

**BIRD SURVEYS OF LATE AND FONUALEI ISLANDS,
VAVA'U, KINGDOM OF TONGA
SEPTEMBER 2013**

**REPORT to MINISTRY of LANDS, ENVIRONMENT,
CLIMATE CHANGE and NATURAL RESOURCES (MLECCNR)**



Late Island

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Implementing Agency: MLECCNR
Executing Agency: Secretariat of the Pacific Regional Biodiversity Program (SPREP)**

Executive Summary

The survey team were able to spend 3 days on Fonualei Island and two days on Late with support from a Vava'u based fishing boat and checked several areas not visited during the previous 2003 and 2004 scientific surveys.

We identified that the Polynesian megapode (malau) *Megapodius pritchardii* continues to survive in good numbers on Fonualei, locating good numbers in a new area suggesting the total population may be close to 1000. We did not locate malau on Late and concluded that there is very little chance that they survive on this island.

Both islands are important refuges for Tongan bird species with Fonualei Island of greater significance for malau, and seabirds which nest there in their thousands, and Late Island having a greater variety of landbirds including the endemic Samoan whistler *Pachycephala jacquinoti*.

No reptiles were found on Fonualei and four widespread species (2 geckos and 2 skinks) were found on Late. A single Tongan flying fox (*Pteropus tonganus*) was seen during the survey – on Fonualei. Very few landcrabs and no hermit crabs were found on either island though coconut crabs (*Birgus latro*) were present on Late. The more diverse fauna on Late reflects the greater diversity of habitats found there including mature forest, which in turn relates to this island having a longer time interval since the last significant volcanic eruption.

The invasive Pacific rat (*Rattus exulans*) was found in small numbers on Late, particularly near the coast and not detected on Fonualei. Previous surveys have made the same findings which presumably relate to Late having had much greater human activity including past planting of coconuts and kava. Samples of rat tails were collected for subsequent DNA analysis. Pigs (*Sus scrofa*) have been reported from Late in the past but we saw no sign of them.

We consider that eradicating rats from Late would be feasible through an aerial drop of poison as there don't seem to be high numbers of rats and very few landcrabs to compete for the bait. There are no major non-target issues there. This would be a very worthwhile activity to benefit the diverse native fauna found there and increase the productivity of forest trees and shrubs. There should be an assessment of the feasibility of making a further attempt to introduce malau to Late once the rats have been successfully removed.

These islands are very important refuges for Tonga's native biodiversity and every effort needs to be made to keep them free of any further invasive species. All parties visiting the islands need to be subject to detailed biosecurity procedures.

1. Introduction (from consultancy TOR):

The objective of the project was improved conservation status of priority threatened species, consistent with selected outcomes set out in the Island Biodiversity Programme of Work (IBPOW). Surveys were initially aimed at establishing the status of species at different sites in the Vava'u Group, Niuafu'ou, Late and Fonualei to assess fate of introduced populations of

Polynesian Megapode. However cancellation of flights to Niuafu'ou resulted in work here being deferred.

Late Island is an isolated 6-km wide circular island about 55 km WSW of the island of Vava'u which rises to 565m. The island is an uninhabited 15sq km island which rises to 565m. It is volcanically active but has been dormant since 1854. Late has some of the finest forest to be found in Tonga and is a global stronghold of the threatened friendly ground-dove *Gallicolumba stairi* and the endemic Tongan whistler. A translocation attempt of the Polynesian Megapode to Late was made in 1992. An initial positive report (1997) was not confirmed by searchers at the translocation site in 2003 and 2004. Late is also home to seven central Polynesian Restricted Range Species, as well as eleven species of seabird which are currently believed to breed on the island.

Fonualei is an isolated island about 65km north west of Vava'u. It is a round volcanic cone with a fumarolically active crater, approximately 1.5km across, which rises to about 195m. There are steep cliffs on all but the eastern side. Fonualei IBA comprises the whole island of Fonualei which supports a recently established population of the Polynesian Megapode and another globally threatened species, the friendly ground-dove *Gallicolumba stairi*. The island is an isolated active volcano, approximately 200 ha in areas and the megapodes lay their eggs in soil heated by volcanic ducts. The introducing of Polynesian Megapodes to Fonualei in the 1990s was successful as the result in 2003 shows a doubling in the population of Polynesian Megapode in the island.

