REPORT ON AN AVIFAUNA SURVEY OF ATOLLS IN THE TUAMOTU AND AUSTRAL ARCHIPELAGOS, FRENCH POLYNESIA

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EXECUTIVE SUMMARY

An avifauna survey was carried out in March-April 2003 of ten atolls in the Tuamotu and Austral Archipelagos, in French Polynesia. The primary objectives were to survey for populations of the endangered titi (Tuamotu sandpiper) and critically endangered tutururu (Polynesian ground-dove) that were formerly widespread in the Tuamotu Archipelago. Secondary objectives were to survey for other key avifauna species (e.g. atoll fruit dove, seabirds, and bristle-thighed curlew) and to determine the status of rats and other predators on the atolls.

Key findings were the discovery of a "new" population of tutururu on Morane; discovery of "new" populations of titi on Reitoru and Tahanea and clarification of the status of the titi population on Morane; a population of atoll fruit doves on Tahanea; confirmation of the numbers (range 11-54 per atoll) of bristle-thighed curlews on most atolls; and the recording of significant seabird colonies on Morane, Reitoru, Tekokota, Tahanea, Fakarava, and Maria (Australs). Morane was the only atoll confirmed to be free of mammalian pests and Tekokota and some isolated motu of Tahanea and Fakarava also appeared to be mammal free.

We recommend several opportunities for improved conservation management. The most important is to formally recognize the conservation values of Morane and protect it as a reserve. It is also very important is to raise the general awareness of biodiversity values on islands and the need for effective biosecurity measures. Other opportunities for improved biodiversity protection include rat eradication from Reitoru, Maria (Australs) and on some motu at Tahanea and Fakarava, plus rat and cat eradication in the Actéon Group. Some of the smaller atolls, which currently have no rare bird species present, might be cleared of pests to provide opportunities for future translocations of rare species. Surveys are also required of some atolls not covered by this expedition.

RESUMÉ (FRANCAISE)

En mars et avril 2003, 10 atolls des archipels des Tuamotu et des Australes ont été visités pour faire l'expertise de l'état de leur faune aviaire. L'objectif principal était d'enquêter sur la situation du Titi (bécasseau polynésien), oiseau en danger d'extinction, et de la Tutururu (gallicolombe de la Société) espèce en danger critique d'extinction, qui étaient autrefois répandus dans tous les Tuamotu. Les objectifs secondaires consistaient en un recensement d'autres espèces clés (comme le ptilope des Tuamotu, les oiseaux de mer et le courlis d'Alaska) et dans la détermination de l'état des atolls quant à la présence de rats et d'autres prédateurs.

Les résultats les plus importants ont été la découverte de trois populations de Titi sur les atolls de Morane, Reitoru et Tahanea, d'une population de Tutururu sur Morane, d'une population de ptilopes des Tuamotu sur Tahanea, d'un nombre conséquent (11-54) de courlis d'Alaska sur la plupart des atolls et de colonies d'oiseaux de mer en nombre important sur Morane, Reitoru, Tekokota, Tahanea, Fakarava et Maria (Australes). Morane est le seul atoll sur lequel l'absence de mammifères prédateurs a été confirmée ; Tekokota, Maria et quelques motu isolés de Tahanea et Fakarava paraissent aussi exempts de mammifères.

Plusieurs options pour une protection efficace de cette avifaune spécifique sont apparues dont l'une est de faire reconnaître la valeur patrimoniale très élevée de Morane et de protéger cette île au besoin au travers du statut de réserve, mais aussi de faire prendre conscience de la valeur de ces îles pour la biodiversité et de la nécessité de mettre en place des programmes efficaces de sécurisation vis-à-vis du risque d'invasion par les espèces de prédateurs exogènes. Les autres possibilités d'action de conservation concernent l'éradication des rats de Reitoru et des motu isolés de Tahanea et Fakarava, ainsi que celle des rats et des chats des îles du groupe Actéon. D'autres enquêtes ciblées sont également hautement souhaitables.

