PRELIMINARY REPORT ON TINAKULA AND REEF ISLANDS SURVEYS OF VAKAVAKATIA (SANTA CRUZ GROUND-DOVE) AND VLUMBA (PALM LORIKEET)

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EOPL Report to Temotu Community, ECD, MBZ Trust and SCGD Action Plan Group.

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Cover photo: Vakavakatia nest – Credit: SS/RP.

Key Terms and Acronyms

Bona	Pacific Pigeon
ECD	Environment and Conservation Division of MECDM
Leibu	Pacific Emerald Dove
LFA	Little Fire Ant
MBZSCF	Mohamed bin Zayed Species Conservation Fund
MECDM	Ministry of Environment, Climate Change, Disaster Management & Meteorology
Phenology	Flowering and fruiting state of trees and other plants
SCGD	Santa Cruz Ground-dove or Vakavakatia
SCGDAP	Santa Cruz Ground-dove Action Plan
TCSDA	Temotu Conservation and Sustainable Development Association
TPG	Temotu Provincil Government
Vakavakatia	Santa Cruz Ground-dove
Vlumba	Palm Lorikeet
WRS	Wildlife Refuge Singapore (Jurong)
YCA	Yellow Crazy Ant

SUMMARY

Field surveys and community consultations were undertaken in the Temotu Province in August-September 2019 to help understand and guide conservation work for Vakavakatia (SCGD) and Vlumba (Palm Lorikeet). These two species populations underwent significant trauma on 23 October 2017 when Tinikula Volcano erupted coating the entire island in ash resulting in medium term loss of food resources. On top of this, over 100 SCGD were intercepted and seized by authorities at Honiara following the 2017 expedition's discovery of trapped birds being held in captivity at Malo, Temotu Province.

Two year's on, in 2019, we found that Vakavakatia and Vlumba have made strong recoveries on Tinakula, in line with the recovery of the ecosystem there. The Vakavakatia have recovered in the face of abundant invasive ant species and a rampantly out of control feral pig population, the latter of which need eradicating. Vakavakatia were found to nest in *Pandanus* trees and a comparison of LFA abundance in different tree species appears to provide an answer to the question of how Vakavakatia can recover in the face of abundant LFA. This is an ideal follow-up hypothesis for local community members, led by David Tao, to test seasonally and so provide very useful information to help guide the recovery of the species, as well as achieve better input and inclusiveness from the community in the SCGD programme. This, together with strenghtened biosecurity (to exclude rats, cats, mynas, etc.) and pig removal are the most urgent actions needed at Tinakula.

Our surveys of the Reef Islands revealed only one rat-free island – a tiny, uninhabited, rapidly eroding, oceanic island. However, several of the other inhabited islands in the Reef Islands do contain important habitat, good soils and diverse angiosperm species that would be suitable for Vakavakatia and Vlumba if rats were removed and cats/dogs excluded (the latter exclusion needed for Vakavakatia). One of these islands, Nukapu at 31 ha in area, met nearly all of the criteria for an ideal introduction site with the bonus that Vlumba are currently visiting it as well, but apparently not resident.

Most of the Temotu leaders and islands' chiefs indicated support for the eradication of rats and introduction of Vakavakatia, or at least going to the next stage (a concept plan for rat eradication). This concept plan, together with a scoping document for Biosecurity, is appended to this report and hard copies will be sent to chiefs and other leaders for review, local discussion and feedback via the TCSDA and Temotu Provincial Government (TPG) before the report is finalised and the next stages (operational plan and funding) addressed. The communities expressed a desire for the captive birds to be returned to Temotu with some useful suggestions re locations. In discussion, there was general agreement to the logic of keeping a productive captive population and establishing back-up populations at Temotu as security against catastrophic events, including rat invasion of Tinakula, which is always going to be a possibility.

ACKNOWLEDGEMENTS

Many people at Temotu Province supported this survey and related work including the Hon. Premier Clay Forau and the Minister of Small Islands Edward Daiwo, with whom we met before and after the surveys. Similar support also came from the Honorary Mathew Matoko (MPA FenuaLoa Ward), Chief Henry Laky (Nukapu), Chief at Matema, Mathia Huntlex (Matema), Chief at Niupani in 2017, Chiefs of Neo and Menivi (Malo), Honorary Member Nixon Lauoli, and Father Hine (Lata). Luke Paul Taule (Senior Fisheries Officer Lata) and his Fisheries staff provided workshop facilities and ongoing support, World Vision SI (Lata) kindly loaned a laptop. Solomon Islands Government support came from Deputy Director of ECD Joseph Huraturu and his staff at Honiara, Francis Tsatsia (Director SI Biosecurity), NZHC Honiara, Titus Godfrey and family (Honiara and Lata). We thank also the support from Steve Cranwell (BirdLife Pacific for ongoing advice on rodent matters), the international SCGD team including Joe Wood (Honiara) for accompanying RO on an earlier consultation visit to Nende, and the earlier considerable effort by OceansWatch in helping to set up conservation infrastructure at Temotu Province, notably the TCSDA. We thank MBZSCF, MECDM and EcoOceania for funding operational and staff components of this work.

1.0 BACKGORUND AND OBJECTIVES

Following the Category Three "minor" eruption of the Tinakula strato-volcano at c.0620 on 23 October 2017, volcanic ash was thrown over 10 km into the atmosphere and downwind for tens of km (Government of Solomon Islands 2017). Many Santa Cruz Ground-doves (Vakavakatia) and other birds are pressumed to have subsequently died on the island or surrounding seas. Days before the eruption, however, at least 70 smuggled Vakavakatia had been found in cages at nearby Malo Island (Pierce 2017) and a total of over 100 birds were subsequently intercepted at Guadalcanal by ECD (J Huraturu pers. comm.). These birds were subsequently cared for in captivity by Joe Wood and team at a basic Agriculture facility near Henderson Airport in Honiara and many were later transferred to better facilities at WRS Singapore. These latter birds are currently faring well in captivity and many are breeding, and some of the Honiara birds have also bred (J. Wood, Ivan Choo Wei Kiat, pers. comms.).

It is the recommendation of the Santa Cruz Ground-Dove Action Plan (Pierce et al. 2018, herafter referred to as SCGDAP) to rehabilitate some of the captive birds currently held at Honiara back on Tinakula, depnding on their being a sufficient recovery in the habitat and also depending on the status of the SCGD population there. Other birds will form the basis of a captive breeding population at WRS Singapore and potentially other sites as a species insurance, and more particularly to be used for founding additional wild populations as suitable sites are identified and/or restored.

The August-September 2019 survey of Tinakula focused on assessing the recovery of the ecosystem and its Vakavakatia population (SCGDAP Objective 2). A related objective is to determine status of invasive species (Objective 3), especially *Wasmannia aurpunctata,* which has invaded Tinakula and is threatening the health of the ecosystem and species, and whether Vakavaktia have been capable of recovering in the presence of the ants. If Vakavakatia are doing poorly then it may be necessary to begin management of invasive ants there and/or relocate some of the birds to other islands and/or other captivity institutions whilst management of invasive ants and rats on islands is undertaken.

In addition, we surveyed several small islands in the nearby Reef Islands to assess whether Vakavakatia are present and/or whether the islands are suitable for or could be restored to accommodate released birds from the growing captive population. This addresses Objective 5 (back-up population) of the SCGDAP.

