

# BIRD RESEARCH AND MONITORING ASSOCIATED WITH SOP MANU PEST ERADICATIONS IN ACTEON-GAMBIER ARCHIPELAGOS, JUNE 2015



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By Ray Pierce, Caroline Blanvillain and Marie-Helene Burle

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## ACRONYMS AND KEY DEFINITIONS

BirdLife	BirdLife Pacific based in Suva, Fiji
IAS/Invasive	Invasive alien species - animal or plant species
Incursion	First detection of invasive species on an island
GPS	Global Positioning System
Hoā	Periodically flooded channel between motu or islets
Monitoring	Ongoing structured surveys of indigenous biota, c.f. surveillance – see below
NZ	New Zealand
PII	Pacific Invasives Initiative based at the University of Auckland, NZ
SOP MANU	Société d'Ornitologie de Polynésie
SPC	Secretariat for the Pacific Community based at Suva, Fiji
SPREP	Secretariat for the Pacific Regional Environment Programme based in Samoa
Surveillance	Ongoing structured searches for invasive species on an island, vessel, etc.
YCA	The yellow crazy ant ( <i>Anoplolepis gracilipes</i> ), an invasive species

## SUMMARY

Field work was undertaken in the Acteon Islands, French Polynesia, during June 2015 primarily to assist with the recovery of Polynesian Ground-dove (Tutururu) and Tuamotu Sandpiper (Titi). This work included mitigation to minimize potential mortality during rat eradications on the Acteon Islands of Vahanga and Tenarunga, plus population surveys and ecological research on nearby rat-free Tenararao. The latter was aimed at assisting with more effective recovery planning for both species and the Tutururu data are being used by CB and RP in the development of Tutururu Action and Recovery Plans.

The populations of Tutururu and Titi on Tenararo appeared to be very healthy, with that of Tutururu being much larger than previously documented. Two Tutururu and four Titi were captured on Vahanga before the first rodent baiting and processed prior to liberation on Tenararo. At least four other Tutururu were recorded on Vahanga and two on Tenarunga during June-early July 2015, with none showing any signs of sickness after up to two weeks of exposure to baits. Numbers of Titi present on Vahanga were greater than previously recorded, but they were harder to monitor because of their often sudden appearances and disappearances. A minimum of 6-8 Titi were recorded on Vahanga during the 7 days leading up to the first rat baiting there, and at least four others were recorded during five days leading up to the second baiting. It was not possible to determine what numbers of Titi disappeared during the baiting and monitoring periods, but this is probably insignificant compared with the very large numbers (in the order of 1000) present on Tenararao.

Another landbird, the Long-tailed Cuckoo (Koel), was present on Tenararao and Vahanga and there were small numbers of shorebirds (Pacific Reef-egret, Bristle-thighed Curlew, Pacific Golden Plover and Wandering Tattler) throughout. Breeding seabirds in the Acteon (and Gambiers) were Kermadec and Murphy's Petrels, Great Frigatebird, Red-footed Booby, Masked Booby, Red-tailed Tropicbird, Brown and Black Noddy and White Tern, while White-throated Storm-petrels and Blue-Grey Noddies were noted at Manui and some other islands. Some additional species were detected during evening fly-on at Acteon including Great Crested Tern and Sooty Tern. Species totals were estimated for each island.

## 1. BACKGROUND

The islands of the Tuamotu and Gambier Archipelagoes support endemic populations of several threatened species, including the Polynesian Ground-dove (*Alopecoenas erythropterus*)(CR) and Tuamotu Sandpiper (*Prosobonia parvirostris*)(EN). With the disappearance of females in Rangiroa's population (Blanvillain et al, 2014), the breeding population of the ground-dove is now confined to Morane and the Acteon Group, particularly the rat-free Tenararo (Blanvillain et al 2001) from which individuals sometimes disperse to neighboring islands which are infested with cats and/or rats. Similarly the Tuamotu Sandpiper has its stronghold at Tenararo but there are smaller populations also present at Morane, Tahanea and Reitoru (Pierce and Blanvillain 2004). Relict populations may also persist in Anuanuaro, Nukutavake and Raraka (Faulquier 2014). The strategic approach for the short-term recovery of both species is to safeguard Tenararo from IAS and secure other rat-free islands in the Acteon Group, notably Vahanga, but also Tenarunga. Following this work, other more distant sites should also be considered as recovery sites (Pierce and Blanvillain 2004, BirdLife 2014).

The recovery of these species in the Acteon hinges on the SOP MANU initiative to remove rats and cats from Vahanga and Tenarunga (Ghestemme and Cranwell 2015). The pest operational work was undertaken in June to early July 2015 and the monitoring and research work was focused in June 2015. There were three components to the current monitoring work:

A: mitigation of impacts on Tukururu and Titi. The operational plan identified these species as being at risk from primary poisoning and hence there was a need the follow actions:

- capture and translocate any Tukururu to Tenararo as was practicable
- survey for the presence of Titi and if significant numbers are present (>20) capture and transfer as many as possible to Tenararo.
- given no prior monitoring was possible, adapt mitigation responses to the situation at hand.

B: gather information on the ecology of Titi and especially Tukururu which would assist in the future management of these threatened species, given that the subpopulations of Tukururu on Morane is small and probably decreasing and no more females persist in Rangiroa (Pierce et al 2003; Ghestemme et al, 2012; Blanvillain et al, 2014)).

C: establish baseline monitoring of these land birds species and their habitat as well as other bird species to help measure potential responses to invasive mammal removal.

## 2. TIMETABLE, ACTIVITIES AND METHODS

Locations and activities were focused on Vahanga and Tenararo, the latter coinciding with highest numbers of study species (Table 2.1).

