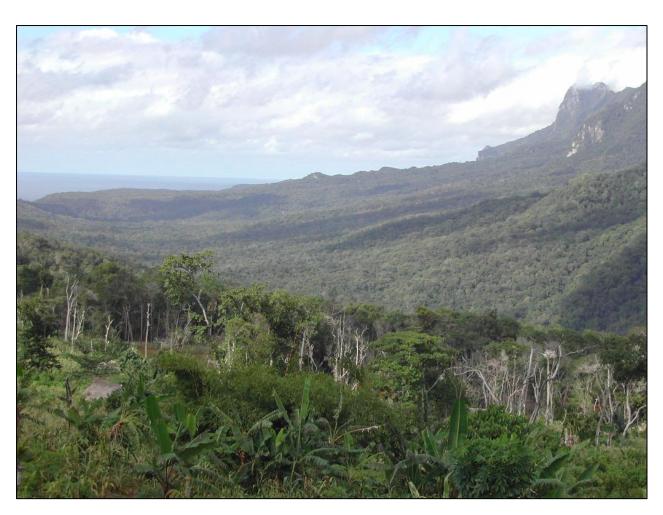
The Biological value of the Natewa Peninsula Vanua Levu, Fiji









2019 Version
An Operation Wallacea Report

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Executive summary

- The Natewa Peninsula encompasses approximately 55,000 ha of the south-eastern section of Vanua Levu, Fiji, and retains large expanses of tropical lowland and hill forest.
- The biodiversity of the Peninsula possesses an extremely high conservation value. To date, a total of three native mammal species, 49 bird species, 12 herpetofauna species, 25 butterfly species, 61 gastropod species, and 84 tree species have been detected in the study area.
- This diversity is impressively representative of species assemblages across Fiji as a whole, given the size of the study area. The Natewa peninsula comprises only around 3.1% of the total land area of the Fijian archipelago, but 59% of terrestrial birds, 50% of native terrestrial mammals and 40% of reptiles known to occur nationally have been found here.
- Faunal groups in the Natewa Peninsula also display high incidence of endemism, with 31.3% of birds (15 species), 25% of herpetofauna (three species) 24% of butterflies (six species) 36.1% of gastropods (22 species) and 31% of trees (26 species) found here being entirely restricted to the Fijian archipelago.
- Numerous species are also very locally endemic to the study area. These most notably include the Natewa Silktail (*Lamprolia klinesmithi*) and Natewa Swallowtail (*Papilio natewa*), which are both entirely restricted to the Natewa Peninsula. A further six species and five sub-species found in the study area are endemic to Vanua Levu and its offshore islands.
- The forests of Natewa also provide valuable ecosystems services, both locally to communities living in the Peninsula via flood prevention, soil protection and crop pollination, and also to global society through the carbon stocks they sequester. Initial analysis put carbon stock estimates in the study area at 20,732,148 metric tons.
- The diverse ecological communities of the Natewa Peninsula are, however, highly threatened by anthropogenic pressures. Unregulated deforestation and forest degradation is extensive in the study area. Introduced Cane Toads, rodents, and most significantly the Small Indian Mongoose (*Herpestes auropunctatus*) also represent a serious threat to ground-nesting birds, reptiles, and other native wildlife. Between 175,000 and 400,000 mongooses are estimated to occur on the Peninsula.
- The urgent conservation status of biodiversity here (and the Fijian archipelago generally) is demonstrated by the number of threatened species present in the Natewa Peninsula. One native mammal, two herpetofauna species, and two tree species are considered by the IUCN to be globally Endangered. A further two bird species, one lizard, six gastropods, and two trees are considered to be Vulnerable, and one mammal, one bird, one amphibian, two gastropod and one tree species are considered to be Near-threatened. Particularly notable examples of threatened species include the Endangered Fijian Free-tailed Bat (*Chaerephon bregullae*) and the Vulnerable Natewa Silktail (*Lamprolia klinesmithi*), and Shy Ground Dove (*Alopecoenas stairi*).
- The surveys completed in the Natewa Peninsula to date clearly highlight the exceptional biological importance of the region. However, opportunities exist to implement new survey work in the future to target as-yet unstudied groups. An inventory has been started on the arachnids of the study area although specimens will need to be exported and examined, and further fieldwork completed, before this inventory can be completed. Priority targets for new survey protocols include macro-moths, dragonflies and orchids. Other priorities for future work include setting up a habitat classification scheme for the entirety of the study area to allow for accurate stratified carbon stock estimates (as well as obtaining more ground-truthed data to enhance the accuracy of carbon stock estimates here). Certain threatened species such as the critically endangered Fijian Monkey-faced Bat may also occur in the study area; verifying the presence of these as-yet-unconfirmed species also represents an important priority for future survey work.