Tinakula is also a very important island for Vlumba, the Palm Lorikeet (VU), and we needed to determine whether it continues to survive on Tinakula following the 2017 eruption. This is a more mobile species and many birds could well have left the island during and after the eruption and some may potentially have returned by August 2019, nearly two years post-eruption.

In summary the key survey objectives were as follows:

<u>For Tinakula</u>

1. Determine post-eruption recovery of ecosystem generally, including birds, grasses, flowering and fruiting levels, invertebrates, etc.
2. Determine whether numbers of Vakavakatia (SCGD) are now comparable to those pre-eruption, along with age and sex structure?
3. Determine if there has been a recovery in numbers of Vlumba (Palm Lorikeet) post eruption to pre-eruption levels and what are they now feeding on?
4. Determine status of invasive ants.

<u>Small Reef Islands</u>

5. Determine whether habitat on outer islands is suitable to support Vakavakatia
6. Determine if any species of rats are present on these islands
7. Determine if any species of invasive ant are present
8. Determine if any species of competitor are present.

2.0 TARGET ISLANDS, TIMETABLE AND METHODS

Target Islands and Timetable

Over half of our survey time in 2019 was allocated to Tinakula , the stronghold of Vakavakatia, and Vlumba, while rapid surveys were undertaken on each of the small islands of Matema, Nukupa, Makalom and Pilini, noting that Niupani had previously been surveyed in October 2017 (Pierce et al. 2017).

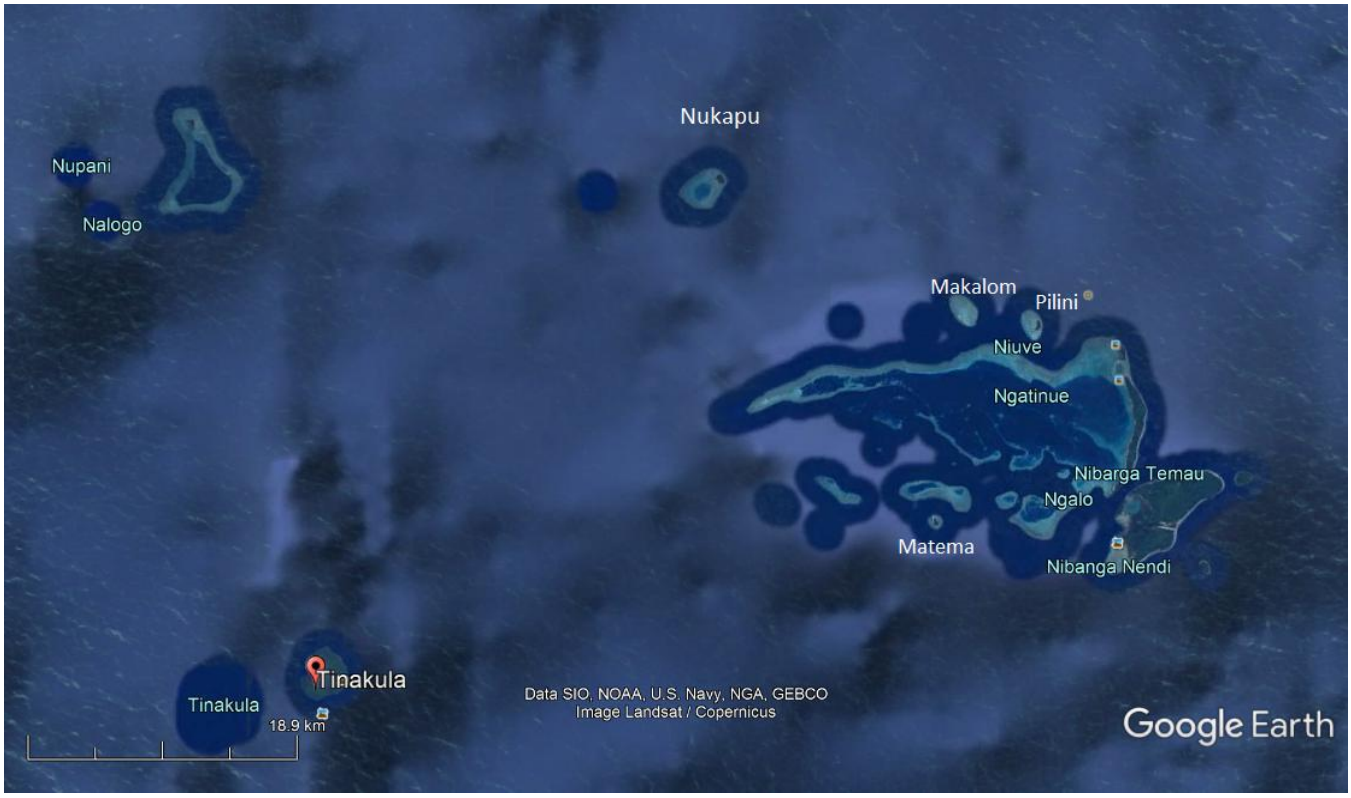


Fig 2.1 - Tinakula and the Reef Islands depicting relative locations of Niupani, Nukapu, Makalom, Pilini and Matema.

Table 2.1 – Timetable, activities and personnel

Date	Location	Activities	Weather
27/8	Honiara-Lata	Flight to Lata, trip planning	Fine
28/8	Lata-Tinakula	Purchase supplies, travel Tinakula	Fine
29/8	Tinakula	Orientation, bird counts, deploy cameras	Fine am, rain pm
30/8	Tinakula	Bird and ant surveys pm	Rain am, fine pm
31/8	Matema, Pilini	Consultation; surveys of habitat, birds and IS	Showers am
1/9	Pilini, Makalom	Consultation; surveys of habitat, birds and IS	Rain on Makalom
2/9	Nukapu, Tinakula	Consultation; surveys of habitat, birds and IS	Fine
3/9	Tinakula	Survey habitat, birds, ants, JV depart Lata	Fine
4/9	Tinakula	Survey habitat, birds, ants	Fine
5/9	Tinakula-Lata	Travel to Lata	Strenthening wind
6/9	Lata	Temotu consultation	Wind/rain
7/9	Lata	Analysis and reporting (RP, LM)	Tropical depression

8/9	Lata	Reporting	Overcast
9/9	Lata-Honiara	Premier debrief, team departs for Honiara	
10/9	Honiara	Debriefs with ECD and SIB; RP departs pm	

Methods

We used the following approaches to measure ecosystem health and species abundances, including invasive species.

- Transect counts were completed along established paths and lava flows and we mainly used those that had previously been used in 2014 and 2016. The abundance of flowering and fruiting plants were recorded on a 0-3 point scale along most transects. Transect surveys were distance-based and time was also recorded (or estimated due to a shortage of time pieces); most were completed 0700-1200 h and a few in 1500-1700 h.
- All Vakavakatia seen and heard from the above transect lines were recorded and subsequent estimates were made by RP et al. of the width of the Vakavakatia detectaility zone. This was the preferred index method of all observers in the party. LM and RP also counted Vlumba and fruitbats along these transects as per 2014 and 2016 observations.
- Point counts for general bird counting were made by LM and RP at comparable sites to those undertaken in 2016. All birds seen and heard from these stations were recorded over a 5 minute period. Originally we had considered extending these to 10 minutes if birds were scarce, but 5 minutes proved more than adequate.
- On the Reef Islands we kept species lists and evidence of breeding of birds, bats and turtles.
- Invasive ant sites were sampled by using five 100 mm x 100 mm waterprof cards lured with a SI dollar-sized blob of peanut butter and jam at opposite corners of the card. After about 30 minutes, ants on these cards were identified sand counted/estimated. Tinakula sites included three of the same sites as in 2016, but all Reef Island sites were new.
- Rat traps were operated on Matema and rat samples were examined from there and Pilini. Night spotlighting walks were undertaken by some team members on Tinakula.
- Feral pig presence/absence was noted during all transects.
- Weeds, notably *Mikania micarantha* and *Wedelia trilobata* were searched for on all islands.
- Key sites were GPsed or initially marked on hard copy maps.