2. Methodology

2.1 Personnel

Field team:

Samiuela Pakileata
Senituli Finau
Viliani Hakaumotu
Filimone Moli

MVAkina Crew: [add other names please]

Vili
Eriki
Ola

Project Coordination:

Ana Fekau

Regional Project Support:

Gianluca Serra, Bruce Jefferies, Easter Galuvao (SPREP).

2.2 Summary of activity on islands

Activity on the islands is summarised below. Techniques adopted were noting birds seen and heard during daytime surveys; the use of playback of calls to detect malau; overnight placement of automatic sound recorders; deployment of glue traps to catch rats and reptiles and snap traps for rats; and brief nocturnal surveys for lizards. Significant locations were recorded as waypoints using GPS devices and placed on maps.

Mon 2/9 Vava'u to Fonualei

Left Neifau, Vavau at 12.35pm on MV Akina in fine southerly weather. Around 6pm Loku Island visible to right. 8.45pm anchored off Fonualei – opposite beach of small rocks on NW corner.



MV Akina at anchor



Fonualei – beach of small boulders (future landing)



**Fonualei – landing beach of large boulders 2013
(Malau nesting ground above fissure with steam)**

Tues 3/9 Fonualei (see map 1)

Sailed down to rocky beach on west side opposite cliff faces issuing steam and landed ashore on large rocky boulders with some difficulty. Two malau ran to greet us as soon as we entered forest. Set up camp (waypoint 459). Several hours of searching up slopes looking for malau – difficult going with thick angled trees and much loose soil. Visited an area between waypoints 462, 463 and 467 observing 30+ adults and 3 malau chicks and found one active burrow with a single egg (466).

Wed 4/9 Fonualei

Set out 9.30am directly uphill, setting glue traps from just above camp to summit & using playback to locate malau. Six birds located before waypoint 473 and last bird at 475 in habitat with much fern ground cover and some trees. Walked to beyond summit making observations of other bird species and back at 3.40pm in heavy showers. Set 15 rat traps to 6.40pm from camp along coast to 483 – peanut butter/roasted coconut.

30 minutes of lizard searching at night in ideal warm conditions with negative results. A few *Carcinus*-type crabs were seen including one up a tree but no hermit or coconut crabs.

I automatic sound recorder set up at camp from 9pm for 12 hours.