Introduction

The Natewa Peninsula (also referred to in some sources as the Tunuloa Peninsula) covers approximately 55,000 ha of the south-eastern section of Vanua Levu; the second largest island in the Fijian archipelago (Figure 1a and Figure 1b). Most of its area is covered by rugged lowland and hill forest extending from sea level to 800m. As with most of Fiji, the underlying geology consists of Miocene-Pliocene volcanic igneous rock (Geological Survey of Fiji 1965; Neall & Trewick 2008) To the south and east the Peninsula is bordered by the Pacific Ocean, while to the north it is bordered by the waters of Natewa Bay, the largest bay in Fiji. The Natewa Peninsula is approximately 60 km long, but at its base is <2 km wide. Much of this narrow isthmus is spanned by biogeographical barriers, most significantly a salt creek and a lagoon Geological Survey of Fiji 1965). As such, the Peninsula is ecologically fairly isolated, and supports several endemic species that cannot be found elsewhere on Vanua Levu. Conversely, this isolation also means that some species present elsewhere on Vanua Levu do not occur on the Natewa Peninsula (Tennent et al. 2018). Due to this distinctiveness, some sources consider the Peninsula to be a separate biotic province in its own right (Olson et al. 2009). This, combined with the extent of its remaining forested area, has led to the Natewa Peninsula being considered one of the highest conservation priorities in the whole of Fiji, both for biodiversity generally (Olson et al. 2009; Kerr 2018) and for specific taxa (BirdLife International 2020). The forests of the study area are also expected to sequester vast carbon stocks, thus are predicted to make an important contribution to mitigating global climate change. They also provide key ecosystems services to the communities of the Peninsula, including flood prevention, soil protection, and crop pollination.

Despite its theorized biological importance, the biodiversity of the Natewa Peninsula remains extremely poorly studied. Prior to the results presented in this report, no surveys had been previously completed for most taxonomic groups here (BirdLife International 2020). The lack of knowledge regarding the biological value of the Natewa Peninsula is concerning, as the area may also face substantial ecological pressures. Invasive species are a prominent threat, most notably the Small Indian Mongoose (*Herpestes auropunctatus*) (Morley 2004, Kerr 2018), the population of which is estimated to number between 175,000 and 400,000 individuals on Natewea (Kerr 2018). The threat this species poses to ground-nesting birds, endemic herpetofauna species, and other native wildlife means it, in likelihood, represents the

largest single threat to the long-term biological security of the Peninsula. Deforestation is also a very clear and present threat to the biodiversity of the peninsula; an issue that has been ongoing since at least the late 1960s (Powling 2018). At present, approximately 3500 people live in the study area (97.8% of which are indigenous Fijians), with this population being mostly concentrated in 16 rural settlements (Kerr 2018). The average income for people living in these communities is far below the Fijian average, with 62% of the population subsisting below the poverty line (Kerr 2018). Given the limitation of employment opportunities here, most people rely on either heavy extraction of forest resources, or clearing forest for agricultural land, to support themselves and their families. This, coupled with rising populations, has led to increasing deforestation activities in the study area.

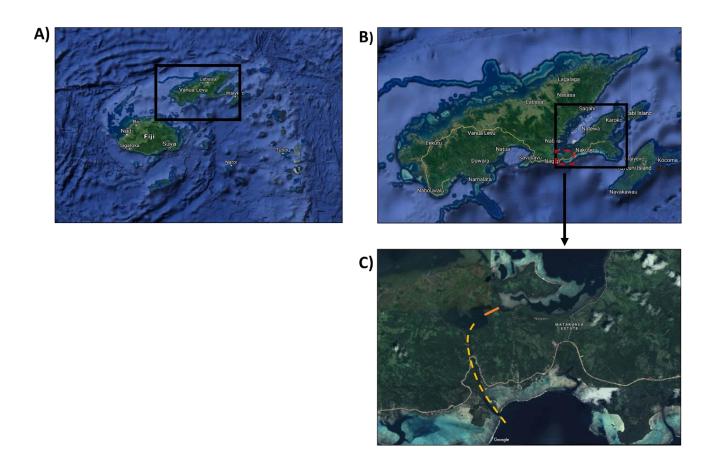


Figure 1 – Location of A) Vanua Levu Island within the Fijian archipelago, B) the location of the Natewa Peninsula within Vanua Levu (perforated red line indicates border area of the study area at the base of the peninsula), and C) the border zone of the study area. The perforated yellow line indicates the natural boundary formed by Salt creek and its lagoon. The solid orange line indicates the terrestrial border marked by the line of a proposed anti-mongoose fence.

The purpose of this report is to provide the first detailed summary of the biodiversity of the Natewa Peninsula, based on data collected during fieldwork completed by Operation Wallacea (www.opwall.com) over three seven-week expeditions running between June and August in 2017, 2018 and 2019 respectively. For an overview of the structure of these expeditions, and the methodologies used to collect the data underpinning the results in this report, please see Speight *et al.* (2018). This report aims to provide empirical evidence for the outstanding ecological value of this site, which in turn will support future attempts to secure protected area status for the Natewa Peninsula, or funding applications for specific projects here, such as initatives to control invasive species. All data reported is sourced from within our well-definied 'Natewa Peninsula study area', which has a well-defined border at the base of the Peninsula. Figure 2c above shows the delimitations of this study area. Specifically, the entire area of the Peninsula east of 'salt creek' and its lagoon, which occurs at the narrowest point of the Peninsula's base, and the line of a proposed 400m-long mongoose exclusion fence which runs from the salt lagoon to Natewa bay.

