabins. Regarding equipment, please refer to "What-to-bring list" section below.

Accommodations:

When not on the field, the invited scientists will be lodged at "Hotel Te Tiare" located in Papeete city centre, on the water front, and hence close to the Post office, shops, taxis and bus terminals, tourism centre, etc... For more info, please see http://www.hoteltiaretahiti.com/.

The hotel doesn't have a restaurant; it is possible to have only breakfast there. Nevertheless, when not with Te rau ati ati members, there are several places where you can eat nearby.

The hotel unfortunately doesn't offer access to the web. To access internet you can either go to an internet coffee (there are two next to the hotel), to Jean-Yves' office (100m away from the hotel) or buy a "ManaSpot" card to access the Papeete Hotspot Wi-Fi (more info on https://www.manaspot.pf/index.php?option=com_frontpage&Itemid=1&lang=english see "Prepaid cards").

Regarding cell phones, you can make or receive phone calls as long as your operator / mobile subscription allows you to use it at the international and if your operator has a partnership with the local network operator Vini. If not, you can still use prepaid cards. For more info, please see http://www.vini.pf/index.php?id=welcome_to_vini_en.

For the time of the field trip, luggage's can be left at the hotel in the locker room.

Languages issues

French and Tahitian are the most spoken languages in French Polynesia, obviously. Nevertheless, an important proportion of the population knows basic English so communicating in Papeete on your free days should not be an issue.

While on the field, as well as during the meeting on the 31st, translation will be assured by members of Te rau ati ati, from English to French or to Tahitian and vice - versa.

What-to-bring list

Attendant to the field trip will need to bring the usual camping equipment, namely a bagpack, a sleeping bag, a sleeping mat or an airbed, an "eating set" (plate, bowl or cup, fork, knife, spoon), hiking boots, a flash light, change for four days and rain clothes - which hopefully will be of no use.

The Tuesday and Wednesday's nights will be spent on Maraeti'a, under tarps. The sleeping area will be big enough to welcome everybody; nevertheless, if tents are optional, it is recommended to bring your own tent if you require more intimacy.

Finally, French Polynesian's valleys are home to zillions of mosquitoes. Don't forget to bring mosquitoes repellent.

List of participants

Below is a list of the people involved in the different steps of the project, and / or confirmed at this point to be present on the meeting on the 31st of august.

Invited scientists

Name	Institution (Country)	Function	Contact
Andrea BUCKMAN	Auwahi and Leeward Haleakala Watershed Restoration Partnership (Hawaii - USA)	Auwahi and LHWRP project coordinator	andrea@lhwrp.org
John MATHER	Pacific Invasive Initiative (New Zealand)	PII project coordinator	j.mather@auckland.ac.nz
Luke MCLEAN	Auwahi and Leeward Haleakala Watershed Restoration Partnership (Hawaii - USA)	Auwahi and LHWRP crew leader	lukapuka11@gmail.com
Arthur MEDEIROS	Auwahi and Leeward Haleakala Watershed Restoration Partnership (Hawaii - USA)	-	amedeiros@usgs.gov
Andrew STYCHE	Department of Conservation (New Zealand)	-	astyche@doc.govt.nz

Officials

Name	Institution	Function	Contact
Ariinui BORDET	Punaauia Township	Chief of the economic integration department	ariinui.bordet@mairiedepunaauia.pf
Christophe BROCHERIEUX	Department of environment	Terrestrial natural areas management officer	christophe.brocherieux@environnement.gov.pf
Terena HARGOUS	Punaauia Township	Chief of the environment	terena.hargous@mairiedepunaauia.pf
		department	
Jean-Yves MEYER	Department of research	Research management officer	jean-yves.meyer@recherche.gov.pf

Members of Te rau ati ati a tau e a hiti noatu

Name	Function	Contact
Noella TUTAVAE	President	hinatrekking@hotmail.fr
Maxime CHAN	Honorary president	-
Henry JAY	Honorary president	-
Tiffany LAITAME	-	tiffany.laitame@hotmail.fr
Paul NIVA	-	nivapaul@yahoo.fr
Elie POROI	Honorary president	eli@mail.pf
Elizabeth POROI	Accountant	eli@mail.pf

Winiki SAGE	Vice president	winiki_sage@opt.pf
Ravahere TAPUTUARAI	-	rtaputuarai@gmail.com
Heifara TUTAVAE	-	hinatrekking@hotmail.fr

Funding supports and acknowledgements

This feasibility study is funded by the Critical Ecosystem Partnership Fund - a joint initiative of l'Agence Française de Développement, 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.

The salaries of the invited scientists for the time of the study are taken in charge by their respective institution - the Department of Conservation of the government of New Zealand, Pacific Invasive Initiative, the Auwahi and Leeward Haleakala Watershed Restoration Partnership.

The Auwahi and Leeward Haleakala Watershed Restoration Partnership funded the travel of one extra expert.

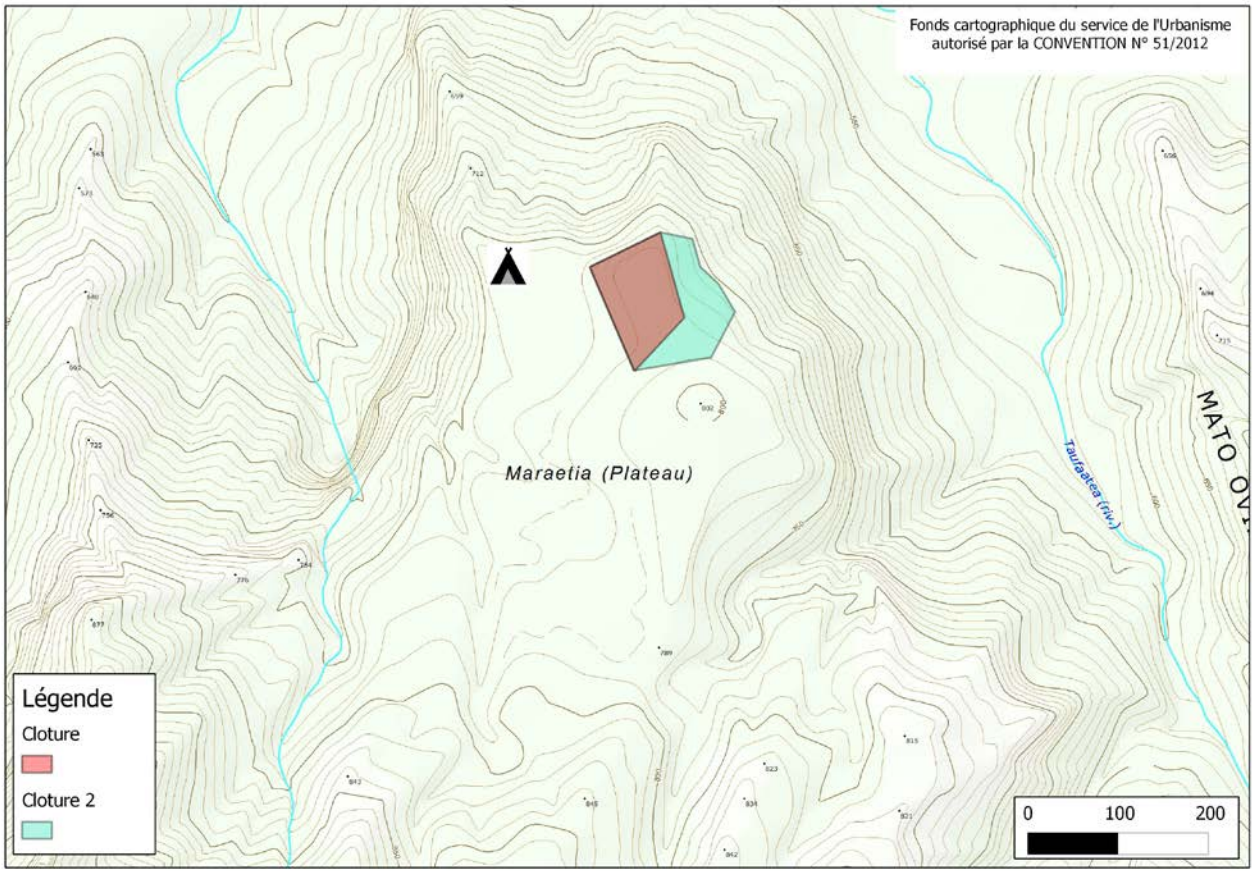
The township of Punaauia is providing the conference room for the final meeting.