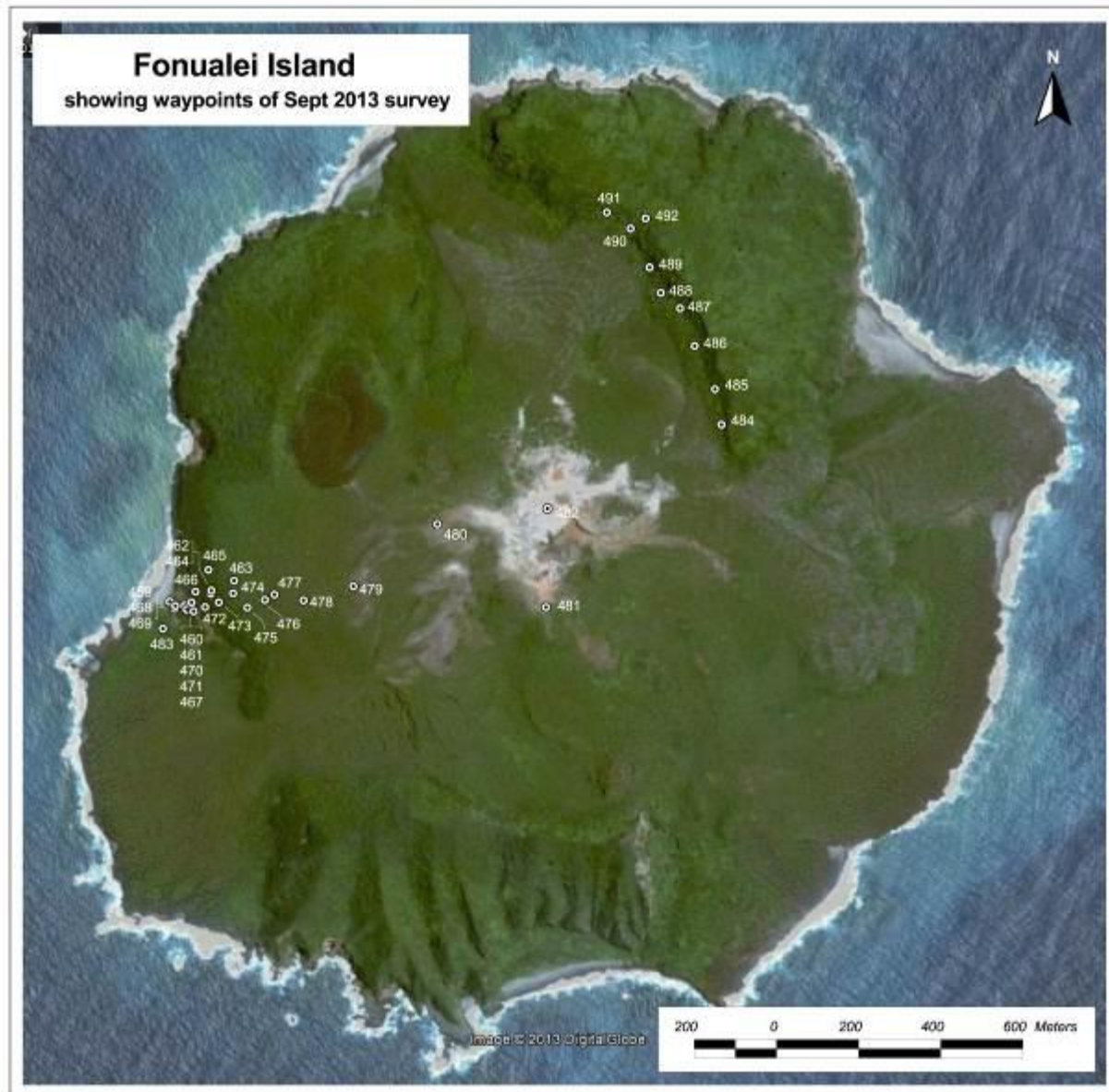
Thurs 5/9 Fonualei

Checked rat traps – 1 sprung by a crab, rest untouched and bait intact.

9.05am climb up hill checking glue traps and reached first sooty tern colony on crater rim after 1hr. Climb down grassy then rocky slopes to east and at 11.50pm dropped into top of gully (waypoint 484). Playback done and response after 5 minutes by a bird that flew close. Playback not required after that point as we encountered malau at regular intervals walking north down the dry bed of the gully. West side of the gully was rocky and the east side was an easy slope with deep soil. Gully a sequence of pairs and expect more on slopes above to coast. 35 malau were seen over gully length of 620 metres (waypoints 484-491), some as singles and some as pairs. Also found malau at the top of the eastern slope at 492 where two mature coconut trees were found so anticipate birds occupying a large area of forest in this area potentially to the coast. Left gully at 3.45pm.

(Note: following this gully round further you would approach the coast at the long beach with small boulders (due west of 491) that we anchored opposite on the first evening. This beach would be suggested as the landing point for future work on malau on Fonualei providing fairly ready access to the gully forest.)

Collected sticky traps on descent – no lizards, rodents, few ants and one spotless crane in a lower trap.



Map 1 Fonualei

Fri 6/9 Fonualei to Late

Checked rat traps – none sprung - most of coconut left. Swam to boat and departed 8.45am in slight swell but no white caps. Arrived Late 5.45pm and at anchor at 6pm. (9 hour trip) – good sailing throughout and no rain.

Sat 7/9 Late Island (see map 2)

9am at camp site (493) after landing though a narrow gap into sheltered small rocky bay. Set up camp and one party of three set out inland on compass bearing south while the other walked round the coast to the east (no waypoints collected as GPS faulty) – both conducting playback

for malau at intervals with no response. Coastal team caught three geckos and a skink. Set glue traps with coconut bait on inland transect (1 on tree 1 on ground) using GPS to measure distances between waypoints: 494, 495 (50m apart), 496, (100m), 497, 498, 499 (first Tongan whistler seen here), 500 (100m apart). One automatic sound recorder placed on top of hill at 501 (AR4 – 15% used – 3pm for 20 hours 123m alt facing SW to summit.), 502 (120m). Turned back 3pm and reached camp at 3.30pm about same time as other party. Placed ten further glue traps - 9 at camp, 10 in coconuts (503), 11 in pandanus (504), where a rat was seen in morning (505), and rocks by coast (506). 5 rat traps set each direction from camp (10 in all).