The taxa-specific sections and the appendices of this report provide fine details of the biological value of the study area. Table 1 below also succinctly summarizes these data to provide an overall visualization of the biological importance of the Natewa Peninsula.

Table 1 – Diversity and endemism in key taxonomic groups in the Natewa Peninsula, Vanua Levu, Fiji.

A)

Group	Number of species	Number of Fijian endemics	% endemism
Mammals	7	0	0%
Terrestrial Birds	49	15	30.6%
Herpetofauna	12	4	33.3%
Butterflies	25	6	24%
Gastropods	61	22	36.1%
Trees	84	26	31%

Mammals

As with most Pacific Island ecosystems (Flannery 1995), the mammalian diversity of the Natewa Peninsula is low. The only native mammals occurring in Fiji are bats (six species occurring in total), and three (50%) of these have been detected by survey work on the Natewa Peninsula to date; the Pacific Flying Fox (*Pteropus tonganus*), the Near-threatened Samoan Flying Fox (*Pteropus samoensis*) and the Endangered Fijian Free-tailed Bat (*Chaerephon bregullae*) (Plate 1) (Appendix 3). None of these species are endemic to Fiji, although the latter two are at risk throughout their range due to hunting and habitat loss. The forests of Natewa therefore represent an important refugia for these declining species. It is possible that other bat species may occur in the study area that have not been detected to date. These include the Fijian Monkey-faced Bat (*Mirimiri acrodonta*), a Critically Endangered Fijian endemic. An individual of this species may have been observed in July 2017, although it was not possible to confirm the species identity from this record and further observations are required to verify its presence. Proving the occurrence of *M. acrodonta* would enhance the biological value of the Natewa peninsula considerably, and targeted surveys for this species remain an important priority for future surveys here.

As well as the three native bat species, four introduced non-volant mammals also occur in the study area. Three of these are rodents; the Pacific Rat (Rattus exulans), the Brown Rat (Rattus norvegicus) and the House Mouse (Mus musculus). These three species are likely to have severe detrimental effects on the Natewa Peninsula's native wildlife – particularly its ground-nesting birds and herpetofauna – given precedent of the impacts of these species on other oceanic tropical islands (Harris 2009). Worst still, however, is the impact the introduced Small Indian Mongoose (Herpestes auropunctatus) is predicted to have had on the biodiversity of the study area. Mongooses were first introduced to Fiji intentionally in 1883, as a hypothesised means of controlling rat populations (which represent an agricultural pest, particularly on sugar cane plantations) (Kerr 2018). These Mongooses have subsequently spread throughout most of the Fijian archipelago, and their omnivorous diet, coupled with the fact their numbers are unchecked due to having no natural predators here, has led to them representing an extreme threat to Fijian biodiversity generally, and the biodiversity of the Natewa Peninsula in particular. Indeed, the impact of *H. auropunctatus* on Fiji, and on other islands where it has been introduced, has led to it being listed as one of the top 100 worst invasive species globally (Lowe et al. 2000). Estimates of the Mongoose populations in the

study area lie between 175,000 and 400,000 individuals (Kerr 2018), and this population representing a severe risk to Natewa's native birds, herpetofauna, and in likelihood other taxa. Controlling this mongoose population thus, in likelihood, represents the single most pressing conservation priority for the Natewa peninsula. A detailed study plan has been submitted which aims to achieve this objective, using a combination of intensive trapping for extant Mongooses in Natewa, and the construction of a 400m fence across the base of the Peninsula to prevent further colonization by this highly invasive species (Kerr 2018) (Figure 1c).



Plate 1 - Fijian Free-tailed Bat (Chaerephon bregullae), photographed on forest edge in the Natewa peninsula in July 2017.

Birds

As with most small island ecosystems, birds represent by far the most diverse vertebrate group occurring in the Natewa Peninsula, with 49 species having been recorded to date (Appendix 4). Fifteen (30.6%) of these are endemic to the Fiji, with three of these (Maroon Shining-parrot *Prosopeia tabuensis*; Fiji Wattled Honeyeater *Foulehaio taviunensis* and Natewa Silktail *Lamprolia klinesmithi*) being locally endemic to Vanua Levu and its offshore islands. The most significant of these local endemics is *L. klinesmithi* (Plate 2) which is entirely restricted to the Natewa Peninsula. The global population of this bird is estimated at just 6000–12,000 individuals, all confined to an area of <260 km² (del Hoyo *et al.* 2020). Given this is, along with the Natewa Swallowtail *P. natewa* (see below), the most range-restricted species occurring in our study area, and it very much serves as a 'flagship' species for the Natewa Peninsula as a whole, *L. klinesmithi* perhaps represents, the single greatest conservation priority for all species occurring in the study area. Data from point count surveys are being used to try and estimate population densities of this species, and targeted behavioural work has also been completed which documents the first nesting behaviour in the Natewa Silktail (England 2019).