The Urbanism department of the government of French Polynesia is providing the maps used for the project.

We are grateful to Jean-François Butaud for the GPS tracks - routes used for the map.

Appendix 3: A possible location for the ungulate proof enclosure.

Note: The green-shaded area is the possible larger-sized enclosure, 16,210 m²; the red-shaded area is the smaller at 8,960 m² (refer to 5.5 Environmentally Acceptable).



Appendix 4: Community meeting list of attendees; Newspaper article

Last name	First name	Institution	Contact
Bordet	Ariinui	Department of integrative economy, Punaauia township	ariinui.bordet@mairiedepunaauia.pf
Brias	Stéphanie	News paper "La Dépêche de Tahiti"	stéphanie.brias@live.fr
Brocherieux	Christophe	Department of environment, Gvt of French Polynesia	christophe.brocherieux@environnement.gov.pf
Buckman	Andrea	Leeward and Haleakala Watershed Partnership	andrea@lhwrp.org
Chan	Maxime	Te rau ati ati a tau a hiti noa tu	fdifdamc@escape.pf
Depierre	Matai	Department of environment, Gvt of French Polynesia	matai.depierre@environnement.gov.pf
Frogier	Tea	Department of research, Gvt of French Polynesia	priscille.frogier@recherche.gov.pf
Hargous	Terena	Department of environment, Punaauia township	terena.hargous@mairiedepunaauia.pf
Levant	Mareva	Punaauia township	mareva.levant@mairiedepunaauia.pf
Mamae	Guillaume	Association pour la protection de la vallée de Punaruu	mamaeguillaume@gmail.com
Mather	John	Pacific Invasive Initiative	j.mather@auckland.ac.nz
McLean	Luke	Leeward and Haleakala Watershed Partnership	lukelhwrp@gmail.com
Medeiros	Arthur	Leeward and Haleakala Watershed Partnership	acm@aloha.net
Meyer	Jean-Yves	Department of research, Gvt of French Polynesia	jean-yves.meyer@recherche.gov.pf
Niva	Paul	Te rau ati ati a tau a hiti noa tu	nivapaul@yahoo.fr
Nordhoff	Arikinui	Association pour la protection de la vallée de Punaruu	ariki.nordhoff@mairiedepunaauia.pf
Poroi	Elie	Te rau ati ati a tau a hiti noa tu	poroi.elie@mail.pf
Poroi	Elizabeth	Te rau ati ati a tau a hiti noa tu	poroi.elie@mail.pf
Styche	Andrew	Department of conservation, Gvt of New Zealand	astyche@doc.govt.nz
Taputuarai	Ravahere	Te rau ati ati a tau a hiti noa tu	rtaputuarai@gmail.com
Tumahai	Ronald	Punaauia township - Mayor	
Tutavae	Noëlla	Te rau ati ati a tau a hiti noa tu / Association pour la protection de la vallée de Punaruu	hinatrekking@hotmail.com

Appendix 5: Newspaper article, 2 September 2012, following the community meeting, Punaauia Hall

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La Dépêche
Dimanche 2 septembre 2012

ÉCOLOGIE - Projet de sauvegarde d'une partie de la forêt endémique

La valorisation de la vallée de la Punaruu est en marche

L'association "Te rau ati ati a tau a hiti noa tu" en partenariat avec l'association "des porteurs d'oranges de la vallée de la Punaruu" ont fait venir une équipe de botanistes engagés dans leur pays respectif. Hawaïens et Néo-zélandais ont réalisé une étude de faisabilité afin de protéger une forêt encore "primitive" dans la vallée de la Punaruu, à Punaauia, commune de la côte Ouest de Tahiti.

Le site choisi se situe sur les plateaux de Maraeti'a et représenterait environ 2 hectares pour commencer sur 20 hectares de forêt. Il a été choisi pour sa richesse en plantes rares ou peu communes, pour ses espèces endémiques présentes massivement mais pourtant menacées de disparition d'ici à 50 ans si rien n'est fait. Après quatre jours de randonnées et d'expertises, du lundi au jeudi, le comité d'experts hawaïens et néo-zélandais invité et les membres des associations engagées se sont réunis à la mairie pour exposer leur projet de sauvegarde d'une partie de la forêt, véritable patrimoine pour la Polynésie.

Car si on ne fait rien, des espèces comme Ochrosia tahitensis, Karaka, Toro'e'a ou encore O'ovao seraient vouées à disparaître dans quelques décennies. Une marge nécessaire pour une sauvegarde efficace qui pourrait s'étendre ensuite sur d'autres sites en danger d'extinction. C'est ce qu'a exposé ce comité d'experts venus prêter main-forte et partager leur expérience au patrimoine de la commune, vendredi à la mairie après avoir passé quatre jours sur les plateaux de la Punaruu.

Grâce à l'obtention d'un financement du "Criticul Ecosystem Partnership Fund", l'association "Te rau ati ati a tau a hiti noa tu" a pu financer la venue d'Andrea Buckman, de Luke Mclean et d'Arthur Medeiros qui, depuis 15 ans, travaillent sur la sauvegarde de la forêt primitive hawaïenne de Auwahi. John Mather de l'organisme "Pacific Invasive Initiative" et Andrew Styche du département de conservation de Nouvelle-Zélande. De par leur expérience, ils ont pu partager leur expertise et leur savoir-faire dans l'élaboration d'un tel projet de sauvegarde. Leur recherche s'inscrit parfaitement dans les objectifs du livre blanc que le conseil municipal a adopté l'année dernière. Le livre blanc qui a établi les richesses, les atouts de la vallée de la Punaruu, insiste également sur le fait de la fragilité de cette nature unique au monde.

À l'instar de ce qui a été réalisé à Hawaii-dans la forêt de Auwahi depuis 15 ans, et où les résultats sont impressionnants, la présence de cette équipe d'expérience a été un réel partage pour les membres des associations ayant participé à cette étude de faisabilité.