Personnel
Team at Tinakula – front from left Judah, Stephen, Canoe Skipper, middle David, bacdk from left Rudy, Ray, Reigen, Ioanne (photo - LM)



Rudy, Judah and Luke and checking ant lures (L), David setting up camera trap ®

3. TINAKULA RESULTS

3.1 Some Early Post-Eruption Observations

There have been some contradictory comments emerge via social media re post-eruption observations. Here we document, as best we can, some credible accounts.

1. <u>23 Oct 2017</u>

Tinakula erupted in the early hours of the morning – there were two people ashore associated with collecting Vakavakatia for profit. The pair sheltered in a small cave near the village. This was primarily an ash eruption which subsequently resulted in ash covering the ground to a depth of 50-100 mm. There was little extrusion of rock and lava except on the steep non-vegetated western side of the island, and the former village site was not totally destroyed as had been previously reported.

2. <u>Late Oct 2017</u>

Date uncertain, but probably only a few days after the eruption - David Tao of Menivi visited Tinakula and observed over 20 dead or dying pigeons on the sea near Tinakula. These comprised mainly Bona, but included some Vakavakatia, the latter closest to shore.

3. <u>Late Oct/early Nov 2017</u>

Stephen Sopi and John saw 4 dead Bona offshore and 2 dead Vakavakatia near shore.

4. <u>Late Nov/early Dec 2017</u>

Date uncertain but former OceansWatch staff and others comprising Fr. Charles, Eddy Pye, Rudy Oti, David Tao, Titus Godfrey, Stephen Sopi and Nelson, with all four of the party members that were interviewed agreeing to the following summary:

A. One dead Bona seen on sea en route from Malo.
B. The party checked a southern bay of Tinakula around Gully 5-6 where a coastal sliver of foliated trees existed, the only foliated trees remaining on the island at this time. Observers split into 2 parties - one party saw 3 live Vakavakatia and the other 4, all of which were along the seashore. There may have been more birds seen as David said he saw a total of c.10 live Vakavakatia along the beach.
C. Landed at usual landing beach N of the village. All trees were defoliated here. The place was silent with zero birds of any species detected.
D. Village – all trees had been defoliated – 1 female Vakavakatia (one member said 2 birds - male and female) was seen near the top of the sea cliffs at village.

3.2 Ecosystem Recovery by August 2019

From an almost totally defoliated forest in late 2017, the forest ecosystem has recovered to a healthy state in August 2019. The main study area of 2016 appeared superficially similar or even more luxuriant than that in 2016. Some detectable differences in ecosystem health were:

- Luxuriant forest canopy along the eastern and southern parts of the island (Fig 3,1)
- Landslips along most of the sides and steep hill slopes where the weight of volcanic ash had apparently caused many trees and banks to collapse (Fig 3.2).
- The gullies throughout the island had been wiped clean by ash and water slides (some likely mixed with molten lava and forming slides). In 2016 these gullies had been suffering from Mikania suffocation, but now a mix of native ferns, herbs, shrubs and Mikania are recovering in the gully space (Fig 3.2).
- Some large coastal *Barringtonia* trees had fallen over but most of these were still alive.
- Some lowering of canopy height to the north of this study area (i.e. northern down-wind end of the island) where scores of dead emergent young trees dotted the hill slopes. These trees had presumably taken the greatest impact from the ash deposit. There was however a luxuriant looking new canopy below these dead spikes (Fig 3.4).
- The steep western side of the volcano is now almost completely devoid of vegetation – recovery of lichens, mosses and ferns is however evident (Fig 3.4).
- Dense grass swards in many clearings and also under canopy – presumably these grasses responded quickly after the eruption and gained more light for growth because of the temporarily defoliated trees (Fig 3.3).

Fig 3.1 – Dense canopy of coastal trees near the landing, September 2019.

Fig 3.2 East Tinakula showing Gully 3 with fern and tree-crowded banks (below).

Fig 3.3 -Site of former village with dense grass regeneration.

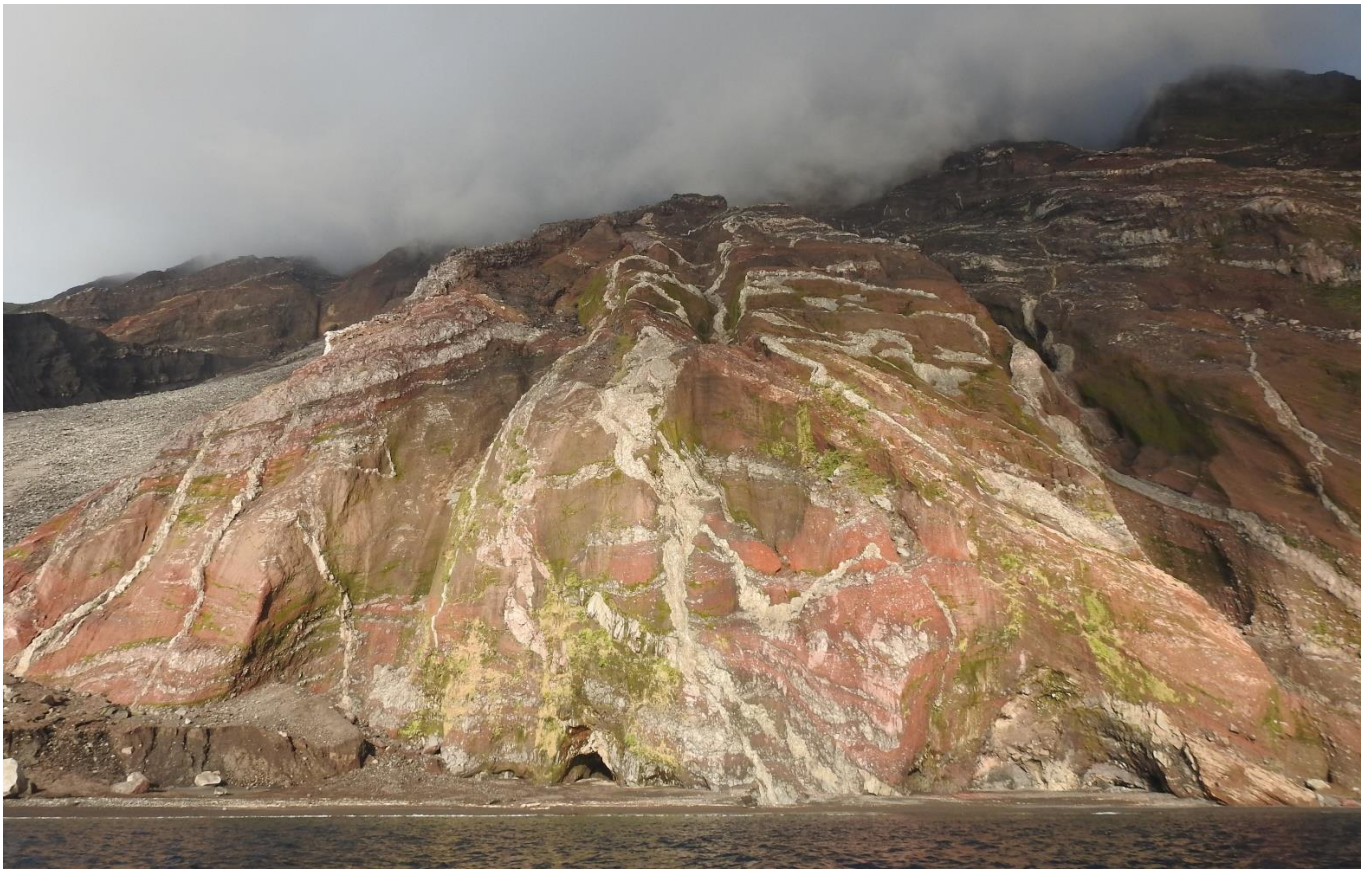


Fig 3.4 – NW Tinakula showing dead tree stems (above); and bare slopes of W Tinakula (below).