Table 2.1 – Key locations and activities associated with Tukururu and Titi May-June 2015  
 CB = Caroline Blanvillain, MHB = Marie-Helene Burle, SC = Steve Cranwell, MP = Madelaine Pott, RP = Ray Pierce, SR = Sialis Rasalato, JZ = Jason Zito.

Date	Other location and activity	Vahanga activities	Tenararo activities
29-31	Papeete prep		
1	Papeete briefing		
2	Papeete-Tureia flight; ant and plants (incl <i>Scaevola</i> ) survey in Tureia		
3	Tureia-Acteon boat travel; seabird transect		
4	Set up camp and logistics	Set up camp and logistics	
5	Opportunistic surveys by SR, JZ, et al.to 4 July	Build aviary	
6-11		Tukururu and Titi surveys	
12		RP and MHB move to Tenararo	Tukururu and Titi release. Set up camp
13		Tukururu survey CB, MP Habitat survey CB	Titi capture
14		CB and one Tukururu transfer to Tenararo	Release Tukururu
15-25			Study Tukururu, Titi and habitat by CB, MHB, RP, return to Vahanga 25 <sup>th</sup>
15-26		Opportunistic surveys by SC, MP, et al.	

26-28		Surveys of Island by CB, MHB, RP, MP	
29		Collected by SV The Shark	
30		Turea-Papeete flight	
1-5		Papeete	

Key field methods were as follows.

#### Tutururu survey

Survey members spread out and walked abreast in parallel lines searching for Tutururu in likely habitat – ground, shrubbery, roosting in low branches. As time progressed it became clear that birds were focused on areas with the shrub *Achyranthes aspersa*, and their fruit and attending invertebrates, all of which were preferred food items in June 2015. Additional attention was given, therefore, to areas containing *Achyranthes* and many birds were found in this way which might otherwise have been overlooked. Each bird was photographed (breast and if possible left and right portrait) to assist in subsequent individual recognition akin to mark recapture. This approach was adapted for subsequent use at Tenararo where the technique was particularly effective for single/paired surveyors and will be described in more detail for use in a protocol being developed by CB and RP for monitoring of the Tenararo and Vahanga clusters in later years.

#### Tutururu capture

We used monofilament mistnets set near preferred feeding areas, e.g. *Achyranthes* and open areas, and birds were gently steered towards the nets. Successfully captured birds were held briefly in an aviary constructed of 25 mm chicken mesh netting and measuring 6 m x 3 m x 1 m tall. The aviary was lined with plastic scrim on the inside and well screened with coconut fronds and young sprouting coconuts. The plastic scrim was used to reduce the chances of Titi escapes given that the 25 mm mesh was too coarse to contain that species as well as prevent both Tutururu and Titi from damaging their beaks against the chicken mesh. Food (red millet and other items including worms from rotting coconut fruits) along with water was provided but the birds were held only a matter of hours before helicopter transfer to Tenararo where they were processed (refer details in Appendix 1).

Attempts to capture a subadult male Tutururu (Fig 3.1A) failed due to firstly its escaping through a hole in the net and secondly because of a combination of reasons (wind gust, changing diagonal angle of flight and probably incorrect net tension). Some of the sites appeared more suited to using walk-in ground nets 0.5 m tall rather than using mist-nets, both of which should be considered for use in later capture operations.

#### Titi survey

The general survey approach (walking abreast) was used for Titi at Vahanga with the addition of playback territorial calls or mimicking chick calls. The outcome was different to that of Tutururu in that the inquisitive Titi all tended to come searching for us and the source of the intrusion. Subsequent surveys on Vahanga were conducted by 1-2 people using play-back.

#### Titi capture

We attempted to catch birds on Vahanga using a single mist net and playback calls. Successfully captured birds were processed and held in the aviary described under Tutururu capture above and provided with perches (forked branches 100-300 mm off the ground) together with food and water as for Tutururu above with the difference that the birds were kept in captivity between one and four days. On Tenararo, Titi were captured using walk in traps made from wire-netting.

### Seabird counts

Large, nesting seabirds (frigatebirds, boobies, tropicbirds) were counted by nest site and the nesting stages were noted. A variation on this was that for red-tailed tropicbirds on Tenararo, nesting numbers of which were estimated by RP based on average distance between perimeter nests at a subsample of motu. Two species of petrels were courting and laying eggs throughout June and nests were sometimes encountered during perimeter surveys for the target species. Seabird fly-ons were conducted on 3 islands by observing for one hour from 1700 to 1800 (dark) along a 200 m corridor on the lee side of the island. Any birds flying off were subtracted from the fly-on total while others flying parallel to the coast were noted separately. A summary table was prepared for each island (Appendix 2). Standard pelagic seabird counts were conducted from the MV Nuku Hau and the SV “The Shark”.

### Habitat description

Habitat description was undertaken in 49 sites in Vahanga and 65 on Tenararo. Species present and their relative abundance were recorded as well as habitat localization (GPS + oceanic/middle/lagoon edge) and soil quality, and these are yet to be analyzed.

## 3.0 TUTURURU AND TITI ON VAHANGA

### 3.1 Tuteururu

Focused surveys at Vahanga during 6-12 and 25-28 June revealed that at least 5-6 Tuteururu were present and surveys during June-early July on Tenarunga revealed two individuals to be present there. The Vahanga birds comprised a subadult male present there throughout June, and two adult males and 2-3 females observed during shorter periods, details of which are provided in Table 3.1 and portraits of some birds in Fig 3.1.