Gérer les plantes envahissantes

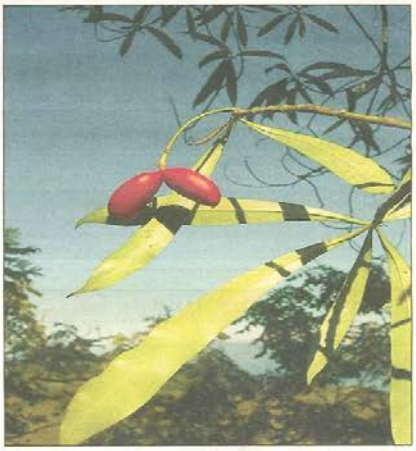
Le projet, s'il voit le jour, se résume à poser une clôture sur une zone entre 2 et 4 hectares, empêchant uniquement les chèvres et les cochons de passer pour qu'ils ne saccagent pas les jeunes pousses des arbres endémiques. Les porteurs d'oranges et les chasseurs ne voient d'ailleurs pas ça d'un très bon œil, mais l'association des porteurs d'oranges et "Te rau ati ati a tau a hiti noa tu" veulent les rassurer : "Ils pourront toujours aller dans cette forêt, il n'y a que trois orangers, qu'ils ne s'inquiètent pas", signale Noëlla, vice-présidente de l'association des porteurs d'oranges. Ensuite, il conviendra de gérer les plantes envahissantes comme le piti et favoriser la pousse des jeunes arbres pour assurer la régénérescence des espèces.

Mais, surtout, c'est un projet qui appelle au rassemblement et à la valorisation d'un patrimoine végétal. L'ouverture de cette vallée, qui mérite pourtant d'être mieux connue des Polynésiens et des touristes, n'est pas encore d'actualité. Mais, l'exemple de l'association de Hawaiimontre qu'une telle action peut fédérer tout une population, toutes générations confondues, voulant se rapprocher de la nature.

La vingtaine de participants à cette étude de faisabilité à la sauvegarde de la forêt de Maraeti'a se sont réunis, vendredi, à la mairie de Punaauia. Un réel partage s'est établi avec les experts botanistes venus de Hawaii et de Nouvelle-Zélande. Leur bilan après quatre jours d'expertise qu'ils ont réalisée durant la semaine sur les hauteurs de la vallée de la Punaruu, a convaincu le maire sur la nécessité d'agir.

Partie avec trois bénévoles, 15 ans après ce sont toutes les communautés de Hawaliqui se mobilisent pour s'associer à la sauvegarde de leur forêt. Aujourd'hui, ils ont plus de 2000 bénévoles et deux autres sites d'actions, de 6 hectares. "Nous organisons des voyages publics, mais aussi avec des petites associations et des scolaires pour les sensibiliser. L'objectif est qu'ils gardent un souvenir fort, car ils plantent eux-mêmes des espèces menacées. Et dans leur façon de penser, ce n'est pas que les scientifiques qui aident la forêt", souligne Andrea, coordinatrice du projet de sauvegarde à Hawaï. La vallée de la Punaruu et sa forêt primitive du plateau de Maraeti'a ne sont pas en danger comme à Auwahi, mais leur potentiel et leur richesse d'espèces unique au monde sont malgré tout en danger d'extinction pour les futurs générations. De plus, valoriser ces espaces encore vierges servirait à favoriser la sauvegarde d'espèces aux vertus médicinales (domaine qui ne demande qu'à être développé au fenua). Mais aussi préserver des espèces d'oiseaux endémiques à Tahiti et en voie de disparition. ■

De notre correspondante SB



L'Ochrosia Tahitensis ne se trouve que sur Tahiti, une espèce endémique en voie d'extinction, si aucun projet de sauvegarde n'est réalisé.

La forêt primitive du plateau de Maraeti'a est à 5 heures de marche, mais le spectacle est magnifique. Malgré la luxuriance de cette forêt, plusieurs espèces endémiques d'arbres sont menacéEs d'extinction.

L'équipe de botanistes venue de Hawaii a exposé son expérience avec la forêt d'Auwahi. Après 15 ans de travail et une communauté entière qui s'est mobilisée derrière eux, la forêt se régénère et cela est un spectacle merveilleux.

Appendix 6: Invasive plant information

TLA*			
Family	Bignoniaceae	Myrtaceae	Rubiaceae
Genus	*Tecoma*	*Psidium*	*Coffea*
Species	*stans*	*cattleianum*	*arabica*
Full scientific name	*Tecoma stans (L.) Juss. ex Kunth*	*Psidium cattleianum* Sabine	*Coffea arabica* L.
Synonyms	*Bignonia stans* L., *Stenolobium stans* (Linnaeus) Seem., *Tecoma stans* var. angustatum Rehd.	*Psidium cattleianum* var. *littorale* (O. Berg) Fosb., *Psidium littorale* Raddi	
Local Name	Piti	Tuava tinito	Taofe
Common Name	yellow trumpet-flower	Strawberry guava	Coffee, Arabian coffee
Habit	Tree / shrub	Tree / shrub	Tree / shrub
PIERWRA	8 (high risk)	18 (high risk)	2 (high risk)
Invasiveness Category			
Decision Tree Result			
Distribution in Pacific	Established in many Pacific Island countries and territories	Established in many Pacific Island countries and territories	
Pollination method (wind, bat, etc.)	Bees, hummingbird (requires external pollination)	Bees	Bees, self-fertile, natural fall of pollen onto lower flowers
Dispersal vectors	Wind and water movement (winged seed). People have been the main international vector through T. stans popularity as an ornamental garden plant.	Birds, pigs, rodents, people	Birds, pigs, rodents, fruit bats, people
Dispersal distance (metres)	Vigorous re-establishment near mature plants from seed-fall, prostate growth habit with stems growing 20 metres or more from the original root crown and adventitious shoots emerging from plant roots or prostrate stems.	No research available. Probably at least 400 m via bird-borne seed dispersal.	No research available. Probably at least 400 m via bird-borne seed dispersal.
Long Distance Dispersal vectors	Wind and water movement	Birds, people	Birds, people
Long Distance Dispersal distance (metres)	Likely to be over 1 km through the movement of winged seeds from a take-off point such as a ridgeline.	No research available. Probably 1 km or more via bird-born seed dispersal.	No research available. Probably 1 km or more via bird-born seed dispersal.
Time to Maturity (years or months)		3 years	3 – 4 years
Height at Maturity (metres)	2-6 m, occasionally up to 10 m	Up to 8 m	
Seed Viability(years)	There is no seed dormancy known and seed longevity is short (Pelton, 1964) (from the Invasive species compendium)	Unknown.	Unknown.
Number of seeds/square metre		1,000 per square metre possible	
Natural Inhibitors to			

growth			
Reproduction time (month)			
Length of reproduction			
Origin	South America	Brazil	Ethiopia
Management Options			
website			