1. INTRODUCTION

The Tuamotu and Austral Archipelagos are a hotspot for eastern Polynesia biodiversity, supporting a number of endemic bird species, most of them threatened. Two species, the titi or Tuamotu sandpiper (*Prosobonia cancellata*) and the tutururu or Polynesian ground-dove (*Gallicolumba erythroptera*), are ranked as Endangered and Critically Endangered respectively. Prior to our surveys, these species were known to be present in moderate to high numbers only at Tenararo in the Actéon Group of the Tuamotus (BirdLife International 2000). Considering that the Actéon Group is the focus of copra harvest and has populations of kiore (Pacific rat; *Rattus exulans*), ship rats (*R. rattus*), and cats (*Felis catus*) (Blanvillain *et al*. 2002), these populations are exposed to significant danger.

One of the problems underpinning conservation planning for threatened species in eastern Polynesia is the lack of up-to-date survey data. Data on birds are completely lacking for some atolls and others have not been surveyed since the 1920s (Pierce & Blanvillain unpub. data, P. Raust, pers. comm.). It is possible, therefore, that additional viable populations of titi and tutururu might be present on other atolls. With these considerations in mind, surveys of nine mostly uninhabited atolls were undertaken in the Tuamotu Archipelago in March 2003 and one atoll in the Australs in April 2003. Specific project objectives were:

1. To undertake a field survey for additional populations of the Endangered titi and the Critically Endangered tutururu.

2. To survey for populations of other threatened or sensitive species including masked boobies (*Sula dactylatra*), brown boobies (*S. leucogaster*), red-tailed tropicbirds (*Phaethon rubricauda*), bristle-thighed curlew (*Numenius tahitiensis*), and atoll fruit dove (*Ptilinopus coralensis*).

3. To undertake general surveys for other migrant and sedentary bird species.

4. To survey all atolls for mammalian pests.

5. To provide recommendations to French Polynesian authorities and Société d'Ornithologie de Polynésie for the management of threatened bird species in the Tuamotu-Austral Archipelagos.

2. SURVEY METHODS

2.1 Selection of atolls for survey

Atolls were selected for survey on the basis of historic records of tutururu and titi, and on the likely occurrence of these species (Seitre 1990, Blanvillain *et al.* 2002; Pierce & Blanvillain unpub. data; P Raust, pers. obs.) (refer to Figure 1).

Figure 1

2.2 Birds

Each atoll had a characteristic central deep lagoon with several vegetated motu around its periphery, separated mainly by dry passes. The vegetated motu were the focus of our bird surveys, but we also surveyed intermediate oa or passes. Observers traversed semi-parallel transect lines along the lengths of each motu, with each surveying a pre-determined habitat feature, e.g. outer reef/beach, outer vegetation edge, forest interior, inner edge, or lagoon edge. The number of observers covering the forest interior varied according to width of the motu and habitat type. We always placed observers in the habitat immediately inside the vegetated margins (outer and inner edge), this being a preferred habitat of the tutururu, and to a lesser extent the titi.

Observers attempted to maintain contact with each other to co-ordinate counting, thereby minimising the chances of duplicate counts or of missing key areas. Because tutururu and titi were the main target species, key areas were identified as those containing abundant foods (e.g. fruiting *Laportea* for tutururu) or suitable habitat (e.g. open mixed shrubland areas for titi).

By doing replicate counts and more intensive follow-up counts on three motu, we found that our survey method under-estimated most species, including titi, tutururu, and nests of red-tailed tropicbird (*Phaethon rubricauda*). The method probably over-estimated bristle-thighed curlew numbers because of their tendency to circle around the atolls as counts were conducted.. Other conspicuous species, e.g. brown boobies and masked boobies, and reef herons (*Egretta sacra*), were assessed more accurately using this method.

On one part of Ahunui and on Paraoa we attempted a variation of this survey method by having teams of 3-4 observers walk the outer sections of a motu before returning to the start point via the inner sections of the same motu. This method, whilst suitable for detecting titi and tutururu, almost certainly over-estimated numbers of bristle-thighed curlews.