Sun 8/9 Late Island

Checked rat traps and glue traps to coast. Caught and processed 2 *Rattus exulans*.

One team re-traced inland transect to waypoint 502 collecting rats from 496 and 500, then continued on to summit (compass bearing S to 160°) finding some ridges with good walking and thick fern-filled gully that required much bush-knife work. Playback of malau calls at intervals until habitat became dry and rocky – no responses. Reached summit (521) at 2pm and back by 3.45pm, collecting glue traps and sound recorder.

Other team based at camp set 5 rat traps and 17 glue traps parallel with coast.

Night-time survey for lizards found two geckos.

Mon 9/9 Late Island – and to Vava’u

Checked traps and processed 5 rats caught on glue and snap traps around coast. Left Late at 12pm and circled partly round island to west before heading to Vavau at 1pm reaching Neifau at 9pm. Sequence of photos taken round coast.



Late – departing from sheltered cove.



Late – final load departure off rocks.



Map 2 – Late Island

GPS work

GPS waypoints were obtained at intervals to locate trap sites and features on the maps. A computer folder with such points will be supplied separately.

Device used: Garmin GPSmap 60CSx

Settings: Position format: hddd°mm’ss.s” Map Datum: WGS84.

3. Results

3.1 Bird Observations – Fonualei Island

Polynesian Megapode (Malau)

About forty birds were seen at each of two sites – the forested slopes above camp and the forested gully in the north of the island. At the first site birds were present from the coast up to waypoint 475 at 156m altitude when the understory was becoming increasingly dominated by thick fern. At the second site birds there was a dense sequence of territories along the floor of the gully and apparently further territories up the slope. Several chicks were seen at the first site and one active nesting burrow located. No active burrows were found at the second site and there was no evidence of heat (or steam) at the surface here but very deep easily dug soils.

Shy Ground-Dove – common in forest and in open grassland near summit

Pacific Pigeon – surprisingly numerous in most habitats.

Spotless Crake – 1 seen and 1 caught on glue trap

Purple Swamphen – c6 pairs; one with two large chicks.

Brown Booby – 100+ birds with chicks at various stages from fluffy white to fledging

Red-footed Booby – less abundant than brown booby – nesting not noted

Great & Lesser Frigatebird – fewer than 100 with chicks in various stages; some males with red throats – generally not identified to species

Sooty Tern – 3 colonies along ridge west of crater with chicks flighted or close to flying – total population 5000-10,000.

White Tern – several hundred seen most in the gully forest

Red-tailed tropic bird – 1 seen

Brown Noddy – sizeable colonies with some sitting on nests in tall trees in gully forest (waypoints 487, 490)

Black Noddy – most noddies seen were identified as brown with small numbers of black present

Golden Plover – 5 flying near summit

Bristle-thighed curlew – 1 seen flying and calling near summit

Turnstone – 3 flying near summit

Long-tailed cuckoo – 1 seen.

Wattled honeyeater – common throughout.

Polynesian starling – common throughout.

Petrels & Shearwaters – no birds were seen or heard well enough to identify to species on either island, but automatic sound recordings will be examined in the hope of locating some specific calls. No active nesting burrows were found on either island.

Native Mammals

Tongan flying fox – 1 seen flying over coastal forest on Fonualei in evening. (None seen Late)

Humpback Whale – seen occasionally near the islands with several close to boat off Fonualei during night.

3.2 Bird Observations – Late Island

Shy Ground-Dove – common in lower forest areas

Pacific Pigeon – heard throughout.

Spotless Crake – 1 caught on glue trap

Brown Booby – few seen

Red-footed Booby – few seen

Frigatebird - few seen – nesting in mature forest

White Tern – good numbers seen in coastal areas and summit crater

White-tailed tropic bird - a few flying in crater.