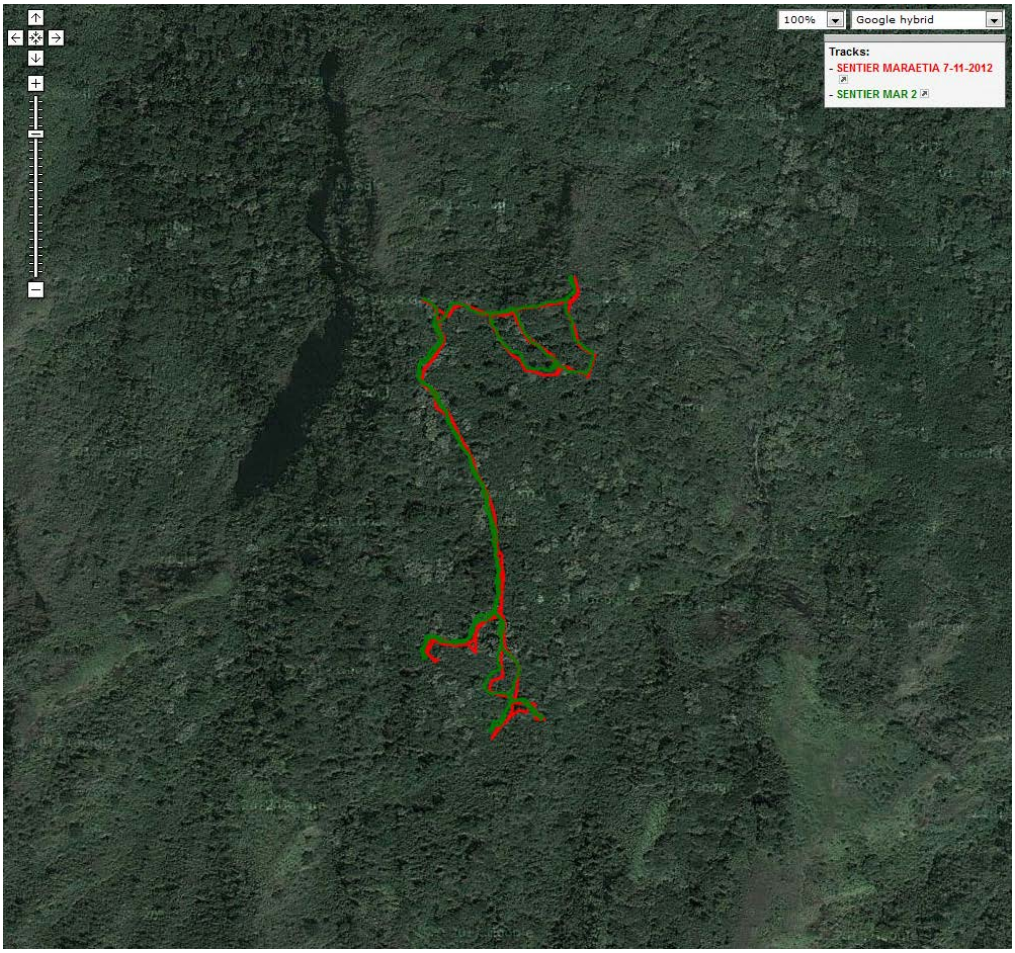
TLA*			
Family	Bignoniaceae	Melastomataceae	Rosaceae
Genus	*Spathodea*	*Miconia*	*Rubus*
Species	*campanulata*	*calvescens*	*rosifolius*
Full scientific name	*Spathodea campanulata* Beauv.	*Miconia calvescens* DC.	*Rubus rosifolius* Sm
Synonyms	*Spathodea danckelmaniana* Buettner, *Spathodea nilotica* Seem., *Spathodea tulipifera* (Thonn.) G.Don	*Cyanophyllum magnificum* Groenland 1859, *Miconia magnifica* Triana 1871	*Rubus commersonnii* Poir., *Rubus coronarius*, *Rubus eustephanos* var. *coronarius*, *Rubus rosaefolius* Smith, *Rubus rosifolius* Smith var. *coronarius* Sims, *Rubus rosifolius* var. *commersonii*, *Rubus rosifolius* var. *rosifolius*
Local Name	Pisse-pisse	Pa'a honu	*Framboisier*
Common Name	African tulip tree	Purple plague, velvet tree	Roseleaf raspberry
Habit	Tree	Tree	Erect to trailing shrub
PIERWRA	14 (high risk)	14 (high risk)	10 (high risk)
Invasiveness Category			
Decision Tree Result			
Distribution in Pacific	Established in many Pacific Island countries and territories	Established in many Pacific Island countries and territories	Established in many Pacific Island countries and territories
Pollination method (wind, bat, etc.)	Birds attracted to the nectar		Insects especially honey bees
Dispersal vectors	Wind-dispersed seeds, water and especially via rivers	Birds, rodents, pigs, people	Birds, rodents, pigs, people
Dispersal distance (metres)			
Long Distance Dispersal vectors	Wind		
Long Distance Dispersal distance (metres)	Winged seed capable of long-distance dispersal		
Time to Maturity	4 years	4 to 5 years	2 years

(years or months)	approximately		
Height at Maturity (metres)	25 m is common, occasionally to 40 m	From 3 m to 15 m	To 2 metres or more in height
Seed Viability(years)		15 years or more	
Number of seeds/square metre		Thousands (In greenhouse trials in Tahiti, a square meter of the uppermost 2 cm of soil from a dense M. calvescens stand, periodically disturbed, produced 17,808 M. calvescens seedlings in six months)	1,000 per square metre recorded
Natural Inhibitors to growth	Prefers shady, sheltered gullies		Moderately shade intolerant
Reproduction time (month)			
Length of reproduction			
Origin		Tropical America	Asia, Australia
Management Options			
website			

TLA*		
Family	Passifloraceae	Verbenaceae
Genus	*Passiflora*	*Lantana*
Species	*maliformis*	*camara*
Full scientific name	*Passiflora maliformis* L.	*Lantana camara* L.
Synonyms		*Camara vulgaris*, *Lantana scabrida*
Local Name	Pomme calabas	Tarataramoa, tātarāmoa
Common Name	Hard-shelled passionfruit	Lantana
Habit	Glabrous, woody, tendril-bearing vine	Low, erect, thicket-forming vigorous shrub
PIERWRA		32 (high risk)
Invasiveness Category		
Decision Tree Result		
Distribution in Pacific		Established in many Pacific Island countries and territories
Pollination method (wind, bat, etc.)		Butterflies, thrips, bees.
Dispersal vectors	Birds, rodents, pigs, people	Birds, rodents, pigs, people
Dispersal distance (metres)		
Long Distance Dispersal vectors		
Long Distance Dispersal distance (metres)		
Time to Maturity (years or		1 year

months)		
Height at Maturity (metres)	3 to 6 m	2 to 6 m
Seed Viability(years)		3 years at least
Number of seeds/square metre		3,000 seeds per square metre produced annually
Natural Inhibitors to growth		Temperatures below 5 degrees Celsius
Reproduction time (month)		
Length of reproduction		
Origin	Caribbean, Venezuela, Colombia and Northern Ecuador	Central America
Management Options		
website		

Appendix 7: Existing walking tracks on the Maraeti'a plateau



Appendix 8: Guidelines for pig-proof fencing

General guidance

The effectiveness of a pig-proof fence is related to how much is spent. Research has indicated that the most successful pig-proof fences are also the most expensive. The most effective pig-proof fences use fabricated 'Rylock' mesh held close to the ground by a plain or barbed wire and supported on posts.

Electrifying conventional, non pig-proof fences greatly improves their effectiveness, if used before pigs have established a path through the fence. Pigs will often charge an electric fence to get through, and unless the fence incorporates fabricated netting pigs often successfully breach the fence.

Fences need to be constructed before the pigs are a problem. Once pigs have habituated to feeding in a particular area, fencing may be ineffective.

The type of fence constructed along with the shape of the enclosure greatly effects the total cost per metre of fencing. In addition, the shape of the enclosure affects the amount of materials needed and labour required for construction. Every time the fence changes direction (sometimes elevation) straining posts and strain wire will be required.

Erecting strainers and posts

Fencing should be constructed in straight lines and be strained between strainer posts. Strainer posts should be used at each end of the fence and at least every 100m (2 nets), also at all changes of direction and sudden changes of gradient (especially at the bottom of dips/hollows).

Straining posts are to be dug in to a depth of at least 90cm, properly rammed, firmed (using stones where necessary) and strutted in the line of the fence. Two struts per post should be used on changes of direction except on acute corners of under 90 degrees where a single strut bisecting the angle of turn may be used.

The point end of the strut should be housed approximately 7.5-10cm deep into the straining post at a height of 75cm above ground level. The bottom end should be dug into the ground and rest tight on a half stake driven into the ground or a large stone well bedded below ground level.