The long-term monitoring data from point count surveys in Natewa will also be used to census trends in local bird communities over extensive longitudinal gradients generally, and also be analysed to determine relationships between avifauna community composition and habitat disturbance in the study area. This will allow for the first emperical appreciation of how forest clearance and degradation impacts upon Fijian bird communities; a key outcome in understanding the consequences of continued habitat destruction in the archipelago.



Plate 2 - Natewa Silktail (Lamprolia klinesmithi) in the forests of the Natewa Peninsula – the only locality where it occurs. Photograph by Greg Kerr.

Herpetofauna

The herpetofauna of the Natewa Peninsula is relatively rich for a Pacific island ecosystem, with 12 reptile and amphibian species having been detected to date (Appendix 5). This includes both of Fiji's native amphibians, the Endangered Fijian Ground Frog (*Cornufer vitianus*), and the near-threatened Fiji Tree Frog (*Cornufer vitiensis*), as well as three gecko species, five skink species, and one snake. Two of these skinks, the Viti Levu Mountain Tree skink (*Emoia campbelli*) and the Viti Copper-headed Skink (*Emoia parkeri*) are highly notable records, as both are previously known to occur only on Viti Levu. Both records therefore represent major extensions to the known ranges of these threatened Fijian endemics. Given the biogeographical separation between Vitu Levu and the Natewa Peninsula, it could also be possible that either or both of these species may represent currently undescribed taxa. This remains entirely speculation at this stage, although represents an important avenue for future research.

The final herpetofauna species detected in the Natewa peninsula is the introduced Cane Toad (*Rhinella marina*), which was brought to Fiji in an attempt to control Cane Beetle pests in sugar plantations. The introduction of Cane Toads has caused widespread ecological

damage across the Australo-Pacific Region (Shine 2010) and has been shown to have an adverse effect on native Fijian herpetofauna specifically (Narayan *et al.* 2015). It is therefore likely that Cane Toads represent a threat to the biodiversity of the Natewa Peninsula, although their population size, and the extent to which they predate or otherwise outcompete native species has yet to be quantified; this represents another important avenue of research for the near future.

A final observation of note regarding the herpetofauna of the Natewa Peninsula relates to the absence, rather than presence of a species; the endangered Fiji Banded Iguana (*Brachylophus fasciatus*). This iconic Fijian species does occur in parts of Vanua Levu, but does not appear to occur in the study area, despite the presence of large tracts of suitable forest habitat. It may be that the species has never colonized the peninsula due to its biogeographical isolation, but it may also be the case that it has been extirpated due to pressure from invasive species, such as the Small Indian Mongoose.



Plate 3 – Cane Toad (Rhinella marina) on the Natewa Peninsula.

Invertebrates

Invertebrate surveys in the Natewa Peninsula have, to date, largely focussed on two key groups; Butterflies (Lepidoptera) and Gastropods (Gastropoda). This is due to the relative simplicity of surveying the former, and the availability of specialist taxonomic expertise for surveying the latter. To date, a total of 13 butterfly species have been detected in the study area (Appendix 6) along with 61 gastropod species (Appendix 7). Preliminary work has also begun on assessing the diversity of arachnids in the study area (Appendix 8). To date only three species have been reliably identified from the Peninsula, although this number will undoubtably increase substantially if permits to export specimens to museums are granted.

Approximately one quarter of the butterfly species detected in the study area are Fijian endemics. The most notable of these is the Natewa Swallowtail (*Papilo natewa*) (Plate 4) which is a newly-described species that is, as far as current knowledge suggests, entirely restricted to the Natewa Peninsula (Tennent *et al.* 2018). Unless it is subsequently found to inhabit other parts of Vanua Levu, this species may be one of the most range-restricted Papilonidae species found anywhere in the World (Tennent *et al.* 2018), and its occurrence here is a major contribution to the biological value of the Natewa Peninsula.

The Gastropod community of the Natewa Peninsula also appears to possess high conservation value, with 22 (36.1%) of the species present being Fijian endemics, ten of which are also considered threatened or near-threatened by the IUCN (2019). Some of the records from the study area appear to represent major species range extensions (with some species not being currently mapped as occurring further north than Viti Levu), and one species (*Diastole* n.sp. 'Viti') in likelihood representing an entirely new species to science, which is likely to prove to be another Natewa Peninsula endemic.

The butterfly and gastropod surveys completed in the study area to date give a good approximate indicator of the invertebrate diversity of the Natewa peninsula. However, many invertebrate taxa remain, at present, entirely unassessed, and some of these taxa may represent important targets for future survey work in the area to focus on (subject to availability of relevant taxonomic expertise). Groups of potential future interest include macro-moths and dragonflies. As above, the continuation of arachnid surveys would also be productive, subject to the availability of export permits for specimens sourced from these surveys.



Plate 4 – Natewa Swallowtail (Papillo natewa) on the Natewa Peninsula.