Table 3.1 – Details of Tuteururu found on Vahanga and Tenarunga June 2015

Bird	Date	Status	Location	Notes
A	7-28	SAd M	M8 to 12th, then M1 25-26	Eluded capture, healthy on 26-28 June
B	10	SAd M	M8, brief view	Potentially same individual as A
C	10	Ad M	Church Motu near Titi Oa	Flying across rubble area, landed
D	12	Ad M	Church Motu, village area	Captured and released at Tenararo
E	14	F	Church Motu, village area	Captured and released at Tenararo
F	26	F/Juv	Big Motu S end	Area of moderate habitat value, wary
G	27	F/Juv	Big Motu central area	Shrubland area; wary,
H	20	F	NE Peninsula	Female seen on 5 occasions to 4 July
I	30	M	NE Peninsula	Seen on 1 occasion only



Fig 3.1A – Subadult male at Motu 8 on 7-8 June 2015 (Left) and same individual at Motu 1 24-26 June (Right)

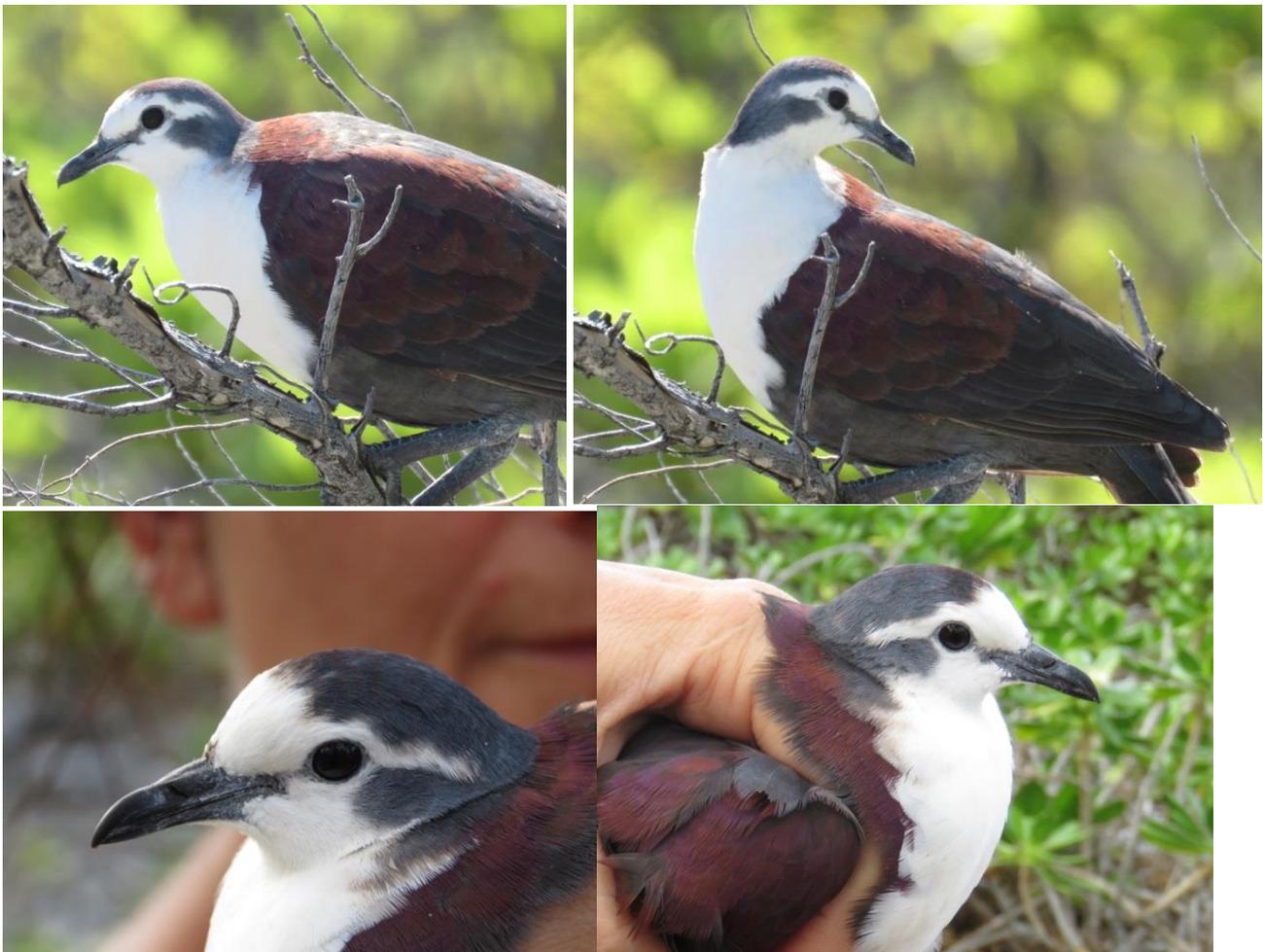


Fig 3.1B – Adult male seen near Titi Hoa 1 on 11 June (L x 2) and a different individual captured at Church Village on 12 March (R x 2) distinguished by several different facial markings.



Fig 3.1C – Female (“Young Blue”) at Tenararo on 21 June one week after her capture on Vahanga and subsequent release at Tenararo (L)

The habitat in which Tukururu were found on Vahanga was atypical of the coconut-dominant habitat that prevails there. We found Tukururu to favour more open shrubland habitats with open sand and prostrate vegetation. A key foraging plant at the time of our visit was *Achyranthes aspersa*, from which Tukururu took fruit and insects. Favored habitats were as follows:

- *Achyranthes*-dominant shrubland usually with nearby open sandy-soil ground with prostrate plants
- Open sand and soil with prostrate plants of *Portulaca lutea*, *Boerhavia tetrandra*, *Scaevola taccada*, and *Cassytha filiformis*
- *Lantana camara* at the village
- Open coral rubble and shrubland with diverse prostrate plants as above.

About half of first daily encounters with birds at Vahanga were of birds in *Achyranthes* (Fig 3.2).