2.3 Mammals

Rodents were assessed by direct observation during the day or night, by trapping, and by using lures of orange- and/or coconut-coated wax gnaw sticks and coconut-coated wax candle pieces attached to trees 0.1 to 1.5 m above the ground. We used direct observations to confirm that rodents were present, and trapping to identify the species present. No trapping was undertaken on Morane because titi were quick to investigate artificial lures, suggesting that several would have been trapped. One Tuamotu reed warbler (*Acrocephalus atyphus*) was seen approaching a set trap on a coconut frond at Haraiki and was scared away from the site. The only non-target species trapped on any atolls were hermit crabs (*Coenobites* spp.) and butcher crabs (*Cardiosoma* spp.).

We surveyed cats by sight and by checking for footprints in sand. We did not have enough time to assess whether cats were present on many of the atolls we visited.

We took particular care not to transport rodents and other pests to or between atolls. We removed seeds and insects from clothing and stores en route from Mangareva to Morane.

3. RESULTS

3.1 Atolls surveyed

Five atolls – Morane, Reitoru, Haraiki, Tekokota, and Maria (Australs) - were surveyed completely, with all vegetated motu visited by biologists. All other atolls were sampled in part only; mostly we surveyed the smaller, isolated motu that were likely to be mammal free, and only portions of the larger motu.

Table 1: Atolls surveyed for avifauna, Tuamotu and Austral Archipelagos, March-April 2003

Atoll	Dates (2003)	Approx. area (ha)	Atoll length surveyed	Motu surveyed	No. of surveyors
Morane	8-10 March	200	100%	100%	9
Ahunui	12-14 March	300	35%	80%	9
Paraoa	15 March	300	25%	80%	9
Manuhangi	15 March	300	35%	80%	9
Reitoru	16-18 March	200	100%	100%	9
Haraiki	19-21 March	400	95%	100%	4
Tekokota	19 March	50	100%	100%	5
Tahanea	22-24 March	1000+	80%	90%	6
Fakarava	25-26 March	1000+	20%	40%	6
Maria (Australs)	11-12 April	200	50%	100%	4

Note: "Atoll length surveyed" is the percent of total length surveyed, including oa. "Motu surveyed" is the percent coverage of vegetated motu.

3.2 Vegetation and habitats

Morane, Ahunui, Paraoa, and Manuhangi had little or no obvious water flow between their lagoons and the sea. Haraiki, Reitoru, Tekokota, and especially Tahanea and Fakarava, however, had wide passages, some navigable by ships. Atypically, Tahanea and Fakarava had small vegetated motu in the central lagoon.

The vegetation on the atolls had a relatively simple composition, with the dominant species being *Pemphis acidula, Tournefortia argentea, Scaevola taccada, Guettarda speciosa,* and *Pandanus tectorius*. On Morane, the outer edges and ends of the motu were characterised by scattered and sometimes dense areas of *Pemphis*, succeeded by scattered *Tournefortia*, with *Scaevola* marking the transition to dense vegetation cover. Most heavily vegetated areas on Morane were dominated by *Tournefortia, Pandanaus,* and *Guettarda*, with ground cover comprising *Scaevola, Boerhavia tetrandra, Cassytha filiformis,* and *Laportea. Cocos nucifera* was relatively scarce on Morane, comprising *c*.30 mature trees in clusters and many juveniles. The vegetation

on large parts of the largest motu on Morane consisted entirely, or almost entirely, of *Pandanus*, with leaves completely covering the forest floor – titi and tutururu were not recorded in these areas. On most other atolls *Cocos* was common, and included plantations on several motu at most atolls visited, with varying levels of vegetation clearance. A list of vascular plants recorded at each atoll is presented in Appendix 1.

Morane was uninhabited and no evidence was found of recent human visits. Parts of Ahunui, Paraoa, Reitoru, Haraiki, and Tahanea had coconut plantations and varying numbers of seasonally occupied dwellings. The main motu on Manuhangi (not surveyed) appeared to have a coconut plantation. Tekokota had been visited apparently for the harvesting of seabird eggs. Fakarava has a town on the main motu and much evidence of periodic use elsewhere, including dwellings on many smaller motu. Tahanea, nominally an uninhabited wildlife reserve, had very recent evidence of occupation in the main village.