Intermediate posts are to be driven into the ground to a minimum depth of 55cm at 2.7m intervals, in line with the strainer posts. Additional metal stakes can be driven into the ground between posts to hold the wire close to the ground where pressure from pigs is or is expected to be greatest, and where the surface is uneven.

Erecting wire

The recommended fence should have a minimum of netting supported by three wires. The wires (12 gauge high tensile) should be properly strained and stapled to the outside of the strainers and posts. The wires should align with the top, middle and bottom wires of the netting. An additional wire could be added above the netting if goats are considered to be a threat. This wire should be 12.5cm above the top of the netting. The bottom wire should be no more than 75mm above the ground. Care should be taken to avoid having the netting sit directly on the ground as it will easily corrode and the entire section of mesh will have to be replaced increasing maintenance costs.

Netting should be clipped to the three support wires and stapled to posts with 40mm (1.5") staples. Staples should be placed on the top, 3rd, 5th and bottom wires (counting from the top) of the netting on each post.

Staples must not be driven fully home on the intermediate posts in order to allow future repair and retensioning work. They are to be positioned diagonally to the grain of the wood to prevent splitting.

Preferably the ground along the fence line should be evened out with all humps levelled and gaps filled in with stone or compacted soil to ensure it is stock proof. If necessary an additional line of wire (barb or high tensile) or piece of netting could be added to the bottom of the fence. If the ground is very uneven and cannot be smoothed or pressure from pigs is expected to be great, metal stakes can be placed in between posts to hold the wire close to the ground.

Fencing should **not** be strained or attached to gate posts, trees, shrubs or other structures. Gaps between the end straining posts and other structures should be stock proofed with tanalised fence rails.

Materials

- TIMBER must be round peeled softwood (not spruce) and pressure tanalised to BS 4072, or timber of equivalent quality and durability.
- Straining posts 2m x 120mm top diameter.
- Struts 2m x 100mm top diameter.
- Intermediate posts 1.7m x 65mm top diameter, pointed.
- *Note - longer posts may be needed in soft or uneven ground conditions.*
- Metal stakes (where necessary to place between posts)
- WIRE must comply with BS 4102 and be galvanised to BS 443.
- Line wire: 4mm (12 gauge) plain mild galvanised wire.
- Barbed wire: Two strand 2.5mm (12½ swg) mild steel galvanised 4 point barbed wire.
- Pig netting: C8/80/15 galvanised pig netting.
- Staples: 40mm x 4mm galvanised wire staples.
- Tools needed: planting spade, shovel, axe, brush axe/machete, fencing pliers, claw hammer, pliers (multi-purpose), wood chisel (I inch), netting clipper applicator, fence strainer, crow bar, 50 m tapes, 2 m tape measure, level.

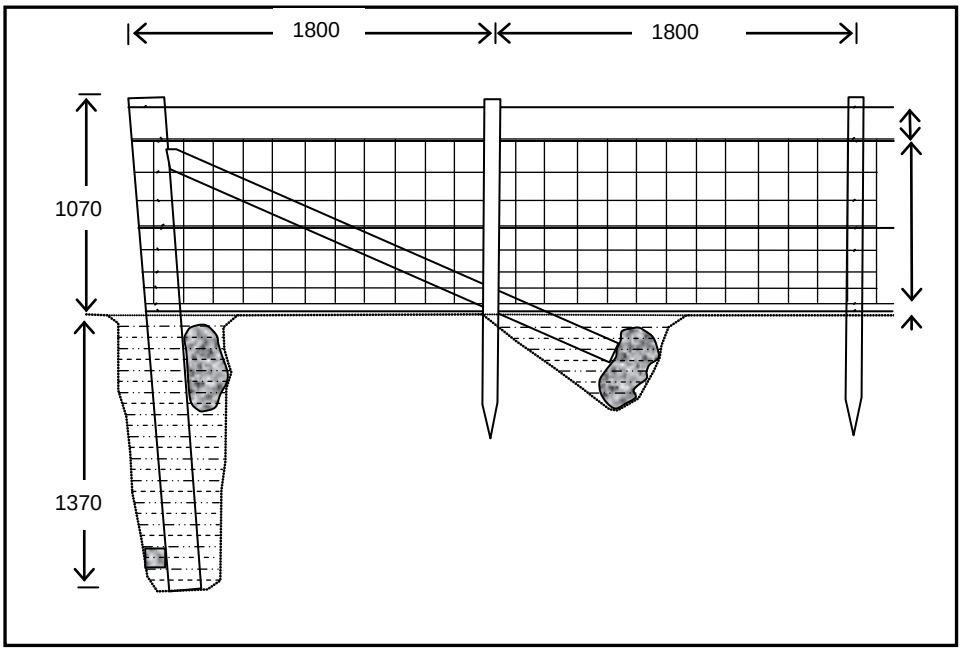
Galvanised wire pig fencing 8/80/15

- 8 strand
- 800mm high
- Uprights 150mm apart
- 2.5mm gauge

http://www.snh.org.uk/publications/on-line/accessguide/fences.asp

Figure X: pig-proof fence. Lengths shown are in millimeters. Variations to the fence shown can include placement of metal standards between posts to hold the mesh and bottom wire close to the

ground, replacement of bottom wire with barb wire, addition of mesh or another wire at the bottom of the fence in hollows and dips



Appendix 9: Rat Control – 1st Generation Anti-Coagulants In Bait Stations

TECHNIQUE

Bait station placement

1. No greater than 100 x 100m apart in forest habitats. *There should be at least one bait station within each rat's home range. Ship rat home ranges vary between 0.6 to 3.2ha for females and 5.6 to 18.9 ha for males[1].*

2. Laid out on grids or, in rough terrain, placed on ridges and spurs with additional lines located on 100 m contours. Spacing should be established as precisely as possible by drafting the network using GIS and downloading location of lines and bait stations onto hand-held GPS that can be used to set-up the infrastructure in the field. Actual placement of all bait stations should be recorded on a GPS as these locations may differ from the original plan created in the office using GIS. *Inaccurate location of lines will cause gaps in coverage where pockets of high rat numbers can persist*. *The GPS location of trap stations can be used to determine gaps in coverage.*

3. A good track infrastructure is important and each bait station should be numbered for ease of relocation and data collection. *Reduces the risk of missing bait stations during checking and allows data collected to be related to individual bait station sites.*

4. Bait stations should be attached to the dry side of trees with the opening 25 -30 cm above the ground. *25-30 cm optimises bait station use by rats and avoids rain and water splashing off the ground affecting bait quality.*

Effective use of 1st generation anticoagulants

5. Baiting must be continuous over at least five days and bait stations must not be allowed to become empty during this period to ensure rats ingest sufficient toxin to kill them. An excess of bait needs to be placed in the bait stations and once rats start feeding on the bait, the bait stations must be regularly refilled to ensure they are never empty. *First generation anticoagulants are a multiple feed toxin. Rats must feed on the toxin for at least 5 consecutive days to ensure they receive a lethal dose. Overseas, rodents have become resistant to first generation anticoagulants after poor baiting strategies.*

6. Assuming rat numbers are high during the initial control; bait consumption will be high and gradually reduce as rat numbers decline.

EQUIPMENT

Bait stations

7. Key elements are: allow rats easy access, limits access by non-targets, protects bait from the elements, limits bait spillage, doesn't get blockages, holds up to 1.5 kg of bait, easy to fill (and transport when establishing the network), be durable and designed for easy attachment. The Philproof rodent bait station is recommended (http://www.philproof.co.nz/baitstation.htm).