3.3 Vakavakatia (SCGD)

Distribution and encounter rates

Vakavakatia were found throughout the lower reaches (below c.200 m asl.) of the study area as in 2016. Two sorties above 200 m asl. extended to above the vegetation limit (at 600 m asl.) during which the highest encounter was at c.210 m (three birds) coinciding with the limit of the currently fruiting trees including *Hibiscus* and figs, all of which are more predominant below c.100 m asl.

The birds were apparently at higher densities in 2019 than they were in 2016. The main measure in 2019 was transects which enabled a direct comparison of the same transects as in 2016 assuming similar detectable swath width of x m. Backup methods of camera traps and point counts were also used in 2019 but attempts to utilise camera traps were largely thwarted by pig interference. Unlike 2016, there was no captive sample to compare birds in the hand.

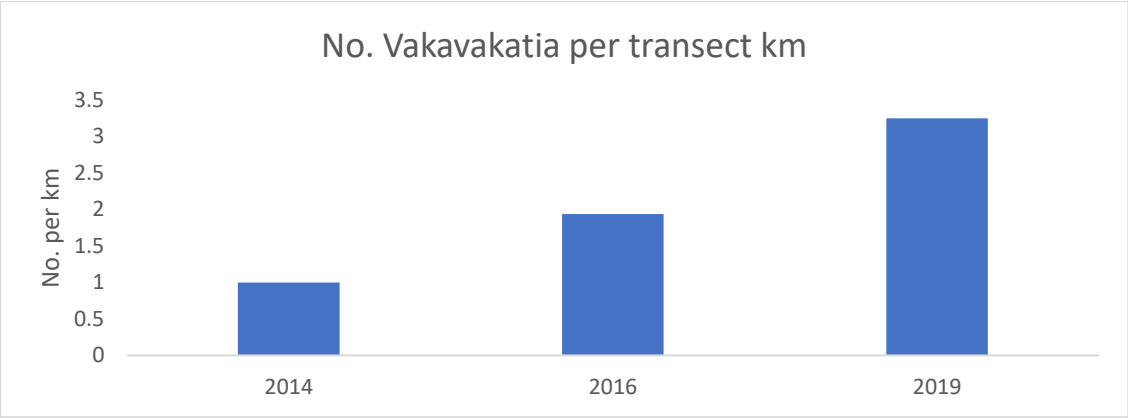


Fig 3.5 – Vakavakatia encounters on transects 2014, 2016 (n = 20 km), 2019 (n = 10.4 km).

Assuming these swath widths of 15 x 2 m are consistent, then 333 m of walking would equate crudely to one hectare of coverage, 1 km to 3 ha, etc. The observed encounter rates of 3.25 birds per km would thus equate to a density of just over 1 bird per ha. No Vakavakatia were seen above 210 m asl. and this swath at 0-210 m asl provides suitable habitat in the NE, E, SE and S sectors of the island amounting to c.x ha of the island.

Of the 24 birds seen closely in 2019 at least 4 were juveniles. One of these juveniles was not fully fledged as it exhibited a noticeably shorter tail than the two accompanying (parent) birds LM pers. obs.), but the others looked to be fully grown. Because many of the 24 sightings provided only brief views, therefore it is likely that this figure of 4 juveniles is conservative.

Breeding was underway in late August-early September 2019 with territorial calling being heard semi-continuously throughout each day. Most calls were coming from steep hill slopes and escarpments (especially those flanking gullies) at altitudes of 20-150 m asl. One nest containing a single egg was found by SS in a young small-leaved Pandanus (Fig 3.6). During two visits, firstly in the early morning and secondly late morning, the female left the nest by dropping to the ground and walking quickly uphill through dense fern understorey. During a night visit the female was sitting, perhaps suggesting that the clutch was incomplete (J. Wood pers. comm.). Nest details are provided in Table 3.1.

Fig 3.6 - Nest of Vakavakatia and nesting habitat.

Table 3.1 – Vakavakatia nest details

Date, time	4 Sept 2019, 0730 h
Aspect	Small side gully moderately sloping at 10-15° and at 40 m asl.
Canopy	*Cocos, Ficus*
Understorey	Moderately dense *Pandanus* spp., tree ferns, ferns, shrubs
Tree, it's height, nest	Pandanus sp. Tree 3 m; nest 1.7 m
Nest material	Bulky - branches, fern fronds, top layer of finer twigs
Bird access/exit nest	Furtively exited via dense ground ferns across small gully
Bird sitting	Female 0730 exited; female 1930 (after dark, remained sitting)

In previous years two of our team members had found a total of c.10 Vakavakatia nests at Tinakula, all in *Pandanu*s. David and Stephen have observations of clutch size to come. Given this nesting preference for *Pandanus* that Vakavakatia appear to have, we checked LFA utilisation of different tree species and found that their use of *Pandanus* was the lowest of all the tree species sampled. This early September sampling period coincided with the green fruit period of *Pandanus*, i.e. there was no flowering or ripe fruit that would otherwise attract LFA. This aspect will be followed up on by DT and potentially the Malo School to see if there are seasonal/flowering changes in ant abundance.

3.4 Vlumba (Palm Lorikeet)

Vlumba were common in the lower altitude forested areas of Tinakula and more conspicuous and with higher detection rates than in 2014 and 2016 (Table 3.2). They were noted feeding in approximately equal amounts of flowers of *Cocos*, fruits of *Hibiscus* and fruits of *Ficus*.

Table 3.2 – Detection rates of Vlumba at Tinakula 2014-19. This table to update.

	2014	2016	2019
Vlumba per km	X	Y	Z
Vlumba 5 min counts	X notebooks	X check notebooks	Y

Other Birds, Fauna

All bird species present in 2014 and 2016 were also present and generally common in 2019. Some comparisons of inter-year counts are still to be made, but all of the ground-dwelling species (i.e.

Vakavakatia/SCGD, Leibu/Emerald Dove, Chicken/Red Jungle-fowl and Spotless Crake were common in 2019. New species added in 2019 were Shining Bronze Cuckoo and Long-tailed Cuckoo – their non-detection in earlier visits can be accounted for by the fact that the 2014 and 2016 surveys took place after these species had migrated south. Other fauna including skinks, geckos, spiders, Lepidoptera (butterflies and moths) and flying-foxes were common, the latter being mainly Pacific Flying-foxes, with only one sighting of a Santa Cruz Flying-fox (EN).