Brown Noddy, Black Noddy – hundreds seen on rocks/cliffs around coast from boat – not identified to species but according to Watling (2003) most would have been black

Tongan whistler – several seen/heard in more mature forest

Long-tailed cuckoo – 1 seen

Wattled honeyeater - common throughout.

Polynesian starling - common throughout.

Crimson-crowned fruit dove – heard regularly in more mature forest

Many-coloured fruit dove - small number heard

Kingfisher – several seen and heard at various altitudes.

White-rumped Swiftlet – few hawking around summit and coast in evening.

Barn Owl – 1 flew along coast in evening

Reed heron (white phase) – 1 seen on coast

Shining parrot – one squawk heard may have been from this species.

No megapodes were detected on Late.



Shy ground-dove (Tū) - male



Nestling frigatebird (Lofa, Helekosi)



Nestling brown booby (Ngutulei)



Spotless crake (Moho) released from glue trap



Purple swamphen & chick (kala)



Sooty Tern fledgling ('Ekiaki)

3.3 Reptiles

No reptiles were seen or caught in glue traps on Fonualei.

The following were recorded on Late:

Oceanic gecko *Gehyra oceanica* – 3 found in timber and at night

Slender toed gecko – *Nactus pelagicus* – 1 found during day and 1 seen at night

Moth skink – *Lipinia noctua* - 1 found in day

Blue tail skink – *Emoia impar* - one caught in glue trap and 1 seen on coastal rocks during day

One unidentified skink was seen in rock and low scrub near the summit

Banded sea snake (*Laticauda colubrina*) – one seen ashore on rocks.

3.4 Rats

Rat trapping

No rats were detected on Fonualei following 34 trap nights of glue trapping from the coast to the summit ridge and 30 trap nights of snap-trapping near the coast. No feeding sign was observed or animals seen during night-time searches. It is concluded that rats are probably absent from the island.

The first rat was seen on Late during the day walking from the boat to set up camp. Seven *Rattus exulans* were caught in glue and snap trapping sessions, 7 males, 1 female and 1 juvenile. Rat densities were not considered high as bait (roasted coconut and smears of peanut butter) remained intact on the majority of snap traps after being left out for two nights. All but two rats were caught in glue traps and two others also escaped from these leaving fur behind.

Samples for DNA analysis

Tail samples were taken from each rat using the usual precautions to ensure no cross-contamination and stored in 95% ethanol. Examination identified that none of the males had prominent testes and the female was carrying no young and not lactating.

Samples obtained on the 8th were 2 labelled 'C' at the camp (waypoint 493 18°47'08.1" 174°39'05.0"), 1 labelled '3' 200m inland (waypoint 496 18°47'14.7" 174°39'07.7") and 1 '7' 600m inland (waypoint 500 18°47'27.4" 174°39'14.2"). Samples on the 9th came from sites along the coast from the camp (no waypoints).



Late – Viliami setting glue trap on Pandanus



Late - Rat on glue trap baited with roast coconut



Late - Rat in snap trap



Late - Juvenile rat on glue trap

4. Discussion

This report summarises the results of brief visits to the two islands with time ashore limited by the length of time taken to reach them and the need to leave Late a day early due to approaching bad weather. Several previous survey teams have been unable to reach the islands at all due to sea conditions. The overall results are similar to, and extend the findings of, previous surveys which provides more confidence that the conclusions are correct.

This discussion focusses first on the malau and includes information on the volcanic history of the two islands which may be relevant to their suitability for the species. It then considers biosecurity and the proposal to eradicate rats from Late.

4.1 Status of Polynesian megapode - Malau

Fonualei Island

Malau are present in good numbers in the two areas of suitable forest habitat visited during the survey and are breeding successfully. Watling (2003) recorded 38-56 malau at the first site we visited and based on the proportion of island visited and the areas of suitable habitat he 'guesstimated' the population at 300-500. We have added a second site which alone would seem likely to hold over 100 birds. Based on our observations including the presence of malau up to almost 160m in altitude where the forest transitions to fern and scrub, it seems likely that the two areas defined in red on the map below offer suitable habitat for the species. Based on encountering c.40 malau in the two areas surveyed (in blue) the population in the northern area could be more than 600 birds. The southern area has not been visited but if birds were found there at similar densities it could hold 400. So I would conclude that there may be 600-1000 malau on Fonualei, significantly more than on Niuafou'ou.