Botany and habitat structure

Botany surveys in the Natewa Peninsula have detected, to date, a total of 84 tree species (Appendix 9) along with numerous non-tree plant species (Powling 2018). Results of the botanical surveys completed to date indicate that the tree community of the Natewa Peninsula is speciose for an oceanic island. The Peninsula also supports numerous very local endemics (three palm species occurring here are only known to occur on Vanua Levu and its offshore islands) as well as globally threatened species (five species present are considered the be threatened or near-threatened by the IUCN). Beyond the fairly robust tree species inventory completed to date, some additional survey work has also examined other botanical groups, notably Orchids. At present results from these additional surveys are not sufficient to generate a systematic inventory for these other plant groups, although further work on these groups in future fieldwork seasons may allow such inventories to be compiled.

As well as the botanical surveys, habitat survey teams have also collated extensive forest structure datasets from plots completed within the Natewa Peninsula, with an objective of calculating carbon stocks sequestered within the forested sections of the study area. A

detailed appreciation of these carbon stocks is of fundamental importance if carbon offset-based funding, such as that provided by REDD+, is to be applied for in the future (United Nations REDD Programme 2020). Using the methods described in Speight *et al.* (2018), a total of 29 20m x 20m plots have been surveyed to date, with circumference-at-breast-height (CBH) measurements being obtained from all trees within these plots. Survey effort was divided between two broad forest types; undisturbed forest and disturbed forest. By taking average carbon stock values from the plots completed in both of these habitat stratifications, and extrapolating these values over the estimated hectarage of both forest types on the Peninsula (24,000 ha for undisturbed forest and 18,000 ha for disturbed forest), overall carbon stocks for the study area were estimated at **20,732,148 metric tons**.

These figures suffice for an early-stage assessment of carbon stocks in the study area, and give a preliminary appreciation of the approximate scale of these stocks. However, more robust estimates are required if applying for large-scale carbon-based funding (such as that provided by REDD+) is an aspiration for the future. Two elements are necessary to develop more detailed carbon stock assessments. Firstly, more data is needed from more plots, and more longitudinal data is required from plots which have already been surveyed. These data will be sourced by further opwall field seasons in the Natewa Peninsula. Secondly, a more detailed appreciation of habitat stratification for the study area is needed to ensure carbon stocks can be more accurately calculated. This is more difficult in the Natewa Peninsula than in some other tropical forest sites, as sections of disturbed and undisturbed forest are often quite intermixed, and are not easy to determine using remote sensing analysis. The most practical solution to this is to incorporate a forest classification survey team in future field seasons. The job of this team will be to explore the entirety of Peninsula (divided for the purpose of this study into 1km x 1km survey squares. The team will complete rapid habitat survey assessments in each of these squares, and assign to each one of four broad habitat stratification categories - "undisturbed forest/regenerated secondary forest/disturbed secondary forest/non-forest". The ultimate goal will be to produce a habitat classification map of the whole study area. The combination of larger datasets and more detailed and delimitated habitat stratification categories will allow future carbon assessments to be accurate enough to support funding applications for large-scale funding, such as REDD+



 $Plate \ 5-The\ forests\ of\ the\ Natewa\ Peninsula;\ a\ major\ source\ of\ carbon\ stocks.$

Conclusions

The results of this report provide extensive evidence that the biodiversity of the Natewa Peninsula is of national significance. The study area, which encompasses just 3.1% of the total land area of the country, supports a disproportionately large proportion of Fijian diversity, with 60% of all terrestrial bird species, 50% of all native mammals, and 40% of all native herpetofaunal species being found here. This includes many globally threatened and/or endemic species, the most notable of which are the Natewa Silktail (*Lamprolia klinesmithi*) and the Natewa Swallowtail (*Papilio natewa*), the known range for both of which is restricted entirely to the Natewa Peninsula. Preliminary habitat survey data also indicates that the forests of the study area stores vast carbon stocks, with current estimates predicting more than 20 million metric tonnes to be sequestered here.

The case for protecting the Natewa Peninsula to ensure the long-term integrity of its biodiversity and ecosystem services is therefore very clear. However, given that severe ecological pressures occur in the study area – most notably from invasive species and deforestation – it is important that any conservation actions here be implemented swiftly, to prevent further deterioration of its unique biodiversity. Proposed conservation initiatives range from legislative action (i.e. gazetting the area as Fiji's first major terrestrial national park) to applied invasive species control projects (Kerr 2018). The data presented in this report demonstrates that such actions represent a strong investment of conservation resources.

While surveys to date have provided a strong overview of the biodiversity of the Natewa Peninsula, there are multiple opportunities for future fieldwork to expand our knowledge of the study area further. Certain invertebrate and botanical taxa remain unsurveyed or partially surveyed to date. Developing systematic inventories for these groups, which include macromoths, dragonflies and orchids, would allow for a more detailed assessment of the biodiversity of the study area, and might possibly uncover more species endemic to the Peninsula. Opportunities also exist to conduct further work in the focal taxonomic groups presented in this report. For example, confirming the presence of the Critically Endangered Fijian Monkey-faced Bat (*Mirimiri acrodonta*) would considerably boost the conservation value of the Natewa Peninsula, as would the discovery of any cryptic diversity within the skink species present; further analysis of these may yield further peninsula-specific endemics. An expansion of habitat structure surveys in the study area, including the development of a land classification map for the Peninsula, is also necessary to develop more robust

assessments of carbon stocks than has been possible to date. However, while further work remains to be completed to refine our knowledge of the study area, the data presented in this report clearly shows the Natewa Peninsula possesses extremely high conservation value, and represents a high priority area for conservation projects aiming to protect the biodiversity of this Pacific island nation.