3.3 Bird species

Thirty-one species were recorded during surveys ashore, including four species on and around Mangareva, our start point (refer to Table 1). Key findings were:

- Three populations of the endangered titi or Tuamotu sandpiper on Morane, Reitoru, and Tahanea.
- A population of the critically endangered tutururu or Polynesian ground dove on Morane.
- Populations of the Tuamotu reed warbler on Ahunui, Paraoa, Manuhangi, Reitoru, Haraiki, and Tahanea.
- A population of the rare atoll fruit dove on Tahanea.
- A perhaps globally significant nesting colony of lesser frigatebirds (c.1000 nests) on Reitoru and a smaller colony on Tahanea (c.200 nests).
- Colonies of other seabirds at Morane, Reitoru, Tekokota, Tahanea, Fakarava, and Maria (Australs).
- Moderate numbers (11-54) of the vulnerable bristle-thighed curlew on all the atolls surveyed.

Table 2: Birds (species and numbers) recorded on survey transects on atolls in the Tuamotu and Austral Archipelagos, March-April 2003

Note: Includes some rare species not seen on transects; underlining denotes evidence of breeding; Gambier Islands counts include observations of birds from the ground on Mangareva and from a boat of Manui, Kamaka, Makaroa, and Motu Teiku . Pelagic seabird observations are not included.

SPECIES	LOCATION											
	Gambier Is	**Morane**	**Ahunui**	**Paraoa**	**Manu-hangi**	**Reitoru**	**Teko-kota**	**Haraiki**	**Tahanea**	**Fakarava**	**Maria (Australs)**	**Total**
Tahiti petrel	20+											**20+**
Murphy's petrel						3+						**3+**
Kermadec petrel	2	25										**27**
Juan Fernandez petrel									1			**1**
Red-tailed tropic bird		33+	13	18		78+	1				442	**575**
White-tailed tropic bird	20+											**20+**
Masked booby		190	1		2	2	2		3		7	**207**
Brown booby	c.20		1		2		3		55	146+	88	**313+**
Red-footed booby		316	313	72	99	612	406	3	175+	143+	397	**2536+**
Lesser frigatebird		3	1	1		1,200+		5	310+			**1520+**
Greater frigatebird	20+	173	9	40+	5	810	12		60+	135	220	**1484+**
Reef heron	5	17	9	17	11	23	11	25	42	3	7	**170**
Spotless crake									1			**1**
Pacific golden plover	3	1		1	2	5	4	38	9	1	3	**67**
Bristle-thighed curlew		22	34	54	28	42	13	31	53	11	41	**309**

SPECIES	LOCATION											
	Gambier Is	**Morane**	**Ahunui**	**Paraoa**	**Manu-hangi**	**Reitoru**	**Teko-kota**	**Haraiki**	**Tahanea**	**Fakarava**	**Maria (Australs)**	**Total**
Wandering tattler	*c.*40	47	32	12	18	30	55	44	47	14	5	**344**
Tuamotu sandpiper		530				57			185	1		**773**
Sanderling											1	**1**
Crested tern	3+	11	42	24	5	27		7	84	15		**198**
Sooty tern		3	2		2		754	2			2	**765**
Grey-backed tern	2							2	2+	5+		**11+**
Black noddy	20+	26+	288	88	23	44	11	100	540	141+	31	**1312+**
Brown noddy	150+	900	837	233	19	660	1,068	333	860	91	72	**5133+**
Blue-grey noddy	8											**8**
Common white tern	600+	1,260	260	494	193	1,184	505	100	560	289	265	**5710+**
Laughing gull	1											**1**
Polynesian gr'd dove		10+										**10+**
Atoll fruit dove			1						11			**12**
Rock dove	12											**12**
Long-tailed cuckoo	*c.*10	1				1			1	2		**c.15**
Tuamotu reed warbler			22	46	12	40		43	55			**218**

Titi (Tuamotu sandpiper)

We found three populations of titi, including over 500 birds on Morane, about 200 on Tahanea, and approximately 60 on Reitoru. A single bird (apparently juvenile) was seen on a small motu in western Fakarava. The Morane population appears very healthy, with birds present on all vegetated motu. Highest densities on Morane (up to 50/ha) were present on small motu of open *Pandanus, Guettarda,* and *Tournefortia,* with extensive *Scaevola* and large areas of open coral sand and pebbles.