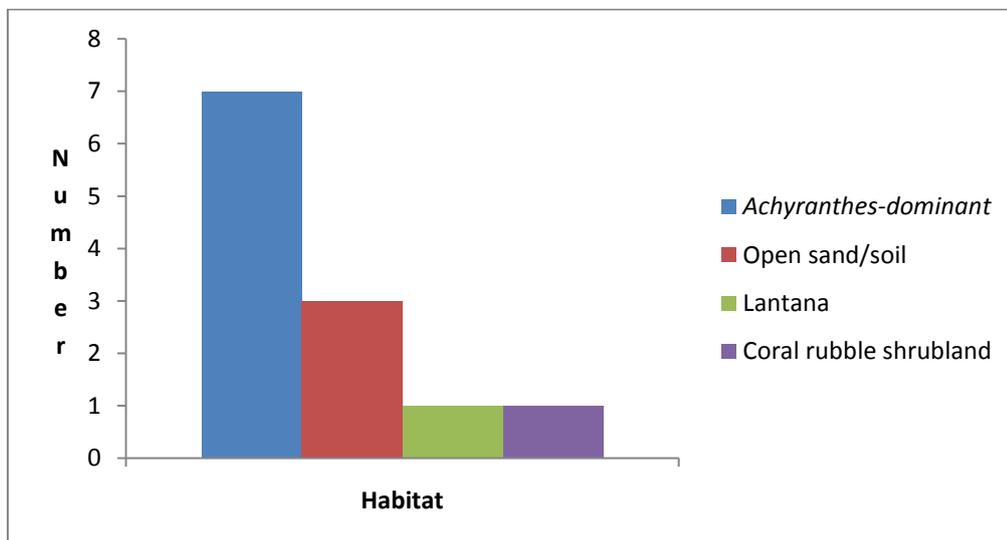


Fig 3.2 – Number of first-time encounters with Tukururu in different habitat types on Vahanga

Food items observed being taken were diverse and included *Achyranthes* fruit, growing shoots of grasses, *Portulaca*, *Boerhavia*, *Scaevola* and *Cassytha*; seeds of grasses, whole seedlings of small plants including *Scaevola*, and insects (including hemipterans and ants), and probably also snails.

Two of the three Tukururu targeted for capture at Vahanga were caught. One was released on

Tenararo the following day and the other the same day, both transported by helicopter. Both individuals were processed and colour banded (Appendix 1) and two of the outermost primaries of each wing were removed to lessen the chances of their flying back to Vahanga. One of these individuals, the female “Young Blue” was sighted twice on Tenararo up to a week after release at distances of 900 m from the release site and 1750 m between the first and final sighting locations.

### 3.2 Titi

Significantly more Titi were present on Vahanga in June 2015 than the 0-4 that had been recorded by various observers in the past (Pierce and Blanvillain 2004, MHB 2012 unpublished). During the surveys of 4-12 June a minimum count of 6-8 Titi was obtained. They were concentrated in two areas – about 4 birds (2 of which were an established pair) in the hoa between Village Motu and Motu 1 (and adjacent shrubland on Village Motu), and another established pair in shrubland at the southern end of Big Motu. In addition there were several sightings of “floaters” comprising individuals and pairs on the Village Motu as far east as the hoa linking Village and Big Motu, as well as in the middle of Big Motu and on several of the small motu, particularly M5-8 (refer maps Appendix 5). It seemed to us that birds were flying between Tenararo and Vahanga on a regular basis (see below for explanations).

Five of these 6-8+ Titi were mist-netted and processed before being temporarily housed in the Tukururu aviary at Village Motu. Each was individually colour-banded, blood and feathers collected and biometrics recorded (MHB data). One of these birds escaped from the aviary due to the unsuitable mesh size. Four of the captured birds were subsequently released on Tenararo on 12 June. The birds that had been caught first, after only 4 days in captivity, had lost 22 and 27% of their body mass and reached a critical state upon release. It is unknown whether they survived and it seemed unlikely that they would not have survived another day or two in captivity. This weight loss is significantly greater than that documented by MHB on Tahanea after a much longer time (3 weeks) of captivity (Burle and Lank 2013). This could be explained by the fact that little amounts of food were kept in dishes within the cage rather than spread in large amounts on the entire cage floor. Additionally the food was less rich in protein. The rationale for the technique used was to limit the risk to attract rats to the cage – a problem absent on Tahanea where the cage was kept on a rat-free motu. The design and maintenance at Vahanga primarily had Tukururu in mind, not Titi, but these results are important for future conservation actions involving captive Titi (translocations, rat eradications).

To prevent translocated Titi from flying back to Vahanga, the outermost primaries were plucked on both wings (1-3 per wing depending on bird condition upon release with birds that had lost the most weight having fewer feathers plucked). However, the individual released in the best condition on Tenararo was later re-sighted on Vahanga and had successfully covered the 7 km ocean flight despite missing its 6 outer primaries. This should also be kept in mind for future Titi work such as translocations.

On our return to Vahanga on 25 June and over the next four days at least four Titi were observed, including the individual that had flown back from Tenararo. It was observed on 26-28 June in the original territory where it had been captured 2 weeks earlier. This bird was wobbly on its feet when trying to perch on 28 June but could fly normally and appeared to be forming a pair bond with another Titi. A single pale morphed Titi was observed at the southern end of Big Motu on 26-27 June, the first sighting of this pale bird and another bird a short distance away on the Big Motu on 26 June (M. Potts pers. comm.). This bird had a distinctive plumage and was neither of the territorial birds seen in the area on 4-12 June. It is likely that new birds coming from Tenararo replaced the

birds that were caught or which disappeared. A very sick individual was observed at the hoa between Village and Big Motu on the evening of 28 May. It showed all signs of poisoning (slow motion, wobbly stance, lots of time on its belly (a behaviour never observed on a Titi previously) and attempted to regurgitate). The banded escapee, which was highly territorial and responded well to playback before capture, was not seen again after its escape from the Vahanga aviary and may have died.