Bait

8. Only freshly manufactured bait should be used. Bait that has previously been in the field must not be reused.

   This ensures high bait palatability, which has a direct influence on success. Old baits are likely to have mould growth and be less palatable.

9. If there is any doubt about bait suitability, palatability trials and/or quality control checks (toxin concentration, mould spores, and bait hardness) should be undertaken prior to operation.

SKILLS REQUIRED

10. A consistently high standard of field work is essential.

11. Operators need:

    - sound bush navigational skills involving compass, map reading, GPS and data recording.

SUSTAINING RAT CONTROL OVER THE LONG TERM

12. Build into costing provision for replacement of lost/damaged bait stations and track maintenance.

13. Careful recording of the amount of toxin used and retrieved can allow better estimates of future needs.

REFERENCES

[1] Perry, M.; Byrom, A.; Anderson, D.; Pech, R.; Warburton, B.; and Wilson, D. 2009. Home ranges and movements of ship rats. *Kararehe Kino*(15):9-11.

[2] Gillies, C. A. 2002. *Managing rodents on the New Zealand mainland-what options are currently available? Summary of a workshop session at the Department of Conservation 'mainland island' hui, Omapere, 20-23 August 2001.* DOC Science Internal Series 47, Department of Conservation, Wellington, New Zealand.

Appendix 10: Kill trapping for rat control

TECHNIQUE

Trap station layout

1. Spacing no greater than 100x50m apart with perimeter traps 25m apart. In high density rat areas, the internal spacing of traps should be 100x25m.

   There should be at least one trap station within each rat's home range. Ship rat home ranges vary between 0.6 to 3.2ha for females and 5.6 to 18.9 ha for males[1].

2. Laid out on grids or, in rough terrain, placed on ridges and spurs with additional lines located on 100 m contours. Spacing should be established as precisely as possible by drafting the network using GIS and downloading location of lines and trap stations onto hand-held GPS that can be used to set-up the infrastructure in the field. Actual placement of all trap stations should be recorded on a GPS as these locations may differ from the original plan created in the office using GIS.

   Inaccurate location of lines will cause gaps in coverage where pockets of high rat numbers can persist. *The GPS location of trap stations can be used to determine gaps in coverage.*

3. A good track infrastructure is important and each trap station numbered for ease of relocation and data collection.

   Reduces the risk of missing a trap during checking and allows capture data to be related to each trap site.

Effective use of traps

4. Initially traps should be checked daily. Once knockdown is achieved, as indicated by low catch rate and verified by tracking tunnel data (usually between 10 to 20 checks), traps only need to be checked once every 2-3 weeks. When rat numbers increase, trap checking frequency also needs to increase.

   Traps need to be cleared regularly - frequency is dependent on site factors (e.g. area under protection and productivity) and the density of rodents present.

5. Record data collected during trapping checks on a copy of the National Predator Trap Catch Spreadsheet (this can be provided on request).

   Ensures adequate and nationally consistent data is collected during trapping operations.

EQUIPMENT

Trap type

6. Key elements are: catch effectively, kill humanely, easy to use and maintain, lightweight, portable and cheap.

   - Victor professional snapback is recommended.
     This trap has passed the National Animal Welfare Advisory Committee (NAWAC) kill trap guidelines (on Norway rats)[2].

- DOC 200 & 150 have also passed the NAWAC guidelines[2] and are suitable where mustelids are also being targeted.

Maintenance of traps

New Traps

7. Standard Victor professional snapback traps should be treated with a preserving agent (e.g. paint or fence stain/oil) as the wooden base is not treated.

   This will lengthen the life of the trap.

Traps in Use

8. A formalised maintenance regime is important. Regular maintenance is essential, including checking for worn pivots, weakened springs & broken trigger mechanisms.

9. Should be cleaned regularly with a wire brush.

   Removes mould, fur and bits of dead animals and allows for identifying what has escaped from an empty sprung trap.

10. When checking Victor snapback traps carry spare traps, treadles and pegs.

    Treadles may be lost when the traps are sprung.

Tunnel/Cover

11. Kill traps must be set in a tunnel or under a cover. The tunnel has three functions: i) orientate the animal relative to the trap, ii) disguise and protect the trap and iii) keep out non-target species[3]. Specifications for tunnel/cover designs that meet these requirements are attached below.

Bait and lures

12. Key elements are high palatability, field life aligned with the frequency of field checking, doesn't attract non-targets, easy to use and cheap. Suitable baits include peanut butter, peanut butter mixed with rolled oats, white chocolate and Ferafeed™.
    Peanut butter lasts 5-7 days in Te Urewera, peanut butter/rolled oats mix lasts up to 14 days at Rotoiti Mainland Island and white chocolate lasts up to 5 weeks in Te Urewera.

13. Baits/lures may need to be alternated over the duration of control programmes.

SKILLS REQUIRED

14. A consistently high standard of field work is essential.

15. Specific on job training of trappers in the use of rat traps and tunnel/covers is recommended.

16. Trappers need:

    - Excellent skills in the use of traps and data recording. Training courses are available through the Department of Conservation.

    - Sound bush navigational skills involving compass, map reading and GPS.

REFERENCES

[1] Perry, M.; Byrom, A.; Anderson, D.; Pech, R.; Warburton, B.; and Wilson, D. 2009. Home ranges and movements of ship rats. *Kararehe Kino*(15):9-11.

[2] MAFBNZ. 2010. *How humane are our pest control tools?* Technical paper 09-11326, MAFBNZ, Wellington, NZ.

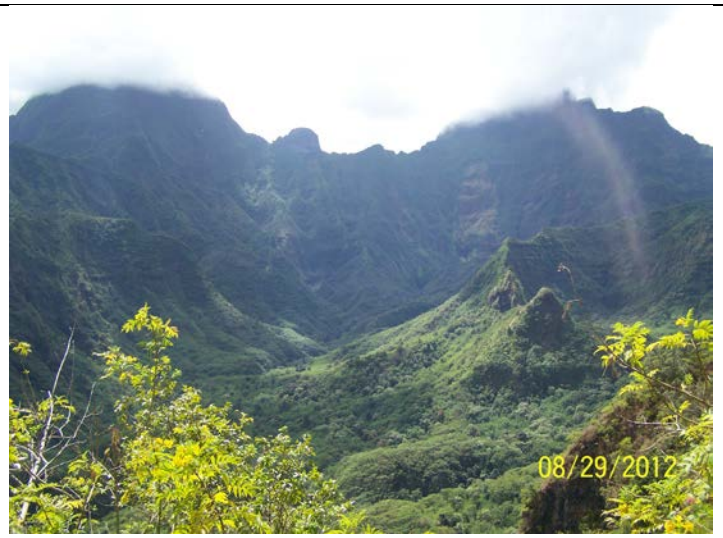
[3] King, C. M.; O'Donnell, C. F. J.; and Phillipson, S. M. 1994. *Monitoring and Control of mustelids on conservation lands. Part 2: Field and workshop guide*. DOC Technical Series 4, Department of Conservation, Wellington.

Appendix 11: Photographs from Tahiti

Members of "Te rau ati ati a tau e a hiti noa tu", the "Association pour la protection de la vallee de Punaruu" and visiting experts before setting out for the Maraeti'a plateau in the upper Punaruu valley, Tahiti, French Polynesia (Photo: Jean-Yves Meyer).

Eastern end of the Punaruu valley industrial zone

One of the shelters at the Anani refuge



Upper Punaruu valley

Wild pig trapped from the upper Punaruu valley

Tecoma stans, Passiflora maliformis and *Lantana camara* near the edge of the Maraeti'a plateau

A typical tangle of *Tecoma stans* on the Maraeti'a plateau

Miconia calvescens reportedly grazed by wild pigs (Jean-Yves Meyer, Rava Taputuarai, Michel Ebb personal comment)

"Rasta" climbing a citrus tree on the Maraeti'a plateau. Fruit visible at mid-right.