The Tahanea population was centred on rat-free motu on the western side of the lagoon, with small numbers of birds also present on some kiore (*Rattus exulans*)-infested motu. None were found on the larger motu of Tahanea, which had kiore present, and it is possible that other rat species and/or cats were also present. The highest densities of titi were found on one motu with scattered trees (including a few *Cocos nucifera*) and extensive *Scaevola*, grass and open sandy areas, including a periodically used human dwelling.

The Reitoru population was small (*c.*60) and scattered diffusely throughout the atoll. Highest densities occurred on small motu with open shrubland and coral sand and pebble areas. None were seen in areas with a dense canopy of vegetation, or in two areas with coconut plantations. Kiore were present throughout the atoll, including on all small motu surveyed, except possibly for one small motu in the north-western corner of the atoll, which had no titi during our survey.

Titi were breeding successfully on all three atolls, with several juveniles (fresh plumage, full-complement of flight feathers, pale legs) being present. One recently broken eggshell was found at Tahanea and single well-grown chicks were observed at Morane and Tahanea. Adults were in wing moult at all three locations, but were fully capable of flight.

Tutururu (Polynesian ground dove)

We saw at least 10 individual tutururu during 48 hours spent ashore at Morane; 6 individuals during the transect survey on 9 March, and a further 4 on 10 March. These 10 birds comprised five adult males, four adult females and a juvenile male, distributed on the largest northern motu (5+) and on two of the small western motu (one pair on one motu and three members of a family group, including a juvenile male, on a second motu). We found at least 7 of the 10 birds in areas of *Laportea* sp. beneath open canopy of *Pandanus tectorius, Guettarda speciosa,* and *Tournefortia argentea,* where they were feeding on the sticky seed heads of *Laportea*.

Atoll fruit dove

We recorded 11 atoll fruit doves at Tahanea, with all but two on several small motu on the central western side of the atoll. A single bird was seen on the main motu at Ahunui. All were found on well-vegetated motu dominated by *Guettarda, Pandanus, Tournefortia,* and *Scaevola,*

Nesting colonies of seabirds

Several colonies of seabirds were located, comprising 190 masked boobies at Morane; 146+ and 55 brown boobies at Morane and Tahanea respectively; large numbers of greater (*Fregata minor*) and lesser frigatebirds (*F. ariel*) at Reitoru and Tahanea, and smaller numbers of greater frigatebirds elsewhere (Table 2); red-tailed tropic birds nesting on five atolls (Table 2) including 442+ at Maria in the Austral Group; moderate numbers of Kermadec petrels (*Pterodroma neglecta*) prospecting at Morane. In addition, large numbers of black noddies (*Anous minutus*) and brown noddies (*A. stolidus*) and common white terns (*Gygis alba*) were breeding on most atolls. A substantial colony of sooty terns (*Sterna fuscata*) was present at Tekokota (Table 2).

Other birds

Migrant species from the arctic included bristle-thighed curlews and wandering tattlers, which were present on all atolls surveyed, and Pacific golden-plover (*Pluvialis fulva*) that were most frequent at Haraiki (Table 2). Crested terns (*Sterna bergii*) were present throughout, with juveniles being common. Adult and juvenile grey-backed terns (*S. lunata*) were observed in small numbers at three atolls with large passes (Reitoru, Tahanea, and Fakarava), and they were frequently seen fishing over the lagoon near the passes.

Low numbers (1-2) long-tailed cuckoos (*Eudynamis taitensis*) were seen on several atolls, including pale-bellied juveniles (Table 2).

Tuamotu reed warblers were present on at least six of the atolls surveyed (Table 2). They were common in natural vegetation and in coconut plantations, the latter with varying undergrowth, including open grassy areas.

3.4 Mammals

Extensive placement of rat lures and ground observations failed to detect any rodents or other mammalian predators on Morane. Similarly, no sign of mammals was found on Tekokota, although only two hours were spent ashore by five observers in late afternoon.