Titi readily consume rodent bait (Burle and Lank 2013), but it was not possible to determine levels of mortality in the Vahanga case. Total mortality would have depended on how long the bait stayed on the ground after the monitoring period (see below) and number of Titi flying from Tenararo during that time, both of which are unknowns. Mortality is likely to have been insignificant when put in the perspective of the very large Tenararo population and the island (Vahanga) being restored.

#### Bait decay

Formal measurement of loss of the “wet formulation” baits was undertaken by IC staff. However, our casual observations on 27-29 May indicated that there was an abundance of intact, firm baits surviving on many parts of Vahanga, particularly in the supralittoral zone. This timing was 15-16 days since they were applied during the first bait application and they had experienced a period of high rainfall (>200 mm) during this period. Hermit crabs were at low to locally moderate densities on the island and apparently were not greatly impacting on these baits in that zone. The apparently high survival rate of these baits is significant as the second bait application was still to happen and took place in early July. This suggests that baits would be available for consumption by any supralittoral foraging animals until early August at least. This is of concern for Titi, curlews, etc. arriving from Tenararo or beyond given that both readily consume rodent baits (Pierce 2008, Burle 2013). Clearly the selection of “wet formulation” bait for rodent eradications and the amount of bait being applied should be seriously questioned for future operations where there are threatened or sensitive birds visiting and where adequate weather forecasting might enable conventional rodent baits to be effectively used. Alternatively, consideration could be given to first and second bait applications of “wet formulation” baits at a closer interval given the lengthy survival of these baits.

## 4.0 TUTURURU AND TITI RESEARCH ON TENARARO

### 4.1 Tuteururu

Preliminary comments only are provided here as there are further analyses to complete.

#### Population

Preliminary results from three replicated counts suggest that the total population on Tenararo is approximately 130-150 birds.

#### Distribution and Habitat

Initial surveys indicated that Tuteururu were concentrated along the lagoon edges of the two main motu, together with all of the hoa margins and especially throughout all of the nine small motu. Fewer birds were found on the outer edge of the main motu and especially within the interior of the two largest motu. This pattern of distribution coincided with the presence of mainly sandy open areas populated with scattered shrubs of *Achyranthes aspersa*, plus combinations of *Boerhavia*, *Cassytha*, *Guettarda*, *Pandanus*, *Portulaca*, *Scaevola*, *Tournefortia* and grasses (Fig 4.1). Key correlates were the proximity of *Achyranthes* and the absence or scarcity of coconut regeneration. A fairly open canopy (<40% cover) of mature coconut trees was tolerated, but more closed canopies of coconuts

inhibited the growth and reproduction of essential understorey plants.



Fig 4.1 – Ideal understorey for Tuttururu on Tenararo comprising fairly open, sandy habitat with a variety of shrubs and grasses.

#### Diet

The diet of Tuttururu was varied within the constraints of available food on Tenararo. Key foods were fruits of *Achyranthes* and *Guettarda*, flowers and/or growing shoots of *Boerhavia*, *Cassytha*, *Portulaca* and grass seeds such as *Digittaria*, the latter taken from live plants or from the ground or sand. Insects and snails were also important in the diet, notably black ants, mites (Hemiptera) and spiders, many of which were taken from food plants.

#### Key threats on Tenararo

Existing or potential threats include the following:

- Habitat loss from coconut encroachment (Fig 4.2) although this is not yet as serious as at Vahanga
- Habitat loss from ocean surges/erosion, which is also less serious than at the lower elevation atoll of Vahanga
- IAS invasion in the form of disease, invasive ants or rodents.

Of these threats, the arrival of IAS would have a catastrophic impact on Tuttururu because Tenararo is currently the only island with a healthy population. This is a very serious risk given the current

spread of invasive ants in the Tuamotu-Gambier, the current spread of Avian pox in Society archipelago plus the lack of controls over landing parties. All threats are being addressed via a Species Action Plan and Recovery Plan (CB, RP in prep). For example, coconut regeneration could readily be managed on key motu at Tenararo and Vahanga.



Fig 4.2 – Regenerating coconuts beginning to suppress *Achyranthes* and other plants at Tenararo.

## 4.2 Titi

Preliminary comments only are provided here as there are further analyses to complete (M-HB).

### Population

No accurate counts of Titi were possible but the impression was that these were the most common bird on the island with c.1000 birds present, plus or minus a few hundreds.

### Distribution and habitat

Titi were present on all motu at Tenararo, being most common where *Scaevola taccada*, a key food species, was abundant. They were least common in areas lacking *Scaevola* or where there had been recent damage of *Scaevola* by ocean surges, e.g. the western side of the island. A more widespread pattern of ocean surge damage on *Scaevola* was observed at Vahanga, impacting virtually all coasts.

### Research

A sample of 36 Titi was processed in order to collect blood samples for genetic analyses and for morphometric comparisons with data from birds on the islands of Tahanea, Reitoru and Morane

(MHB data). A sample of *Scaevola* flowers and fruits was also obtained for similar comparisons with the other islands and control sites.

### Threats

The threats to Titi are likely to be similar to those stated above for Tuteruru.

## 5.0 OTHER BIOTA

### 5.1 Land-birds and shorebirds

Apart from Tuteruru and Titi, the only two land-bird species recorded in Acteon and Gambier were Atoll Fruit-dove (*Ptilinopus coralensis*) and Long-tailed Cuckoo (*Eudynamys taitensis*). Atoll Fruit-doves were common on Tenararo and were in medium numbers on Vahanga where they were clearly more common than detected in previous visits with an average of 2.5 birds detected per hour of surveys of all motu on Vahanga (range 0-5, n = 15, RP). Small numbers of Long-tailed Cuckoos were detected on Vahanga and especially on Tenararo for the duration of our visit. They were conspicuous via their vocalizations during overcast or wet weather conditions on Tenararo, but probably only in the order of 10 birds were present for the entire atoll and even fewer on Vahanga.