Fonualei Island showing forested areas that may be inhabited by malau

Late Island

No malau were detected on Late. This survey covered an area on the northern side of the island. This side has been the one traditionally visited by Tongans with areas used periodically for kava plantations and it has significant areas of coconuts. Judging by a circuit of much of the island by boat the habitats we surveyed from shore to summit were typical of the island as a whole.

Watling (2003 & pers. comm.) surveyed the eastern part of the island in 2003 (c. 1 day) and 2004 (c. 1 week) focussing on the area around the crater lake where malau eggs were initially buried in 1991-93. He also found no birds and no indications of their presence.

Combining our findings, I would conclude that malau are very unlikely to survive on Late. The 'release' area has been surveyed in detail and we have now added a transect through typical forest from another part of the island. There does not appear to be any different habitats that have not been surveyed with the possible exception of the floor of the summit crater (as photo below) where there was forest and some open, sandy-looking areas.



Late – looking down into main crater

Section 7.2 identifies that a volcanologist did detect some activity and steam on Late in the 1970s and it would be worth finding out whether this was in this area. It could theoretically be accessed from the south as the crater ‘breaks open’ in this direction, or more readily by helicopter if one is used for a rat eradication (see 7.3).

An obvious question is whether a further attempt to establish malau on Late is worthwhile, perhaps this time transferring adults and chicks as worked on Fonualei. It is suggested that this is not considered until rats are eradicated, and that a range of experts are consulted. Clearly Late has been volcanically less active than Fonualei over the last 200 years (section 7.3) and appears to provide less opportunity for eggs to be incubated through heat derived from such activity. However megapodes as a group have other incubation strategies including using the heat of the sun on exposed beaches or cinder fields, and using decompositional heat from plant matter in burrows between tree roots. I am uncertain whether the malau can use such strategies.

4.2 Volcanic history of the two islands

Late clearly has a more mature, diverse vegetation cover than Fonualei and appears inert. However a volcanologist reports some minor activity there on his website: “In 1970's weak solfataric activity was present in the crater. Steam was found in a fracture near the graben on the eastern side of the island. Lack of strong fumarolic activity and the thick jungle on the volcano, indicate no recent volcanic activity” (<http://www.volcanolive.com/late.html>). It is unclear which crater is referred to. Partial eruptions of Late were reported in 1790 and 1854 confined to the north-east flank of the island so most of the habitat on the island has had more than 220 years to develop, potentially many more.

In contrast, Fonualei was said to have been *'so shaken by an eruption in June, 1846, that canoes can now sail in and out of the crater'* and the islet *'which until that year was covered with verdure and abounded with fruit, as reduced in August, 1847, to a huge mass of lava and burnt sand without one leaf or blade of grass of any kind. All things that had life had been utterly destroyed, the inhabitants having, however, warned by violent earthquakes which preceded the eruption, happily escaped previously to Vava'u.'* (Rev Lawry in Spennemann 2004). So its forest had formed from bare lava over a period of only 160 years. Other more minor eruptions have been recorded on Fonualei in 1906, 1939, 1951, 1957 and 1974 (data of Global Volcanism Program, Department of Mineral Sciences, National Museum of Natural History, Washington, USA).

From a malau viewpoint, Late Island does not appear to currently offer the same opportunities for incubation of eggs through volcanic heat that Fonualei does. However it is noted that in 2006 a large raft of pumice rock was found on the sea surface near Late and a new volcanic island appeared to its south, so Late could go through another period of activity at any time.

4.3 Biosecurity

Any visit to islands significant for the conservation of native biodiversity need to address the biosecurity risk of introducing invasive species. Biosecurity precautions need to be taken prior to departure from home base and upon arrival on the islands. Ideally all food, equipment and personal effects would be packed in sealed containers before departure. In practice this was not possible with food and cooking pots bought loose on the last morning and root crops delivered to the boat just prior to departure. The photo below shows stems of kape (giant taro) with roots covered in soil, and tops with spaces between leaf stems that could provide refuges for invertebrates or even reptiles. These were completely peeled before being taken on to the islands.



Photo: Giant taro with soil – a high biosecurity risk

Other root vegetables were delivered in sacks covered with soil and washed in the sea before being allowed onto Late.