Kiore were present on parts of all other atolls surveyed (refer to Table 3), with extremely high densities in some coconut plantations. In a coconut plantation on Ahunui, 20 standard snap-traps caught 22 kiore (including two double-kills) after only two hours of being set in the late afternoon (equating to a trapping index of 110% uncorrected trap nights).

Table 3: Mammals recorded on atolls in the Tuamotu-Austral Archipelagos, March-April 2003 (✓ = present)

LOCATION	SPECIES		
	Pacific Rat (Kiore)	Ship Rat	Feral Cat
Gambier Is	✓	✓	✓
Morane	-	-	-
Ahunui	✓	-	-
Paraoa	✓	-	-
Manuhangi	✓	-	-
Reitoru	✓	-	-
Tekokota	-	-	-
Haraiki	✓	-	✓
Tahanea	✓	-	?
Fakarava	✓	?	✓
Maria (Australs)	✓	-	-

Several motu along the western Tahanea chain appeared to be free of all mammalian predators, but a few were infested with kiore. At least some of the small motu in Fakarava Lagoon were mammal-free, but kiore were seen on most large motu during our brief visits there.

Cats were confirmed to be present on at least one motu on Haraiki (one sighting, three sites with footprints in the sand) and are likely to be present elsewhere on the atoll. They were also suspected of being present on the main motu of Tahanea and were present on the main motu at Fakarava.

3.5 Other terrestrial fauna

We recorded a variety of other terrestrial fauna (refer to Appendix 2), including a terrestrial leech at Morane, but did no surveys specifically for these faunal groups. The introduced *Polistes sp.* wasp was present at most atolls, but was notably absent at Morane. We found turtle nests at several atolls, and hatchlings were seen at one, with well over 100 nests seen at Paraoa.

4. SIGNIFICANCE OF FINDINGS

Our survey clarifies the distribution of the critically endangered tutururu and the endangered titi in the Tuamotu and Austral Archipelagos. Viable populations of these species were previously known only from Tenararo in the Actéon Group, where risks of predator invasion are high (Blanvillain *et al*. 2002). Morane, which was found to support both species during the current survey, is a more isolated and less-visited atoll than Tenararo, so biosecurity risks are likely to be lower. Although only ten

individual tutururu were confirmed during the brief survey, the population could number as many as 30 individuals. The titi population estimate was also likely conservative and the total population may have been as large as 600-800 during our visit.

In addition to tutururu and titi, the indigenous biodiversity values of Morane are exceptionally high. The habitat is virtually unmodified by humans. Coconut trees are rare and localised, and exotic plants are absent. The atoll supports important colonies of seabirds, particularly masked boobies, red-tailed tropicbirds, and Kermadec petrels. Surveys at other times of the year could reveal additional species that are winter breeders, e.g. Murphy's petrel. The invertebrate fauna may include a number of unusual species, e.g. a terrestrial leech. The introduced *Polistes* wasp and mosquitoes (Culicidae) appear to be absent.

The other two populations of titi surveyed on this trip - at Reitoru and Tahanea - present further opportunities for the managed recovery of this species. Both populations appear to be experiencing predation pressure from kiore, with Reitoru appearing to be most severe. The quality of habitat at Reitoru was high and similar to that of Morane in composition and extent. If Reitoru was predator-free it would probably support a population of c.500 titi.

The Tahanea population of titi appears to be secure at present, largely because of the wide expanses of permanent water between individual western motu, precluding rapid colonisation by rats and other predators. However, the probable presence of rats and cats on the larger eastern motu means that dispersing titi (and atoll fruit doves) are unlikely to recolonise significant areas and these larger motu are probably population sinks for the productive western motu chain. With time, more pest species are likely to arrive on the western motu, and thus further erode existing population sources for these species.

The failure to find the northern subspecies of tutururu on Tahanea and other atolls is not surprising. Tutururu are terrestrial, have specialist food requirements and are likely to move from motu to motu, perhaps from atoll to atoll, with seasonal changes in the availability of food. Rats, and sometimes cats, on larger motu could quickly decimate tutururu populations, whereas impacts on the atoll fruit dove and titi, which are generalist feeders may be lower. The key to protection of populations of tutururu, therefore, appears to rely on keeping entire atolls free of predators.