Three species of shorebirds were present in low numbers throughout – Bristle-thighed Curlew (*Numenius tahitiensis*), Pacific Golden Plover (*Pluvialis fulva*) and Wandering Tattler (*Heteroscelus incanus*). On Tenararo the three curlews initially present on 12 September increased to seven a few days later, very likely a result of the four birds seen earlier on Vahanga departing to Tenararo, possibly coinciding with the start of the helicopter activities. Pacific Reef-heron or egret (*Egretta sacra*) were also present in small numbers.

### 5.2 Seabirds

Highlights were over 1000 pairs of Murphy's petrels (*Pterodroma murphii*) nesting at Temoe in June 2015, 800+ pairs of Red-tailed Tropicbirds (*Phaethon rubricauda*) nesting at each of Temoe and Tenararo in June 2015 and White-throated Storm-petrels (*Nesofregata fuliginosa*) present at Manui. A full list of seabirds observed on the Acteon Islands and Temoe are provided in Appendix 2 and baseline fly-on surveys at Acteon in Appendix 3. Total counts are probably not entirely representative of seabird abundance because of the narrow sample period and being outside the breeding season for some species. For instance Great Crested Terns (*Sterna bergii*) were not nesting at the time of our visit on Tenararo where c.50 pairs were nesting in November 2000 (RP pers. obs.). In June 2015 Great Frigatebirds had mainly well grown pulli on Tenararo and Vahanga, whereas Red-footed Boobies were mainly prospecting, and Masked Booby pairs were arriving and starting to lay during our 10 days at Tenararo. Brown noddies and black noddies had finished nesting on Tenararo in June 2015. The June sampling of Temoe produced many more Murphy's petrels than a visit in April 2010 (Butaud 2011).

### 5.3 Turtles and crabs

Green turtles (*Chelonia mydas*) were present on most islands. Over 100 diggings were seen on the NW beaches of Tenararo and fresh tracks indicated that at least 7 individuals had been ashore there in early June. Fewer diggings were present at Vahanga. Coconut crabs were present in very low densities on Tenararo and none were observed on Vahanga. Hermit crabs were generally at moderate

to low densities on Vahanga and Tenararo, except locally at the Vahanga Village where they were more common and attracted to our presence after a few nights. The low densities of crabs may have contributed to some extent to the observed high persistency of the baits, especially those on the upper beaches of Vahanga.

## 5.4 Invasive ants

Following the observation of yellow crazy ants (*Anaplolepis gracilipes*) at Tureia, expedition members were briefed as best on their identification (4.5 mm, yellowish brown, square-shaped antennae) and survey methods comprising searching of flowering noni (*Morinda citrifolia*) and laying out protein and sugar lures. Only Vahanga and Tenararo were adequately surveyed in this way and both appeared to be free of invasive ants. However other concerning finds were as follows:

- Presence of *A. gracilipes* on Manui *M. citrifolia* (M. Potts pers. comm.)
- Presence of *A. gracilipes* on Tureia, a staging port for local workers visiting the Acteon (RP)
- Presence of *Tetramorium bicarinatum* at Turea Airport around the existing (older) building (RP)
- Presence of *Tetramorium bicarinatum* at Tenarunga from where worker ants were apparently carried aboard the SV The Shark (RP).

There are also old reports of *A. gracilipes* from the Gambier Islands, along with little fire ant (*Wasmannia auropunctata*) (ISSG database), both very destructive to other biota including seabirds. Even inaccessible islands like Manui and Temoe are likely to be vulnerable. For example, Graham Wragg (pers. comm.) reported locals camping with tarpaulins etc. on Manui, having apparently swum ashore with equipment and supplies in dry containers.

## 5.5 Flora

Plants observed on Vahanga and Tenararo are appended (Appendix 4). Habitat parameters are being further evaluated by CB and RP as part of Tukururu studies.

## 6.0 PRELIMINARY RECOMMENDATIONS

Key recommendations will be described in detail in species action and recovery plans currently being prepared, but some preliminary recommendations include:

- Discourage and if possible preclude unnecessary landings at key islands, particularly Tenararo and other islands that are now free of invasive species to ensure no (more) IAS or diseases get ashore
- Undertake surveys for invasive ants on key islands (e.g. Temoe, Manui) and staging islands, given that at least three seriously invasive ant species now occur in the Acteon-Gambier
- Work with local authorities and communities to raise awareness of IAS including invasive ants, dispersion of avian pox through poultry, invasive birds and sea birds and work towards improved biosecurity and management
- Begin dialogue with stakeholders for managing habitat on key islands including to minimize coconut impacts
- Carefully consider the prolonged potential impacts of “wet formulation” rodent baits and bait quantity on threatened species and take appropriate precautionary actions in future operations.