Wild pig tusk damage to a small *Pouteria tahitensis* tree

The endangered forest species *Ochrosia tahitensis* growing on the Maraeti'a plateau

A *Pouteria tahitensis* seedling on the Maraeti'a plateau

Appendix 12: Biosecurity Checklist

Biosecurity Tasks	Completed?	
Have I given clear verbal biosecurity instructions to **all** trip members?	Yes	No
Have I checked they have understood these instructions?	Yes	No
Have any printed instructions been distributed to team members?	Yes	No
Are all supplies (food and equipment) packed in plastic air-tight and insect-proof containers?	Yes	No
List gear too bulky/awkward to fit into containers here: **(Check these items immediately prior to departure!)** • Gear 1 • Gear 2 • Gear 3 • Etc. *Add more as necessary* (Suggestion: treat equipment with insect spray and leave overnight to kill ants and any other invertebrates that could be hiding in gear)	 Yes Yes Yes	 No No No
Has everything been stored in an equipment room in sealed containers? If not, has it been re-checked immediately prior to departure? (Remember 'extras' like boats, radios, day-bags, last-minute items, etc).	Yes Yes	No No
Check with every member of trip: • All food packed in sealed bags? • All fresh food items checked for presence of ants, snails and other invertebrates? • Boots and other footwear clean and free of soil/seeds? • Packs kept in invasive-free areas or checked and re-packed since? • Packs, pockets, Velcro fasteners, socks, etc., clean of seeds? • Has anyone in party worked in area of known invasives infestation recently?	 Yes Yes Yes Yes Yes Yes	 No No No No No No
IF THE ANSWER TO *ANY* OF THE ABOVE IS "*NO*" – THEN FURTHER ACTION IS REQUIRED!		
What are the added risks on this trip? • Are any items being stored in areas that are not rodent- or insect-proof? • Are we taking fresh food which may contain ants, insects, soil etc.? • Are we leaving/ travelling at night? • Are there planned stops enroute where invasives could enter or exit? • Do we have bulky or non-invasive proof packages • Is the boat/vehicle we are travelling on invasive-free?	 Yes Yes Yes Yes Yes Yes	 No No No No No No
IF THE ANSWER TO *ANY* OF THE ABOVE IS "*YES*" – BE AWARE YOUR TRIP HAS EXTRA RISKS!		
Have I addressed these concerns by identifying 'on-the-spot' solutions? (How do I deal with the added risk to minimise potential risk to the site?).	Yes	No
IF YOUR ANSWER TO THIS IS "*NO*", THEN YOUR TRIP SHOULD NOT PROCEED UNTIL YOU HAVE		

Biosecurity Tasks	Completed?	
ADDRESSED THESE ISSUES!		
When travelling between sites where known invasives exist, or where invasive species management projects are underway: Are you travelling from the site with the least number of invasive species to the site with the most? If not, are you able to change the order of the visits so that the worst site is visited last?	 Yes Yes	 No No
1. Before leaving a site • Check that all personnel are free of the invasives at the site • Check that all equipment is free of the invasives at the site • Check that all vehicles/boats are free of the invasives at the site	 Yes Yes Yes	 No No No
2. In transit to the next site: If any sign of an invasive is detected while enroute to the new destination, **STOP**! Do not continue to any other site until the problem has been identified and remedial actions implemented. (NOTE: throwing an invasive out the window of a vehicle or overboard from a boat is not good practice. You do not know where it may end up).		
3. On Arrival at Destination: • Have I inspected all containers for rodent, ant or other invasive entry or damage which could allow such? • Has everything been unpacked or opened up and carefully inspected in an open area? • Have I instructed everyone on rules for disposal of organic and other rubbish? • If planning to go to another site from here, have I considered and established how to apply quarantine procedures before we leave? • If on a daytrip only, have I ensured only day-bags are being taken, and that they have been checked, cleaned and packed only on the day of departure?	Yes Yes Yes Yes Yes	No No No No No

IF YOU HAVEN'T DONE THESE TASKS, WHY NOT?! PLEASE DO IT!

It is not possible to totally eliminate the risk of accidental introduction of invasive species - short of prohibiting all trips to the site.
However risks can be minimised. Any non-compliance with the checklist above means that you are putting the flora and fauna of the site at an unnecessarily increased level of risk.

Please do your bit to help preserve the conservation values of the site.

Appendix 13: Predator Traps DOC series trapping systems

PREDATOR TRAPS
Doc series trapping systems

Current Best Practice Rat Kill Trapping

Department of Conservation
Te Papa Atawbai

These Department of Conservation 'current best practice' tunnel designs, must be used with Victor Professional traps.
These tunnels are designed to exclude non target species, guide target species and provide public safety.

Victor Professional rat traps set in a timber or corflute tunnel have passed NAWAC (National Animal Welfare Advisory Committee) standards as humane kill traps for rats. These setting instructions must be followed to meet these standards.

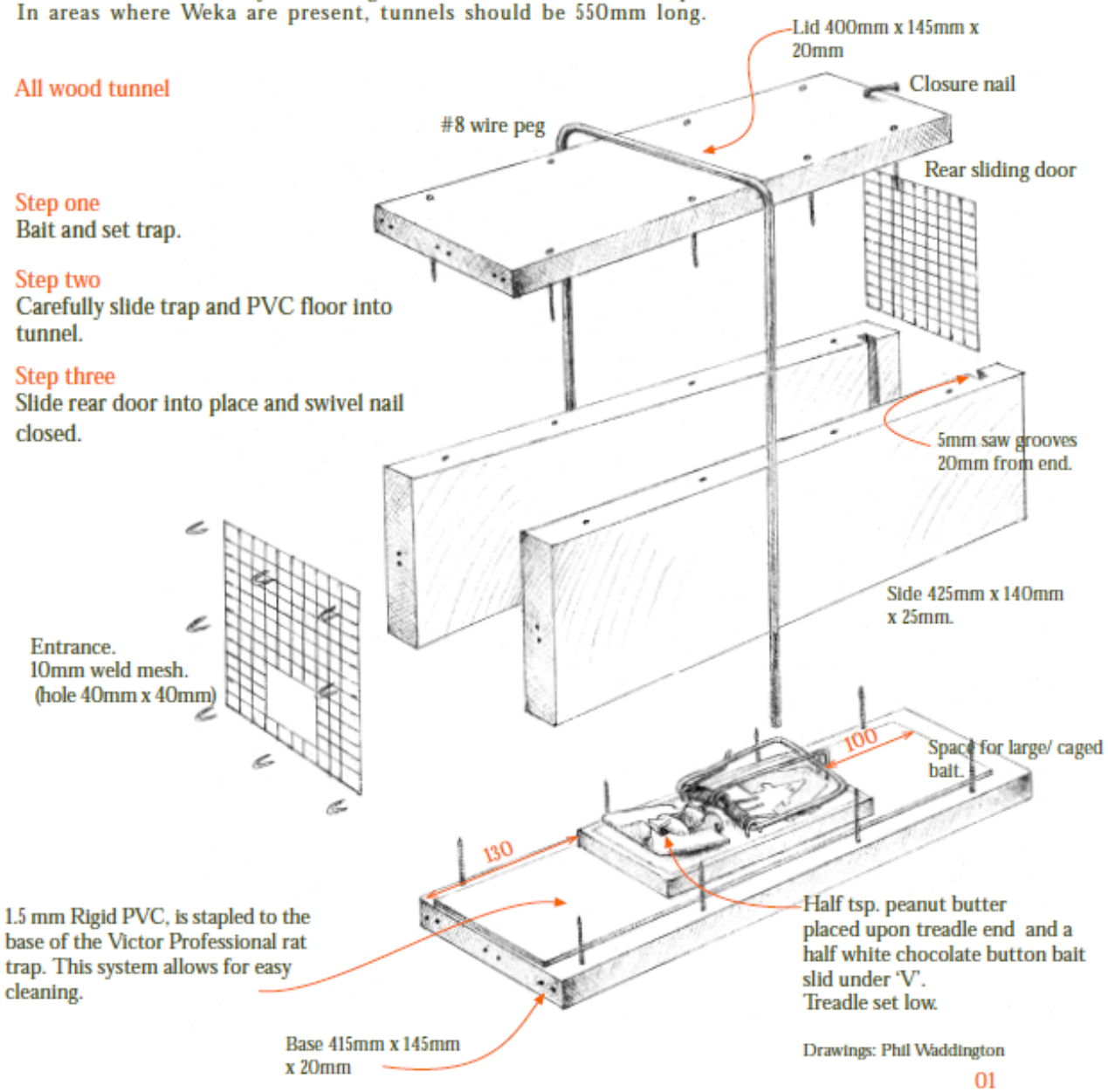
Outlined below are two systems using the Victor Professional Rat traps.
In areas where Weka are present, tunnels should be 550mm long.