We acknowledge that trying to eradicate pests on islands already hosting endangered birds means that special care has to be taken not to kill the species which are the subject of the protection effort. On atolls where there is a potential risk of non-target kills (e.g. titi on Reitoru, atoll fruit dove on Tahanea, and bristle-thighed curlew throughout), a staged approach by motu is recommended in order to detect any problems that might arise. Alternatively, it might be easier to clear pests from islands without endangered species, which can subsequently be re-introduced. Thus Reitoru might be dealt with by clearing all the pests from neighbouring Manuhangi, say, then taking a significant portion of the Reitoru population there, before clearing pests from Reitoru; this would minimise the risk of accidental poisoning of titi.

Rat eradication usually allows opportunities for an increase in biodiversity and the transfer of endangered species to the newly pest-free island. Reitoru might provide a cost-effective location for the recovery of titi and also for new populations of tutururu and/or atoll fruit dove. Tahanea and Fakarava also offer opportunities for biodiversity recovery via targeted pest control and for working with the local community to protect and promote these values.

After rat eradication, Maria (Australs) would be an ideal site for the translocation of Rimitara lorikeet (*Vini kuhlii*), Rimitara warbler (*Acrocephalus rimitarae*), titi, and a fruit dove species.

On all our surveys, we recognised a strong relationship between the presence of coconut plantations and the low diversity and scarcity of birds. We believe this has two causes: firstly because the human activity associated with coconut cultivation and periodic copra harvesting leads to increased opportunities for predators to arrive, and secondly because of the super abundance of food for rats. For example, no ground-nesting species such as titi and tutururu would be able to survive the high-density rat population on Ahunui. Our conclusion is that islands with coconut plantations potentially compromise the recovery of threatened species of birds. This is a very emotive issue for local people, and will need extremely persistent and subtle persuasion to convince them that coconut cultivation is undesirable on atolls where threatened species are being managed for recovery. The world market price for copra has been so low for several decades that harvesting coconuts on remote islands is only profitable because of major subsidies from government. An effective method of reducing the chance of rat and cat invasions to island sanctuaries would be to remove government subsides from islands set aside as reserves for their actual or potential biodiversity values.

Our survey was necessarily incomplete and there are more atolls in need of urgent survey. However, in spite of these gaps it is clear that the Tuamotus are blessed with an abundance of islands and potential reserves, with sufficient potential to restore biodiversity values in this region.

There are several opportunities for long-term conservation management. These include the development of close partnerships with island owners and visitors, and to use this approach to increase the ecological security of the atolls. This should include improvement (by education) of the awareness of local communities of the biodiversity value of their atolls and the risks posed by invasive species. Standards and protocols should be developed collaboratively for the ongoing reduction of biosecurity risks. Morane in particular requires urgent biosecurity management to prevent the arrival of cats, rats, and other pests.

5. RECOMMENDATIONS

- Morane in particular is in urgent need of immediate protection as a reserve, and a campaign to achieve this is needed now at both regional and global levels. This is the highest priority result of our survey and we recommend prompt action

- Carry out immediate further surveys on other Tuamotu atolls that could potentially support threatened species, e.g. Maria (Actéon), Niau, Marutea Sud, and the Duke of Gloucester Islands.

- Raise general awareness of biodiversity values, the ecological sensitivity of these atolls, and address biosecurity needs of key atolls in the Tuamotu and Austral Archipelagos. This awareness could be addressed by a long and serious 'hearts and minds' campaign to win approval for these measures, including education in schools; posters; discussions and negotiations with governments, local bodies, traditional leaders, and landowners; consulting other stakeholders by way of public meetings; and controlled visits by key people to pristine islands.

- Eradicate rats and cats from Vahanga, Tenarunga and Matureivaovao, which are the three atolls closest to Tenararo, the atoll with the only other known large population known of titi and only other known population of tutururu.

- Explore options with the owners of Reitoru and Maria for the eradication of rats from the atolls and proceed with eradication if permission is granted. Increase the level of pest vigilance thereafter and consider options for threatened species translocations.

- Explore options for the eradication of rats from selected small motu at Tahanea and Fakarava.

- Eradicate mammalian pests from atolls that do not have rare species on them at present, to provide safe havens for rare species in need of future translocations.