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APPENDIX 1 – Morphometrics of Tukururu captured on Vahanga

Bird number	1	2
Age	Adult	Subadult
Sex	Male	Female
Colour bands (left)	Purple	Blue
Date of capture	12 June 2015	14 June 2015
Date of release	12 June 2015	15 June 2015
Weight (g)	144	96
Head and bill length	43.6	42
Culmen	16.8	18.8
Tarsus	34.7	-
Wing length	150	137
Tail length	77	-
Primary wing moult	All old feathers – 0 <sup>10</sup>	All slightly worn feathers - 0 <sup>10</sup>
Secondary wing moult	Old x 6, Pin 4 – 0 <sup>6</sup> , 1 <sup>4</sup>	All slightly worn feathers - 0 <sup>10</sup>
Tail moult	All old	All old feathers
Primary feather removal	2x2 outermost removed	2x2 outermost removed
Photos	Fig 3.1B	Fig 3.1C
Capture site	Vahanga 100 m NE of camp	Vahanga village
Release	Tenararo	Tenararo
Subsequent sightings	Nil	2 on Tenararo to 21 June 2015
Notes	Infer at least two years old	Rufous wing coverts

Appendix 2 - Island bird summary. Estimated no. of individual birds (i) or pairs (p), v= visitor

Island name		Tenararo	Vahanga	Tenarunga	Temoe
Dates June 2015		12-25	4-29	4-30 - 4 July	June
Observers		CB MHB RP	CB MHB SC RP	ST, JZ	JFB RL LY
Common names	Scientific name				
Murphy's Petrel	<i>Pterodroma ultima</i>	<20 p	<10 p	V	1150 p
Kermadec Petrel	<i>Pterodroma neglecta</i>	<20 p	<10 p		10 i
Red-tailed tropicbird	<i>Phaethon rubricauda</i>	c.800 p	<10 p	V	c.800 p
Red-footed Booby	<i>Sula sula</i>	300+ i	c.100 i	V	189 + i
Masked Booby	<i>Sula dactylatra</i>	30+ p			58+ i
Great Frigatebird	<i>Fregata minor</i>	110+ p	100+ p	V	18 i
Lesser Frigatebird	<i>Fregata ariel</i>				1 i
Sooty Tern	<i>Sterna fuscata</i>	<10 i		V	
Great Crested Tern	<i>Sterna bergii</i>	c.20 i	<10 i		6 i
Brown Noddy	<i>Anous stolidus</i>	c.100 i	c.20 i		7 i
Black Noddy	<i>Anous minutus</i>	c.100 i	<10 i	V	22 i
Common White Tern	<i>Gygis alba</i>	100+ i	c.100 i	V	160 i
Pacific Reef Heron	<i>Egretta sacra</i>	c.10 i	c.10 i	present	11 i
Pacific Golden Plover	<i>Pluvialis fulva</i>	3 i	2 i		
Tuamotu Sandpiper	<i>Prosobonia parvirostris</i>	c.1000 i	<10 i		
Wandering Tattler	<i>Heteroscelus incanus</i>	c.20 i	c.20 i	Few	26 i
Bristle-thighed Curlew	<i>Numenius tahitiensis</i>	7 i	3 i	Few	5 i
Atoll Fruit Dove	<i>Ptilinopus coralensis</i>	>100 i	c.30 i		
Polynesian Ground-dove	<i>Alopecoenus erythropterus</i>	130-150 i	<10 i	2	
Long-tailed Cuckoo	<i>Eudynamis taitensis</i>	c.10 i	<10 i		

Appendix 3 – Seabird fly-on counts at Acteon in June 2015 (x) = number of birds observed flying parallel to beach and/or displaying, these being excluded from fly-on totals

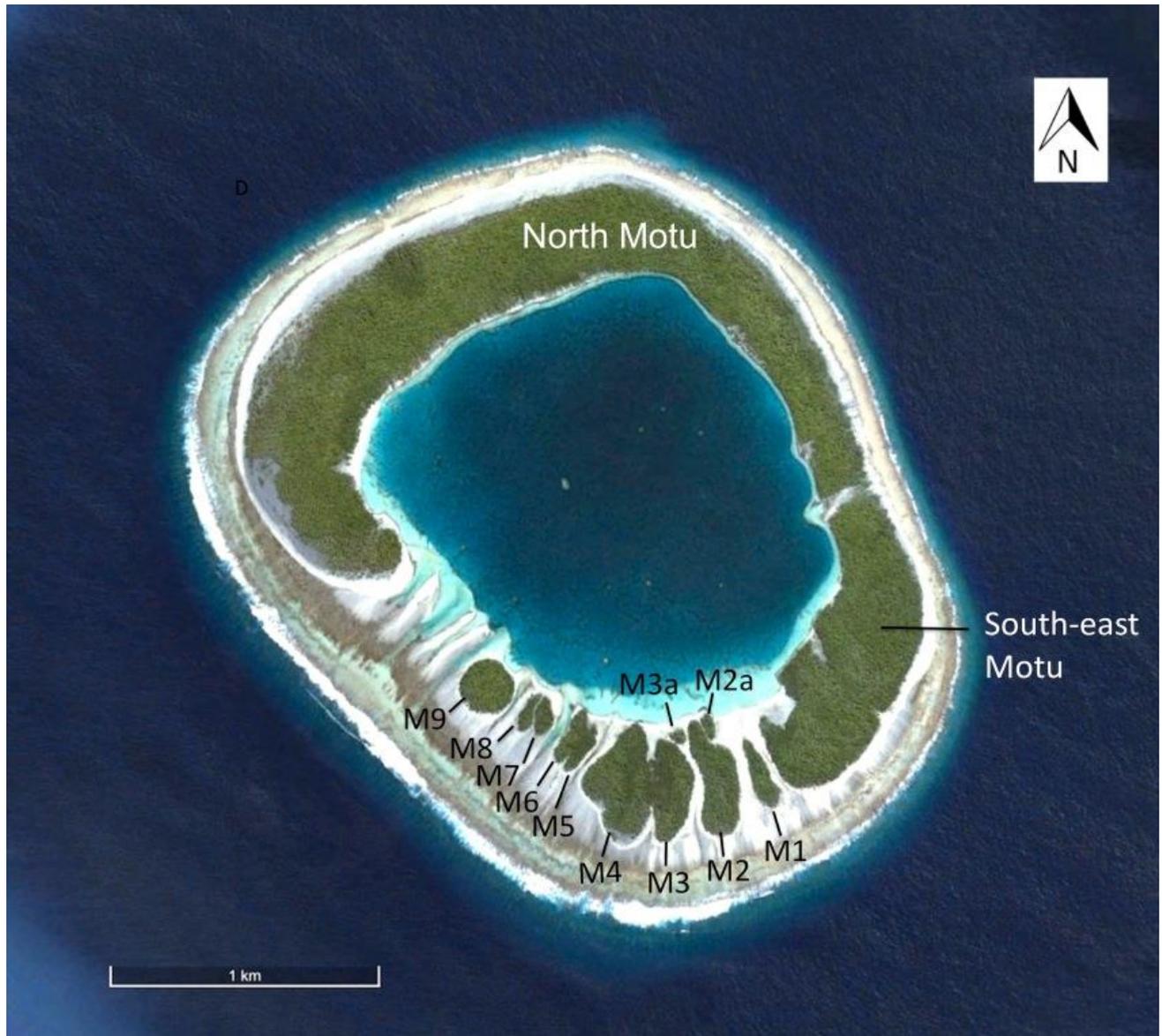
	Vahanga			Tenararo		Tenarunga	
	6	8	27	13	15	27	28
Observer	RP	RP	RP	RP	RP	TR	TR
Location	Village			Cistene		Peninsula	
Wind Direction	0	0	NE	E	E	-	N
Wind strength 0-4	0	0	1	1	1	-	1
Cloud 0-4	0	1	1	2	3	-	1
Murphy's Petrel			(3)	1 (2)	2 (2)		
Kermadec Petrel	2	1	(2)	(2)	1 (1)		
Masked Booby				1 (2)	2 (3)		1
Red-footed Booby	1	3	1	27	25		
Great Frigatebird	3	2		5	8	2	2
Red-tailed Tropicbird				1	2	1	
Pacific Reef Heron				(2)	(1)		1
Pacific Golden Plover					(2)		
Bristle-thighed Curlew		(1)			(3)		
Titi				(2)	(4)		
Wandering Tattler				(2)	(2)		
Sooty Tern					(5)		
Great Crested Tern			(2)	(3)	(5)	1	
White Tern	6	9	4	27	24		
Brown Noddy				16	19		
Black Noddy				5	3 (4)		