Plate 6 – The Natewa Peninsula

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Appendix 1 – Species of conservation concern occurring on the Natewa Peninsula

Table summarising threatened and near-threatened species detected on Buton. Taxonomy and nomenclature for each group follow those described in Appendices 3-8. Species indicated * are also endemic to Fiji. Threat status and population trends follow IUCN (2019).

Class	Common name	Latin name	IUCN Category	Population
Mammals	Samoan Flying Fox	Pteropus samoensis	NT	Decreasing
	Fijian Free-tailed Bat	Chaerephon bregullae	E	Decreasing
Birds	Barking Imperial-pigeon	Alopecoenas stairi	Vu	Decreasing
	Tahiti Petrel	Pseudobulweria rostrata	NT	Decreasing
	*Natewa Silktail	Lamprolia klinesmithi	Vu	Decreasing
Herpetofauna	* Fiji Ground Frog	Cornufer vitianus	E	Decreasing
·	* Viti Levu Mountain Tree	Emoia campbelli	Е	Decreasing
	* Viti Copper-headed Skink	Emoia parkeri	Vu	Decreasing
Gastropods	*Snail sp.	Diancta macrostoma	Vu	Unknown
	*Snail sp.	Palaina godeffroyana	Vu	Unknown
	*Snail sp.	Omphalotropis circumlineata	NT	Unknown
	*Snail sp.	Sinployea adposita	Vu	Unknown
	*Snail sp.	Sinployea monstrosa	Vu	Unknown
	*Snail sp.	Trochomorpha abrochroa	Vu	Unknown
	*Snail sp.	Trochomorpha accurata	Vu	Unknown
	*Snail sp.	Trochomorpha lüdersi	NT	Unknown
Trees	Dakua makadre	Agathis macrophylla	E	Decreasing
	*Kauvula	Endospermum robbieanum	Vu	Stable
	*Buabua ('Mbumbua')	Fagraea gracilipes	NT	Unknown
	Vesi	Intsia bijuga	Vu	Unknown
	*Palm sp.	Balaka macrocarpa	E	Unknown
Total –	21 species			

Appendix 2 – Fijian endemic species and sub-species occurring on the Natewa Peninsula

Tables summarising **A**) species endemic to Vanua Levu, and **B**) sub-species endemic to Vanua Levu and its offshore islands, which have been detected on the Natewa Peninsula. Taxonomy and nomenclature for each group follow those described in Appendices 3-8. The endemism extent column indicates if a species or sub-species is endemic to the Vanua Levu region (including its offshore islands), or the Natewa Peninsula specifically.

A)

Class	Common name	Latin name	Endemism extent
Birds	Orange Dove	Chrysoena victor	Vanua Levu and offshore islands
	Maroon Shining-parrot	Prosopeia tabuensis	Vanua Levu and offshore islands
	Fiji Wattled Honeyeater	Foulehaio taviunensis	Vanua Levu and offshore islands
	Natewa Silktail	Lamprolia klinesmithi	Natewa peninsula
Butterflies	Fijian Swallowtail	Papilio natewa	Natewa peninsula
Trees	Palm sp.	Balaka seemannii	Vanua Levu and offshore islands
	Palm sp.	Balaka macrocarpa	Vanua Levu and offshore islands
	Palm sp.	Veitchia filifera	Vanua Levu and offshore islands
Total -	8 species		

B)

Class	Common name	Latin name	Endemism extent
Birds	Fiji Whistler	Pachycephala vitiensis optatata	Vanua Levu and offshore islands
	Polynesian Triller	Lalage maculosa woodi	Vanua Levu and offshore islands
	Fiji Streaked Fantail	Rhipidura layardi erythronota	Vanua Levu and offshore islands
	Fiji Shrikebill	Clytorhynchus vitiensis buensis	Vanua Levu and offshore islands
	Fiji Bush-warbler	Horornis ruficapilla castaneopterus	Vanua Levu and offshore islands
	Island Thrush	Turdus poliocephalus vitiensis	Vanua Levu and offshore islands
Total -	5 species		

Appendix 3 – Mammal diversity in the Natewa Peninsula

Table showing mammal species detected on the Natewa Peninsula. Taxonomy and nomenclature follows Wilson & Reeder (2020). Species marked * are regionally endemic to Fiji. Species indicated † are assessed as threatened or near-threatened by the IUCN (2019) and are further summarized in Appendix 1. Species indicated X in the 'Reserve' column have been detected within the boundaries of the Natewa forests study area. Species unmarked in this column have only been detected in habitats adjacent to the forested study area.