3.5 Invasive Species

Invasive ants

Little Fire Ants were abundant at Tinakula, with numbers being remarkably similar to those at the same sampling sites in 2016 and 2019. There was a slight preference for peanut butter lures as in 2016, but sugar lures were also heavily attended (Fig 3.10).

Thirty second counts were conducted on trunks and lower branches of a range of forest species revealing a positive correlation with fruit-ripening and flowering trees. Thus, *Hibiscus*, *Cocos*, *Morinda* and *Ficus* spp. all had ripe fruit and/or flowers and were heavily utilised by LFA. Only a few species sampled were not heavily utilised by LFA, and notably one of these was *Pandanus*.

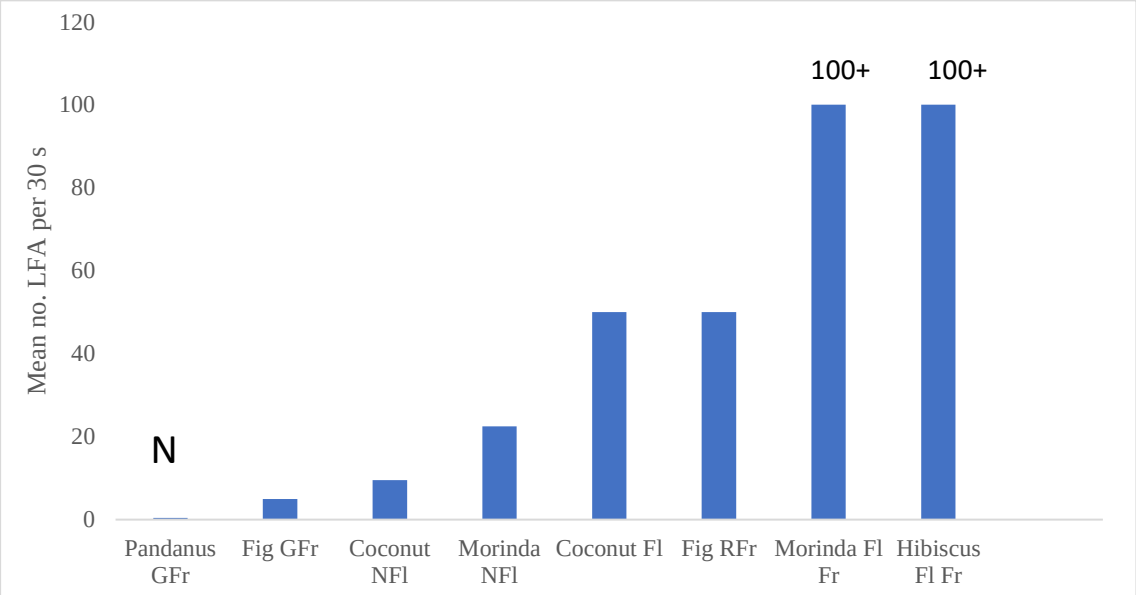


Fig 3.7 – Mean number of LFA detected per 30 seconds on lower trunk and branches of different tree species at Tinakula on 4-5 September 2019. Note: GFr = green fruit, NFl = No flowers, Fl = flowers, RFr = ripe fruit, Fl = flowering, Fr = ripe fruiting. N = nesting tree.

Feral pig

Pigs were being raised for market by a local on Tinakula during 2016 and they were effectively contained between two precipitous gullies. These pigs are no longer being farmed, however, and they have escaped to penetrate virtually the whole island. Two of our party ascended Tinakula's summit and found that pigs were present all the way to the highest vegetated areas at c.600 m asl. They also extend as far as we surveyed along the coastal fringe to the south and north. They are feeding on a mix of fruits including fallen coconuts, roots including fern roots and probably also worms. In the process they are digging up the soil and causing extensive damage (Fig 3.8) thereby destroying regenerating ferns, shrubs and trees and depleting fruits and invertebrate foods of Vakavakatia. They are probably capable of killing Vakavakatia chicks as well and some low nests but refer to 3.4 below and the Discussion for management recommendations.


Fig 3.8 - Pigs are causing serious damage (L) but are relatively tame and could be lured and trapped ®

Mikania

This species is less abundant than in 2016, presumably a result of mortality following the 2017 eruption. It is recovering, however, and is now found in more sites than in 2016, being spread sporadically along gullies and edges of clearings and the back of ocean beaches (Fig 3.9).

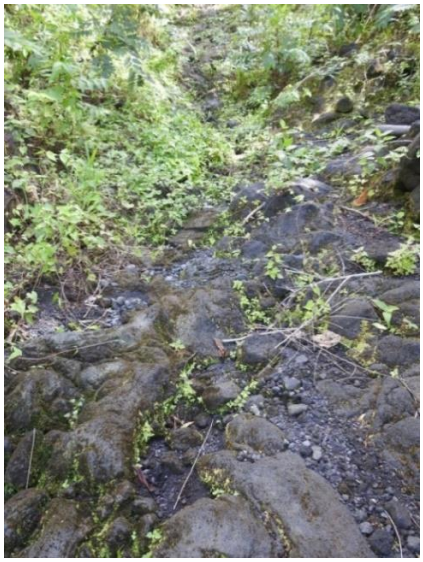
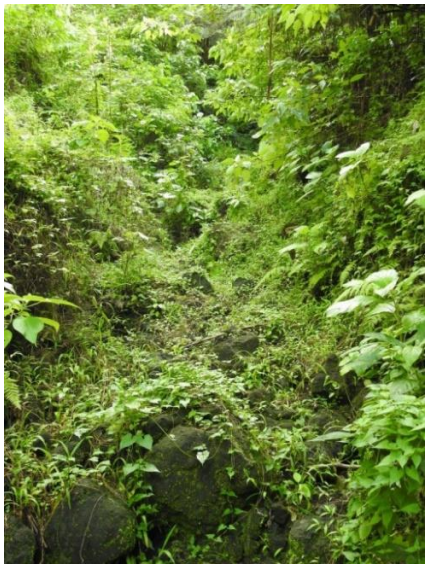




Fig 3.9 – Gullies are being recolonised in 2019 (L) compared with 2016 (Middle and R).


Fig 3.10 - LFAs on lure cards at Tinakula (L); Common Myna feeding in garden habitat at Lata (R);

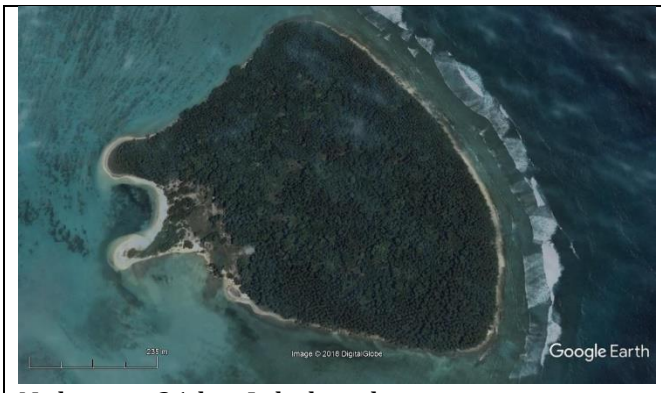
Common Mynas

This species was intorduced to Lata about 2015-16 and pairs are now spread diffusely throughout town and on Malo north to Neo. Tinakula at 30 km from the mainland is well within myna flying range. If they established at Tinakula (volcanic islands provide ideal habitat and foods for them) they would pose a significant threat to the small, hole-nesting Vlumba.