Appendix 4 – Flora species observed on Vahanga and Tenararo in June 2015. Species names follow Butaud 2014. Where observations add to Butaud 2014, this is noted by capital X.

Species	Family	Local names	Tenararo	Vahanga
Indigenous				
<i>Achyranthes aspera</i> var. <i>velutina</i>	Amaranthaceae	Aerofai	x	x
<i>Boerhavia tetrandra</i>	Nyctaginaceae	Nunanuna, Toroura	x	x
<i>Cassytha filiformis</i>	Lauraceae	Tainoa, Tainoka	x	x
<i>Cordia subcordata</i>	Boraginaceae	Tou		x
<i>Digitaria stenotaphrodes</i>	Poaceae		X	x
<i>Guettarda speciosa</i>	Rubiaceae	Kahaia	x	x
<i>Heliotropium foertherianum</i>	Boraginaceae	Gneogneo, Pupiu	x	x
<i>Kadua romanzoffiana</i>	Rubiaceae	Poroporo, Koporoporo	x	x
<i>Lepidium bidentatum</i>	Brassicaceae	Rorohoro, Horahora	x	x
<i>Lepturus repens</i>	Poaceae	Nanamu, Mauku	x	x
<i>Microsorium grossum</i>	Polypodiaceae	Metuapuaa	x	x
<i>Nesogenes euphrasioides</i>	Chloanthacée		x	x
<i>Pandanus tectorius</i> var. <i>tectorius</i>	Pandanaceae	Fara, Puhara, Tima	x	x
<i>Pemphis acidula</i>	Lythraceae	Miki miki, Tupapa	x	x
<i>Pisonia grandis</i>	Nyctaginaceae	Gatae, Puka, Pukatea	1 cluster	
<i>Portulaca lutea</i>	Portulacaceae	Aturi, Pokea	x	x
<i>Psilotum nudum</i>	Psilotaceae	Aito	x	x
<i>Scaevola taccada</i> var. <i>tuamotuensis</i>	Goodeniaceae	Naupata, Ngapata, Kopapa	x	x
<i>Suriana maritima</i>	Surianaceae	Gegie	x	x
<i>Triumfetta procumbens</i>	Malvaceae	Urío	x	x
Introduced				
<i>Acalypha godseffiana</i> var. <i>godseffiana</i>	Euphorbiaceae	Faux-caféier		x
<i>Chamaesyce hirta</i>	Euphorbiaceae	Eniu, Gnaiu		x
<i>Cocos nucifera</i>	Arecaceae	Haari, Niu	x	x
<i>Conyza canadensis</i>	Asteraceae			x
<i>Eragrostis pilosa</i>	Poaceae	Nanamu		x
<i>Hibiscus</i> sp.	Malvaceae			x
<i>Lantana camara</i>	Verbenaceae	Lantana, Tarataramoa		x
<i>Morinda citrifolia</i>	Rubiaceae	Nono	x	x
<i>Solanum viride</i>	Solanaceae	Oporo, Poro	x	x
<i>Terminalia catappa</i>	Combretaceae	Auteraa, Koueriki		x
<i>Triumfetta rhomboidea</i>	Tiliaceae	Piri piri	x	

Appendix 5 – Locations of key bird sites at Tenararo, Vahanga and Tenarunga

A. Tenararo



B. Vahanga

Motu nomenclature and locations of Tukururu sightings – refer Table 3.1



### C. Tenarunga

Location of Tukururu sightings – map from Zito (2015). Refer also Table 3.1.