Washing taro in the sea at Late

Upon arrival on Fonualei, all bags and boxes were opened on to a spread-out tarpaulin to check for any for any unwanted species. Ideally a can of fly spray should have been available to kill any insects that were found.

It was more difficult to ensure that insects were not taken from Fonualei to Late after tents had been erected and equipment set out on the first island. Given this it was important to visit Fonualei, the more remote and unmodified island, first. Any pest animals found on Fonualei would be likely to be present on Late, whereas the reverse was not true. As it happened sea water entered a number of the containers when leaving Fonualei and they were re-packed and checked for pests on the boat.

4.4 Information for planned rat eradication, Late Island

An eradication of rats from Late had been identified as a priority before this survey, following a review of invasive species issues in Tonga. The following conclusions are offered in relation to this:

- There is no evidence of rats on Fonualei – if rats had been detected their eradication could be a higher priority than Late given the presence of the Polynesian megapode
- The Pacific rat (*Rattus exulans*) is present on Late though not in particularly high density.
- Rats were not in breeding condition though a juvenile was trapped

- There are very few competitors for poison baits on Late – no land crabs were seen except a few Coconut crabs; there are few ants and there was no evidence of the presence of pigs (reported in the past)
- There are no significant non-target species at risk. Coconut crabs may be affected. Some shy ground-doves were taken in captivity in Samoa prior to an aerial poisoning operation as they were considered at risk. However birds left on the islands survived so this precaution is not necessary.
- Fallen fruit was relatively abundant. Fruits were gathered up for the first photo below but the second was natural.



Late – fruit on forest floor

- There are several caves on the island and large fissures in the crater. From a topographical and logistical viewpoint an aerial operation using a helicopter will be appropriate. Even if rats are living in caves, etc. it seems likely that they will need to come to the surface to feed and thus be exposed to baits. The cliffs are relatively low but will need to be thoroughly treated, ideally in conditions of minimal wind.



Late – coastal cave

Late – inland cave

A sequence of habitat photos were taken on the walk to the summit and a second sequence of views of the island taken from the boat during the partial circumnavigation. These will be made available for the feasibility study for the rat eradication.

4.5 Logistics and Safety

This survey was supported by a relatively slow fishing boat. This somewhat reduced time ashore but this disadvantage was outweighed by the benefits of having it anchored off the islands throughout the trip. This was very positive from a safety viewpoint. It also allowed us to be supplied with fresh fish, and water once our supply had run out. I supplied two-way radios that proved invaluable, allowing us to communicate daily with the boat from shore to organise our activities. An emergency locator beacon was also hired in New Zealand and kept with the field team at all times.

Volcanic islands, particularly active ones, can be dangerous places. There was a ‘near miss’ when a boulder dislodged by one of the party caused several very large ones to fall close to a following team member. Health and safety needs to be treated as a priority and people should at least work as pairs at all times.

5. Recommendations

1. These island need to be treated as very important refuges for Tonga’s biodiversity. An assessment is needed to decide whether their conservation is better assured by leaving them as they are or giving them some form of legal protection.
2. Human visitors are the greatest manageable threats to the biodiversity of the islands though they are vulnerable to natural disasters such as volcanic eruptions, cyclones and tsunamis. Visitation should not be discouraged and any teams going there need to take detailed biosecurity precautions. A biosecurity plan should be drawn up for each island.
3. An operation to eradicate rats from Late Island should continue to be developed as both achievable and beneficial. An aerial poisoning operation appears the most cost-effective option. There is no evidence that such an eradication operation is needed on Fonualei.
4. An assessment should be undertaken to decide whether a further attempt should be made to reintroduce malau to Late once the rats are removed. Fonualei could act as the source population.
5. The islands should be re-visited at c. 5-yearly intervals to monitor their biodiversity using the 2013 and 2003/04 results as baselines. For Fonualei it is suggested that a landing is made at the beach of small boulders in the northwest of the island pictured on p.4 which gives access to the forested gully in which many malau were found. The nesting ground on the western side where we camped can then be checked by walking via the summit. For Late the landing site is less important as there are no malau to monitor and the birds and reptiles are likely to be evenly distributed across the island. Options include the northern site we used or the north-western one chosen by Watling (2003). The interior of the crater is a final area that could be checked for malau – and for sources of heat for incubation.