4. REEF ISLAND SURVEY RESULTS

4.1 General

Except for uninhabited Makalom, each of the small islands of the Reef Islands typically supports a small human population living in one cluster of dwellings adjacent to a sandy landing bay along the sheltered western shores (Fig 4.1). On each island the single village then merges with a much larger area of cultivated gardens and forest which dominate the interior, culminating in an exposed and eroding coral-rock coastline on the oceanic side. The clustering of dwellings was most noticeable at Nukapu and Pileni, whereas Niupani and Matema supported more diffusely spread dwellings and associated domestic animals (pigs, chickens, dogs, cats). The gardens were typically dominated by bananas, papaya and breadfruit trees, but many other species were also being grown particularly at Nukupa. Water was present in different ways, but the high rainfall of these islands (mm) throughout the year negates the need for standing water. A general summary of important features of the islands is provided in Table 4.1.



Nukapu – 31 ha; Inhabited

Matema – 16 ha; Inhabited

Makalom c. 1.5ha; Uninhabited

Pelini 22 ha; Inhabited

Niupani – c.21 ha; Inhabited

Fig 4.1 – Reef Islands that were surveyed – note villages located on western side

Table 4.1 - Island summary. Green shading indicates positive features from a Vakavakatia perspective, brown indicates negative features wrt completing rat eradications and/or establishing Vakavakatia.

Y = Yes present in moderate levels, YY = present at high levels; ? = presence unknown as survey was completed during persistent rain.
Note: 1 = distance to larger landmass, 2 = invertebrate diversity and abundance, 3 = competors aree primarily Leibu (Pacific Emerald Dove) and locally chicken; 4 = dwellings present.

Island	Tinakula	Nukupa	Niupani	Matema	Pelini	Makalom
Feature						
Human population	0	c.45	c.25	c.45	150+	0[4]
Nearest land (km)[1]	28	31	37	12	5	5
Island area (ha)	1200	31	21	15	22	1.5
Area forest/garden	500+	39	19	12+	18	1.5
No. tree/shrub spp.	Data to come					
Grasses/sedges	Data to come					
Invertebrates[2]	Medium	Medium	Medium	Medium	Medium	Medium
Soil development	High	High	Med	Low	Med	Low
Freshwater	Seeps	Wet areas	Swamp	Wells	Wells	None
Rats	N	YY	YY	YY	YY	N
Cats	N	2	Y	Y	YY	N
Dogs	N	2	Y	Y	YY	1
Chickens	Y Wild	Y	Y	Y	Y	N
Competing birds[3]	YY	Y	Y	Y	Y	Y
Pigs	YY Wild	Y	Y	Y	Y	N
Snakes	N	N	N	N	N	N
Weeds	*Mikania*	N	N	N	*Wedelia*	N
LFA	YY	YY	YY	YY	YY	?
YCA	Y	Y		N	N	?

4.2 Flora

Except for one small island (Makalom), native trees diversity was moderate or high across the islands, with exposed shores supporting many hardy oceanic island genera, e.g. *Tournefortia, Guettarda, Scaevola, Pandanus, Cassytha, Triumfetta,* and *Boerhavia.* The interior of the forests included figs (*Ficus* spp.), *Barringtonia* spp., *Pisonia, Cordia,* and many other angiosperm trees, palms, *Pandanus* spp., tree ferns, ferns, sedges and grasses (Appendix 1). On the leeward side of the islands there were sizeable areas of fruiting *Hibiscus* and other trees. Makalom, however, is a small, uninhabited (but three temporary dwellings present in September 2019) oceanic island supporting mainly coastal plant species including all the oceanic island species mentioned above. It was clear from the islands surveyed that Nukapu has the best developed soils, supports the most diverse flora and invertebrates and has the largest area of potential SCGD habitat.


Fig 4.3 Left ID to come; Right *Tournefortia* JV


Fig 4.2 - Makalom vegetation with *Cassytha*, *Scaevola*, *Tournefortia*, etc.

Fig 4.4 - Nukapu outer coast below with *Triumfetta*, *Scaevola*, etc.

Fig 4.5 - Nukapu tall trees, forest clearing.

Fig 4.6 - Typical understorey in gardens at Nukapu, Pelini, Matema (above and below).

4.3 Fauna

Many of the bird species on Tinakula are also present on the Reef Islands, including most of the pigeons, kingfisher, etc. (Appendix 2). We detected no Vakavakatia in the Reef Islands and no community members, whom we showed the Temotu range of pigeon species, indicated the species presence, but they did recognise some of the common pigeons. Vlumba were however present in very small numbers on Nukapu during our survey and the community recognised them as a regular visitor there – certainly the habitat includes many favoured foods of this species (but see IS section below). Other notable species detected were White-tailed Tropicbirds breeding on Pelini and especially on Nukapu, and green turtles attempting to breed (but nest recently excavated by human or dog) on Makalom.

4.4 Invasive Species

Rats

Only Makalom was rat-free, but it is a very small oceanic island that has suffered impacts from humans (and a dog at the time of our survey), and has likely had a history of other human-related impacts, e.g. cat strandings. All other islands supported small rats of the *Rattus rattus* complex (large ears, very long tail) and weighing up to 81 g (Table 4.2). The rats are considered by the communities a nuisance to gardening, foodstuffs and health, and they are keen to get rid of them. There was reportedly a failed attempt at rat eradication on Nukapu via trapping.

Table 4.2 – Rat morphometrics from Reef Islands.

Feature	Mean (n = 6)	Range
Head and body length	122.2	107.5-133
Tail length	163	150-175
Right hind foot	29.6	27-34
Ear length	17.8	16.1-19.3
Ear covers eye?	Y	
Weight	55.7	38.5-81
Female no. nipples		8 (2)
Dorsal colour	Brown	
Ventral colour	Grey	

Cats

House-based cats were present on all inhabited islands in varying numbers (e.g. c.2 on Nukapu) and individual cats were sometimes seen hunting in the gardens. Consultations indicated that if the rats were removed there may be no need for cats.

Dogs

A few (two on Nukapu) to many dogs (common on Pelini) were present on each island, including a single wild dog on Makalom. Initial discussions on some islands suggested that there was little need for, nor attachment to, dogs, and people might be inclined to give them up if Vakavakatia were to be introduced to their islands.

Invasive ants

LFA wre present on all islands and YCA was also present at Nukapu and Tinakula (Appendix3). The Nukapu YCA infestation is believed to have come about around 2010 when timber was imported. An identical explanation and timing was given for a nearby Fenua Loa invasion by the Hon Mathew Matoko, MPA, Fenualoa Ward, with whom we met at Fenua Loa on 31 August.

Weeds

Fig 4.7 – Pelini meeting on invasion site to discuss and agree on tactics for *Wedelia* eradication (L); *Wedelia* smothering Taro at Nende, September 2019 (®).

Singapore daisy (*Wedelia trilobata*) was found at three sites at Pelini, the largest of which is c.20 x 20 m and is illustrated below. It reportedly arrived at Pelini in about 2018 and is rapidly spreading. Our advice was to have a community work day to remove it completely (by the roots) and burn all on site, and maintain ongoing surveillance there and at adjacent areas. The alternative approach of inaction would have devastating consequences for Pelini gardens and the ecosystem. No *Mikania micrantha*

was seen beyond Nende and Tinakula, but there is a need to implement biocontrol at Tinakula. There is a clear need for awareness raising and improved biosecurity for weeds and IS generally.