All wood tunnel

Step one
Bait and set trap.

Step two
Carefully slide trap and PVC floor into tunnel.

Step three
Slide rear door into place and swivel nail closed.



Drawings: Phil Waddington

01

Pacific INVASIVES INITIATIVE

PREDATOR TRAPS
Doc series trapping systems

Current Best Practice
Rat Kill Trapping

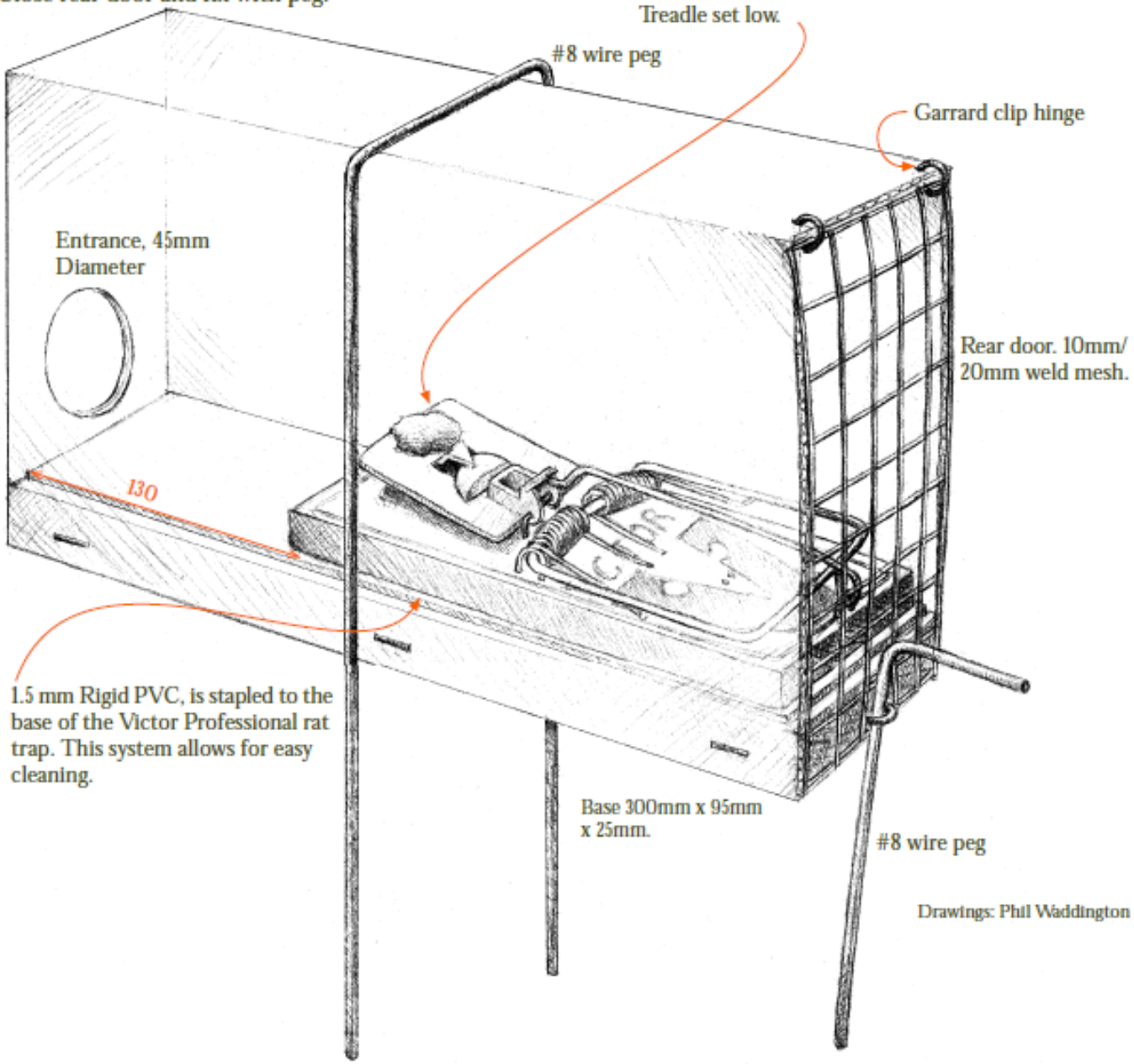
Department of Conservation
Te Papa Atawbai

Coreflute tunnel with wood floor

Step one
Bait and set trap.

Step two
Carefully slide trap and PVC floor into tunnel.

Step three
Close rear door and fix with peg.



Drawings: Phil Waddington

02

Pacific INVASIVES INITIATIVE

PREDATOR TRAPS
Doc series trapping systems

Department of Conservation
Te Papa Atawbai

Trap Purchase/ Information

Trap Purchase

Victor Professional rat traps are available in New Zealand from:

MS Woodcraft Ltd.
128 Marine Pde Mt Maunganui,
Tauranga
T| 07 575 5920 F| 07 574 8910

Pest Management Services
T| 0800 111 nopest F| 04 293 1456
E| general@nopest.co.nz
A| P.O. Box 121 Waikanae.
Kapiti 6454, N.Z

Wood Tunnel Purchase

Wood tunnels can be purchased from:

Haines Pallet Co. Ltd.
T| 04 568 6898 F| 04 5686480
E| haines.pallets@paradise.net.nz
A| 111 Hutt Park Road, Seaview.

Coreflute Tunnel Purchase

Corflute trap tunnels can be purchased from:
Wood base not provided.

Clearview Packaging Ltd.
T| 04 5890797 F| 04 589 0930
E| cartons@clearviewpkg.co.nz
A| 2 Victoria Street, Alicetown
Lower Hutt.
P.O. Box 38011
Wellington Mail Centre.

Advice and contacts

Predator control advice, trap development contacts and feedback.

Alastair Fairweather
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Animal and Plant Pests
Research Development & Improvement
T| 07 8580013 F| 07 858 0001
E| afairweather@doc.govt.nz
A| 1st Floor
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65 Victoria Street
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