- Finally, we identified coconut plantations and copra production as agents of significant biodiversity loss throughout the islands surveyed. We recommend that these factors be dealt with by the removal of Government subsides for copra production on atolls suitable for reserve status.

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PLANTS RECORDED ON ATOLLS IN THE TUAMOTU AND AUSTRAL ARCHIPELAGOS, MARCH-APRIL 2003

Key: P = planted/plantation; R = rare; V = village

SPECIES	ATOLL									
	Morane	**Ahunui**	**Paraoa**	**Manu-hangi**	**Reitoru**	**Tekokota**	**Haraiki**	**Tahanea**	**Fakarava**	**Maria Australs**
Angiosperms										
Achyranthes velutina	✓				✓		✓	✓	✓	
Boerhavia tetrandra	✓	✓	✓	✓	✓		✓	✓	✓	
Callophyllum inophyllum			✓R						✓V	
Capsella sp. aff. *bursa-pastoris*							✓	✓	✓	✓
Cassytha filiformis	✓		✓	✓	✓	✓	✓	✓	✓	✓
Casuarina equisetifolia	✓R	✓R					✓R		✓	✓P
Chamaesyce chamissonis								✓	✓	
Cocos nucifera	✓R	✓P	✓P	✓PR	✓PR	✓	✓P	✓	✓	✓P
Cordia subcordata		✓	✓		✓			✓	✓	✓
Eugenia reinwortiana							✓	✓		
Guettarda speciosa	✓	✓	✓	✓	✓		✓	✓	✓	✓
Hedyotis romanzoffiensis		✓	✓	✓			✓			
Laportea sp.	✓	✓	✓	✓	✓		✓	✓	✓	✓
Lepidium bidentatum	✓R									
Morinda citrifolia	✓	✓P	✓					✓	✓	

SPECIES	ATOLL									
	Morane	**Ahunui**	**Paraoa**	**Manu-hangi**	**Reitoru**	**Tekokota**	**Haraiki**	**Tahanea**	**Fakarava**	**Maria Australs**
Pandanus tectorius	✓	✓	✓	✓	✓		✓	✓	✓	✓
Pemphis acidula	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pipturus sp.								✓	✓	
Pisonia grandis					✓	✓	✓	✓	✓	✓
Portulaca aff. lutea	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Scaevola taccada	✓	✓	✓	✓	✓		✓	✓	✓	
Leucaena leucocephala		✓R								
Sesbania atollensis									✓	
Tacca leontopetaloides		✓					✓			
Thespesia populnea		✓R			✓R	✓P		✓		
Tournefortia argentea	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Triumfeta procumbens	✓	✓	✓	✓	✓		✓	✓	✓	✓
Unidentified white flowering herb	✓	✓	✓	✓	✓		✓	✓	✓	✓
Ferns										
Phymatosurus grossus			✓		✓		✓	✓	✓	✓
Asplenium nitidum										✓
Nephrolepis spp										✓
Grasses										
Thuarea sp.	✓	✓	✓	✓	✓		✓	✓	✓	✓
Unidentified grass							✓	✓	✓	✓

OTHER TERRESTRIAL FAUNA RECORDED ON ATOLLS IN THE TUAMOTU AND AUSTRAL ARCHIPELAGOS, MARCH-APRIL 2003

Key: R = rare

SPECIES	ATOLL									
	Morane	**Ahunui**	**Paraoa**	**Manuhangi**	**Reitoru**	**Tekokota**	**Haraiki**	**Tahanea**	**Fakarava**	**Maria Australs**
Turtle sp.		✓	✓		✓		✓			
Skink spp.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
House gecko		✓R								
Mourning gecko				✓				✓	✓	✓
Hermit crab	✓	✓	✓	✓	✓		✓	✓	✓	✓
Coconut crab	✓	✓		✓	✓		✓	✓	✓	✓
Land crab (Cardiosoma)	✓	✓			✓		✓	✓	✓	✓
Terrestrial leech	✓R									
Giant centipede	✓R									
Dragonfly							✓R	✓	✓	✓R
Polistes		✓	✓	✓	✓			✓	✓	✓