4.5 Island Community Consultations

Considering that much of Temotu still has poor communications and that we arrived on doorsteps largely unannounced, it was heartening to learn of the interest that local people had in the project. This interest was at two levels, firstly in regards to the plight of the Vakavakatia and Vlumba (birds they had limited knowledge of), and especially secondly, that there may be ways of getting rid of rats from small islands like their own. There was strong interest in the latter, to the extent that RP committed to provide a concept plan for rat eradications at earliest opportunity (ideally appended to this report). That concept plan needs to go with this report to each island community as hard copy for discussion and their subsequent written and/or verbal input via Nende, ideally through meetings facilitated by the TPG and/or TCSDA. The TCSDA is a registered association and with local government may be the best way forward for consolidating local support and garnering international partners and sponsors to help with these and other local environmental management issues.

Fig 4.8 - Discussions with chiefs at Nukapu (left) and Matema (right)

5. NENDE CONSULTATIONS

We met with the Hon. Premier Clay Forau before and after the surveys, the latter for debrief and discussion and which included Minister for Small Islands Edward Daiwo, and LM, RO and RP. We summarised the key findings including Vakavakatia and Vlumba recovery, Reef Islands that would be suitable for both species if rats removed, pigs blitzing Tinakula, mynas posied to impact Temotu biota. Then we discussed the pathways ahead including improving biosecurity for Tinakula and the Reef/Santa Cruz Islands, pig removal from Tinakula, and prioritising rat and myna eradications, returning Vakavakatia to Temotu. We agreed that to get to these ultimate goals we will need to provide some scoping documents in this current report, particularly for rat eradication and biosecurity, to subsequently be discussed and commented on by island communities and local government. Also a relationships document to describe working toether of different groups.

We met with about 30 community members from Neo and Menevi in the Fisheries building at Lata for 3-4 hours on 6 September. This meeting began badly in some matters of process, suffered from ongoing personal agendas, but finally developed a mutual understanding and resolved ways of progressing restoration at Tinakula and the Reef islands.


Fig 5.1 – Left Discussions with Hon. Premier Clay Forau (Rt) and Minister for Small Islands Edward Daiwo (2nd from right); right Menivi and Neo chiefs and representatives meet at Fisheries.

6. DISCUSSION AND RECOMMENDATIONS

Discssion

Key findings of the 2019 survey were that there has been a strong recovery of Vakavakatia and the ecosystem generally on Tinakula. Moreover the island is still rat-free and is possibly the largest island in the Solomon Islands to be free of invasive rats, so is a very special place ecologically and has an important role for current and future conservation. Going forward, the key need is to strenghten the biosecurity of Tinakula and surrounding islands to ensure that rats, cats and other invasives never access Tinakula. Fortunately, the local communities are very proactive about environmental awareness and associated management needs. Given the natural recovery of Vakavakatia on Tinakula, there is no need for releases of captive birds there, and moreover any releases would also introduce potentially disruptive elements (disease, additional birds) with assoociated risks to the population.

There are some serious problems on Tinakula however, paramount of which is that pigs have escaped their former farmed area and they have completely invaded the island. The fragile, terrestrial habitat is being very seriously degraded by pigs which will impact the Vakavakatia carrying capacity of Tinakula. There are likely also to be direct predation events on Vakavakatia nests and chicks. Left unchecked, the ecosystem will become progressively degraded with the diversity and abundance of plants in the canopy and undergrowth ultimately declining. Discussions with the communities responsible for Tinakula indicate full agreement with the need to totally eradicate pigs from this fragile and important island, but this will need to be done in a coordinated way and being careful about biosecurity.

Other issues on Tinakula look to be more manageable. Previous concerns on the impact of *Wasmannia* on the health and breeding productivity of Vakavakatia (Pierce et al 2018) seem less of a concern now, given the nest site preference (*Pandanus*) has low LFA use during at least part of the breeding season. This should be further researched however, including potentially via students studying the LFA use of *Pandanus* in controlled situations, e.g. at the grounds and.or vicinity of the Malo School. *Mikania* is also a significant concern given it will smother habitat and feeding areas for Vakavakatia on Tinakula. However, there are effective biocontrol approaches developed for this species that need investigating further and implementing as appropriate. The spread of Common Mynas is a concern for hole-nesting species such as Vlumba, and the myna population needs to be eradicated.

There will always be a risk of invasives like rats accessing Tinakula and more serious volcanic events than occurred in 2017, so back-up island populations are needed. The surveys revealed some potential islands in the Reef Islands that would provide suitable habitat for Vakavaktia if cats and rats were removed. Rat

eradications are achievable and we recommend that one or more islands be trialed for rat eradication and Vakavakatia translocations in the Reef Islands, with Nukupa providing the most favourable logistics of all potential islands for such a trial. Although these islands are relatively small (c.30 ha each) the diverse and abundant foods present suggest that SCGD would reach high densities there, as occurs with congeners elsewhere on small islets with locally abundant food.

Ongoing risks at these islands include potential reinvasion of rats, disease introduction and food stress via droughts. Rat reinvasion can be addressed via strenghtening local biosecurity by implementing a biosecurity action plan – this could potentially be used to provide a model for going forward in other Provinces of the Solomon's. Risk of disease introduction is probably minimal as chicken movement is typically from these outer islands to the Lata markets. Food stress seems unlikely too given the rich soils and diverse flora and a trend at least in recent years towards an apparently longer wet season at the Santa Cruz Islands. If food was to become an issue for Vakavaktia in the future then supplementary feeding would be possible via the community.

All of this work requires significant community effort with a need for ongoing technical support and this is best driven by the local TCSDA and TPG with support from ECD and SIB and other technical experts, and from project donors.

Recommendations

1. Strenghten the TPG/TCSDA/ECD link and seek funding for TCDSA infrastructure and specific projects (mynas, rats, biosecurity, etc.) to support the communities as below.
2. Scope and cost the eradication of rats from Nukapu and other small Reef Islands and present to community and local government for their discussion and feedback. This scoping has been completed separately and provided to the community. Once eradication is achieved, Vakavakatia can be released and monitored.
3. Strenghten biosecurity via a pilot biosecurity project based at Nende/Malo
4. Remove pigs from Tinakula. Urgently pressure the pig "owner"to prefeed, trap and remove pigs. If this fails TCSDA needs to urgently seek funding for professional hunters. All activities at Tinakula require strong biosecurity.
5. Remove Common Mynas from Temotu Province – currently they are concentrated at Lata and Malo where they are tame so they could be be pre-fed and trapped. Traps are available in Honiara. Needs systematic approach and avoid scaring the birds. Australian traps (with two levels) may be better.
6. Ultimately consider other larger islands in Temotu Province that may be suitable for Vakavakatia and other sensitive biota if rats are removed, e.g. Tevei at Vanikoro, but these are huge undertakings.
7. Research initaives - DT and others to examine seasonal use of *Pandanus* by LFA on Tinakula, this being the tree used as nest site on the island. Consider also using motion cameras to determine success of Vakavakatia nests during peak LFA activity on *Pandanus*. School to be encouraged to undertake studies of LFA use of *Pandanus* seasonally and under measured flowering and fruiting regimes.
8. Support captive breeding programmes of Vakavakatia in Solomon Islands and internationally to ensure sufficent genetically appropriate birds are available for future releases.