6. Discussions should be held with SPREP and Island Conservation to identify the best place to store the rat tails collected on Late Island, so that they would be available if needed in the event of a re-invasion after eradication. (A secure site where they are periodically checked to ensure they do not dry out is needed). Alternatively DNA analyses could be carried out now if funds were available and the results stored securely.
7. Our findings on malau should be incorporated in a revised version of the Conservation Strategy for the species once a planned re-survey to Niuafu'ou is completed.
8. A press release should be prepared and distributed internationally summarising the results obtained on Fonualei and Late.

Acknowledgements

I thank the Ministry of Lands, Environment, Climate Change and Natural Resources for contracting me to assist with these surveys – it was a privilege to visit such special places and work with the Ministry Team. This report was significantly improved through comments received on an earlier draft from CEO 'Asipeli Palaki. I thank Samiuela Pakileata, Senituli Finau and Viliami Hakaumotu for their energy, support and good humour throughout the fieldwork. Filimone Moli, Uola Matangi and Aliko Taufu were also of significant assistance on Late. Vili Olive and Aliko Taufu skilfully ferried us to, and on and off, the islands and everyone took care to make the trip a safe and enjoyable one.

'Ana Fekau undertook all the organisation for the project and dealt with the challenges of changing flight schedules and boat availability very efficiently. It feels good to be delivering you results that will be valuable for bird conservation in Tonga to repay your support. I appreciated the assistance provided on Vava'u by Winnie Laumanu.

Ann Goeth and Huw Lloyd generously shared their knowledge and experience of the malau. Dick Watling provided invaluable detailed advice about previous visits to Fonualei and Late that helped with the design of the present survey and allowed us to make maximum use of the time available. All three showed a strong commitment to the conservation of the bird and these special places.

Gianluca Serra, Easter Galuvao and Bruce Jefferies at SPREP provided support and advice throughout the planning of this work and it was a pleasure to share time with the last on Vava'u. David Moverley (SPREP) and Richard Griffiths advised on invasives issues.

Rhys Buckingham of Wildlife Surveys provided recording and playback equipment and Les Moran kindly organised the loan of cases and dry bags from colleagues at the New Zealand Department of Conservation.

The natural drama of Fonualei in particular, with steam issuing from many vents and fissures after rain and grass too hot to sit on, made the expedition a very special experience. I appreciated this opportunity and thank all those who made it possible.



Author with Senituli and Samu on Fonualei



Aliki and Vili



Viliani and Uola



Filimone

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Note: No report was written by Watling following his 2004 survey of Late as they were forced by bad weather to abandon equipment there and walk for many hours to a suitable site for getting back to the boat. Notebooks, etc. had been destroyed by the time they were retrieved. He communicated by email the fact that they camped for a week near the lake and did myriad broadcasting of malau calls without a response. They also did a lot digging about around the lake, especially around the place where the eggs were apparently buried and found no elevated

temperatures. They concluded that there were no malau present in this area and no thermal vents around the lake.

Annex 1: Itinerary (Butler)

Thurs 29 August – Nelson to Auckland (NZ 8388)
Fri 30 August – Auckland to Nukualofa (NZ 970)
Sat 31 August – Nukualofa to Vavau (Real Tonga)
Sun 1 September – Vavau
Mon 2 September – Vavau to Fonualei
Tues 3 September – arrive Fonualei
Wed 4 September – Fonualei
Thurs 5 September - Fonualei
Fri 6 September – Fonualei to Late
Sat 7 September - Late
Sun 8 September - Late
Mon 9 September – Late to Vavau
Tues 10 September – Vavau to Nukualofa (Real Tonga)
Wed 11 September – Nukualofa to Auckland (NZ 277)
Thurs 12 September – Auckland to Nelson (NZ 8375)

Fonualei Images



Malau nesting ground with steam in background



Malau nesting burrow with 1 egg (waypoint 466)



Brown booby on crater rim with steaming slopes



Main Crater



Looking north into gully forest



Sooty tern colony

Late Images



Coastal view by landing area



Lowland forest



Mid-slope Ridge forest



Low forest and scrub near summit



Looking across summit crater



View to north from summit