Order/Super- Order	Family	Common name	Scientific name	Population	Reserve
Carnivora	Herpestidae	(I)Small Indian Mongoose	Herpestes auropunctatus	Unknown	Х
Rodentia	Muridae	(I)Pacific Rat	Rattus exulans	Stable	X
		(I)Brown Rat	Rattus norvegicus	Stable	Х
		(I)House Mouse	Mus musculus	Stable	Х
Chiroptera	Pteropodidae	Pacific Flying Fox	Pteropus tonganus	Decreasing	
		†Samoan Flying Fox	Pteropus samoensis	Decreasing	
	Molossidae	†Fijian Free-tailed Bat	Chaerephon bregullae	Decreasing	X
Total – 3 Orders / Super-orders	4 Families	7 species			

Appendix 4 – Bird diversity in the Natewa Peninsula

Table showing bird species detected on the Natewa Peninsula. Taxonomy and nomenclature follows HBW & BirdLife International (2017). Species marked * are regionally endemic to Fiji. Species indicated † are assessed as threatened or near-threatened by the IUCN (2019) and are further summarized in Appendix 1. Species indicated <M> are wintering or passage migrants. Species indicated X in the 'Reserve' column have been detected within the boundaries of the Natewa forests study area. Species unmarked in this column have only been detected in habitats adjacent to the forested sections of the study area.

Family	Common name	Scientific name	Population	Reserve
raililly	Common name	Scientific flame	Population	Reserve
Phasianidae	(I)Red Junglefowl	Gallus gallus	Decreasing	
Anatidae	Pacific Black Duck	Anas superciliosa	Unknown	
Columbidae	*Barking Imperial-pigeon	Ducula latrans	Decreasing	X
	Metallic Pigeon	Columba vitiensis	Stable	Х
	Many-coloured Fruit-dove	Ptilinopus perousii	Decreasing	Х
	*Orange Dove	Chrysoena victor	Stable	Х
	†Shy Ground-dove	Alopecoenas stairi	Decreasing	Х
	(I)Eastern Spotted Dove	Spilopelia chinensis	Increasing	
Apodidae	White-rumped Swiftlet	Aerodramus spodiopygius	Stable	Х
Cuculidae	Fan-tailed Cuckoo	Cacomantis flabelliformis	Stable	Х
Procellariidae	†Tahiti Petrel	Pseudobulweria rostrata	Decreasing	
Ardeidae	Pacific Reef Egret	Egretta sacra	Stable	
	Green-backed Heron	Butorides striata	Decreasing	
Fregatidae	Lesser Frigatebird	Fregata ariel	Decreasing	
Sulidae	Red-footed Booby	Sula sula	Decreasing	
	Brown Booby	Sula leucogaster	Decreasing	
Charadriidae	Pacific Golden Plover	Pluvialis fulva	Decreasing	
	Wandering Tattler	Tringa incana	Stable	
Laridae	Greater Crested Tern	Thalasseus bergii	Stable	
	Black Noddy	Anous minutus	Stable	
	Brown Noddy	Anous stolidus	Stable	

Tytonidae	Common Barn Owl	Tyto alba	Stable	Х
Accipitridae	*Fiji Goshawk	Accipiter rufitorques	Stable	
Accipititude	Swamp Harrier	Circus approximans	Stable	
		- Сисис аррисиние		
Halcyonidae	Collared Kingfisher	Todiramphus chloris	Decreasing	
Falconidae	Peregrine Falcon	Falco peregrinus	Stable	
Psittacidae	*Collared Lory	Phigys solitarius	Stable	X
rsittatiude	*Maroon Shining-parrot	Prosopeia tabuensis	Decreasing	X
	Wardon Silling-parrot	Prosopeia tabaerisis	Decreasing	^
Meliphagidae	*Fiji Wattled Honeyeater	Foulehaio taviunensis	Unknown	Х
- 1 - 0	*Orange-breasted Myzomela	Myzomela jugularis	Stable	Х
	,	, , , ,		
Pachycephalidae	*Fiji Whistler	Pachycephala vitiensis	Stable	Х
Campanhagidaa	Dalunacian Trillar	Lalaan manulasa	Ctable	V
Campephagidae	Polynesian Triller	Lalage maculosa	Stable	X
Artamidae	*Fiji Woodswallow	Artamus mentalis	Decreasing	Х
Rhipiduridae	†*Natewa Silktail	Lamprolia klinesmithi	Decreasing	X
	*Fiji Streaked Fantail	Rhipidura layardi	Stable	Х
Monarchidae	Fiji Shrikebill	Clytorhynchus vitiensis	Decreasing	X
	*Slaty Monarch	Mayrornis lessoni	Decreasing	Х
	Vanikoro Flycatcher	Myiagra vanikorensis	Stable	Х
Petroicidae	Pacific Robin	Petroica pusilla	Decreasing	Х
Hirundinidae	House Swallow	Hirundo javanica	Increasing	
Pycnonotidae	(I)Red-vented Bulbul	Pycnonotus cafer	Increasing	
Scotocercidae	*Fiji Bush-warbler	Horornis ruficapilla	Decreasing	Х
Zosteropidae	*Fiji White-eye	Zosterops explorator	Unknown	Х
Losteropiade	Silvereye	Zosterops lateralis	Stable	X
Sturnidae	Polynesian Starling	Aplonis tabuensis	Unknown	Х
	(I)Common Myna	Acridotheres tristis	Increasing	
Turdidae	Island Thrush	Turdus poliocephalus	Decreasing	X
		,		
Estrildinidae	(I)Red Avadavat	Amandava amandava	Stable	
	*Fiji Parrotfinch	Erythrura pealii	Stable	Х
Total – 30 Families	49 species			