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Appendix 1 – Common Woody Plants Observed in the Reef Islands Sept-Oct 2019 – a preliminary list

Species	Common Name	Tinakula	Nukapu	Niupani	Pelini	Matema	Makalom
Albizia sp.	A Fabaceae	P					
Aleurites sp.	Candlenut	P					
Areca catechu	Betel nut	P	P	P	P		
Artocarpus sp.	Breadfruit	P	P				
Averrhoa carambola	Carambola		P				
Barringtonia sp A	Barringtonia	P	P	P	P	P	
Barringtonia sp B	Cut nut/Nuwa	P	P	P	P	P	
Calophyllum sp.	Beach calophyllum	P	P	P	P	P	
Canarium harveyi	Nyinga	P	P	P	P		
Carica papaya	Papaya	P	P	P	P	P	
Cassytha filiformis	Love vine	P	P	P			P
Casuarina equisetifolia	She-oak		P	P	P	P	
Citrus sp.	A lime	P	P	P	P	P	
Cocos nucifera	Coconut	P	P	P	P	P	P
Cordia subcordata	Cordia	P	P	P	P	P	
Cyathea sp.	Tree fern	P					
Ficus sp A	An edible fig	P	P	P			
Ficus sp B	Strangler fig	P	P				
Freycinetia sp.	A pandan climber	P					
Gmelina sp.	A beechwood	P	P	P	P		
Guettarda speciose	Beach gardenia		P	P	P	P	P
Hernandia sp.	Lantern tree	P					
Hibiscus	Nodapna	P	P	P	P		
Inocarpus fagifer	Mabe	P	P				
Ipomoea sp.	A morning glory		P	P	P	P	P
Mangifera indica	Mango	P	P				
Melastoma sp.	Melastomataceae	P	P				
Metroxylon sagu	Sago Palm	P	P	P	P	P	
Mikania sp.	Mikania vine	P					
Morinda citrifolia	Noni	P	P	P	P	P	
Musa sp.	Banana	P	P	P	P	P	
Pandanus tectorius	Pandanus	P	P	P	P	P	P
Pandanus Sp B	Pandanus	P	P				
Piper sp.	Kavakava	P	P	P	P		
Pisonia grandis	Buka	P	P	P	P		
Premna sp.	A mint	P	P	P	P	P	P
Pterocarpus indicus	A rosewood	P					
Scaevola	Saltbush		P	P	P	P	P
Schefflera sp.	Araliaceae	P					
Spondias sp.	An apple	P	P				
Syzygium sp.	An apple	P	P	P	P	P	
Terminalia catappa	Coastal almond	P	P	P	P	P	
Tournefortia argentea	Tree heliotrope		P	P	P	P	P
Wedelia trilobata Herb	Singapore daisy				P		

Also, to identify: Fue, Pa-a, Kalika, Tolutolu, Neyu, Nau/apple, Nabe, Nobir, Hau, Whanara, Pomaru, tovao

Appendix 2 – Turtles, Flying-foxes and Birds Present on the Islands Surveyed

Y = recorded (**bold = breeding confirmed**), S = sign found, - = not recorded

Island	Matema	Pelini	Makalom	Nukupa	Niupani	Tinakula
Date	30/8/19	31/8/19	31/8/19	1/9/19	Oct 2017	Aug/Sep
Species						
Green Turtle (EN)	-	-	**Y**	-	-	-
Pacific Flying-fox – Melepa	Y	Y	S	Y	Y	Y
Temotu Flying-fox – Mako (EN)	-	-	-	-	-	Y
Pacific Reef Heron	**Y**	Y	-	Y	Y	-
White-tailed Tropicbird	-	**Y**	-	**Y**	-	-
Brown Booby	-	-	-	-	**Y**	**Y**
Red-footed booby	-	-	-	-	**Y**	-
Lesser frigatebird	-	Y	-	Y	Y	Y
Great frigatebird	-	Y	-	Y	Y	-
Pacific Golden Plover	Y	Y	-	Y	Y	-
Bristle-thighed Curlew (VU)	-	Y	-	Y	Y	-
Wandering Tattler	Y	Y	-	Y	Y	Y
Ruddy Turnstone	Y	Y	-	Y	Y	-
Great Crested Tern	-	Y	Y	Y	Y	-
Brown Noddy	Y	Y	-	**Y**	Y	-
Black Noddy	Y	Y	Y	**Y**	Y	-
White Tern	-	-	-	**Y**	?	-
McKinlay's Cuckoo-dove – Leo	-	-	-	-	-	**Y**
Pacific Emerald Dove – Leibu	Y	Y	-	Y	Y	**Y**
Red-breasted Fruit-dove – Nuan	Y	Y	-	Y	Y	**Y**
Pacific Pigeon – Bona	Y	Y	-	Y	Y	**Y**
SCGD – Vakavakatia (EN)	-	-	-	-	-	**Y**
Coconut Lorikeet – Vlu	Y	Y	-	Y	Y	**Y**
Palm Lorikeet – Vlumba (VU)	-	-	-	Y	-	**Y**
Long-tailed Cuckoo	-	-	-	-	-	Y
Shining Bronze-Cuckoo						Y
Collared Kingfisher – Penda	Y	Y	Y	Y	Y	**Y**
Swiftlet spp.	-	Y	-	Y	Y	Y
Pacific Swallow	Y	Y	-	Y	Y	Y
White-throated Whistler – Utopia	-	-	-	-	-	Y
Cardinal Honeyeater – Mangavu	Y	Y	-	Y	Y	**Y**
Polynesian Starling	Y	Y	-	Y	Y	**Y**

Appendix 3 - Presence of ant species on paired lures, each operated for approximately 30 minutes at four islands in 2019 and at Niupani October 2017

Abbreviations: PB = Peanut Butter, Tin = Tinakula. Mat = Matema. Pel = Pelini, Nuk = Nukapu, Niu = Niupani, Vill = village, gard = garden. GPS and Niupani data to come.

Island	Tin	Tin	Tin	Tin	Mat	Mat	Pel	Nuk	Nuk	Niu	Niu
Station	T1	T2	T3	T4	M1	M2	P1	Nu1	Nu2	Ni1	Ni2
Site	Edge	Vill	Gully	Gully	Forest	Village	Forest	Gard	Forest	Vill	Gard
Lat 10.											
Long 166.											
Date	30/8	30/8	4/9	4/9	31/8	31/8	1/9	2/9	2/9	*	*
Approx time	0930	1410	0800	0830	1200	1230	Am	0800	0815		
Cloud (0-3)	3	3	1	1	3	3	3	1	1		
Stn 1 PB	80	125	250	900	0	50	1000	70	24		
Stn 2 PB	100	120	250	1100	0	30	2000	0	25		
Stn 3 PB	130	210	350	600	8	0	200	0	0		
Stn 4 PB	70	170	400	240	8	100	500	0	0		
Stn 5 PB	130	240	250	300	8	50	300	9	5		
Total LFA PB	510	865	1500	3140	24	230	4000	79	54		
Stn 1 Jam	80	35	220	100	4	6	500	18	9		
Stn 2 Jam	26	33	4	60	4	14	1500	0	0		
Stn 3 Jam	5	85	120	50	4	0	500	0	0		
Stn 4 Jam	25	55	50	30	14	65	300	0	5		
Stn 5 Jam	20	6	50	40	8	12	250	0	6		
Total LFA Jam	156	214	444	280	34	97	3050	18	20		
LFA Totals	**766**	**1079**	**1944**	**3420**	**58**	**327**	**7050**	**97**	**74**		
Total YCA	0	0	12	11	0	0	0	15	22		
Total BCA	6	0	0	0	5	15	0	0	2		
Total Kati	0	0	0	0	4	0	0	13	2		