Appendix 5 – Herpetofauna diversity in the Natewa Peninsula

Tables showing **A**) Amphibian and **B**) Reptile species detected on the Natewa Peninsula. Taxonomy and nomenclature follow Frost (2020) for Amphibians and Uetz *et al.* (2019) for Reptiles. Species marked * are regionally endemic to Fiji. Species indicated † are assessed as threatened or near-threatened by the IUCN (2019) and are further summarized in Appendix 1. Species indicated X in the 'Reserve' column have been detected within the boundaries of the Natewa forests study area. Species unmarked in this column have only been detected in habitats adjacent to the forested sections of the study area.

A)

Family	Common name	Scientific name	Population	Reserve
Bufonidae	(I)Cane Toad	Rhinella marina	Increasing	Х
Ceratobatrachidae	*†Fiji Ground Frog	Cornufer vitianus	Decreasing	Х
	*†Fiji Tree Frog	Cornufer vitiensis	Decreasing	Х
Total – 2 Families	3 Species			

B)

Family	Common name	Latin name	Population	Reserve?
Gekkonidae	Pacific Slender-toed Gecko	Nactus pelagicus	Stable	Х
	Mourning Gecko	Lepidodactylus lugubris	Unknown	Х
	Oceania Gecko	Gehyra oceanica	Stable	Х
Scincidae	Pacific Bluetail Skink	Emoia caeruleocauda	Stable	X
	*†Viti Levu Mountain Tree skink	Emoia campbelli	Decreasing	Х
	Copper-tailed Skink	Emoia cyanura	Unknown	Х
	Dark-bellied Copper-striped Skink	Emoia impar	Stable	Х
	*†Viti Copper-headed Skink	Emoia parkeri	Decreasing	Х
Boidae	Pacific Boa	Candoia bibroni	Stable	
Total – 2 Families	9 species			

Appendix 6 – Butterfly diversity in the Natewa Peninsula

Table showing butterfly species detected on the Natewa Peninsula. Taxonomy and nomenclature follows Häuser et al. (2020). Species marked * are regionally endemic to Fiji. Species indicated † are assessed as threatened or near-threatened by the IUCN (2019) and are further summarized in Appendix 1. Species indicated (I) are introduced to the study area). Species indicated X in the 'Reserve' column have been detected within the boundaries of the Natewa forests study area. Species unmarked in this column have only been detected in habitats adjacent to the forested sections of the study area.

Family	Common name	Scientific name	Population	Reserve
Hesperiidae	Fiji Grass Dart	Oriens augustula	Unknown	Х
	Brown Awl	Badamia exclamationis	Unknown	Х
	Awl sp.	Badamia atrox	Unknown	Х
Papilionidae	*Fijian Swallowtail	Papilio schmeltzi	Unknown	X
	*Natewa Swallowtail	Papilio natewa	Unknown	Х
Pieridae	Common Grass Yellow	Eurema hecabe	Unknown	Х
	Common Emigrant	Catopsilia pomona	Unknown	Х
	Orange Emigrant	Catopsilia scylla	Unknown	Х
Lycaenidae	*Fijian Blue	Jamides candrena	Unknown	Х
	(I) Lantana Scrub Hairstreak	Strymon bazochii	Unknown	Х
	*Fiji Lineblue	Nacaduba dyopa	Unknown	Х
	Common Grass Blue	Zizina labradus	Unknown	Х
	Gaika Blue	Zizula hylax	Unknown	Х
Nymphalidae	Monarch	Danaus plexippus	Unknown	X
	Common Crow	Euploea lewinii	Unknown	Х
	Pacific Crow	Euploea boisduvalii	Unknown	Х
	Dwarf crow	Euploea tulliolus	Unknown	Х
	Dark Blue Tiger	Tirumala hamata	Unknown	Х
	Great Egg Fly	Hypolimnas bolina	Unknown	Х
	Spotted Egg Fly	Hypolimnas antilope	Unknown	Х
	Meadow Argus	Junonia villida	Unknown	Х
	Common Evening Brown	Melanitis idea	Unknown	Х
	*Common Fijian Ringlet	Xois sesara	Unknown	Х
	*Fijian Emperor	Polyura caphontis	Unknown	Х

	Vagrant	Vagrans egista	Unknown	Х
Total – 5 Families	25 Species			

Appendix 7 – Gastropod diversity in the Natewa Peninsula

Table showing Gastropod species detected on the Natewa Peninsula. Taxonomy and nomenclature follows Barker & Narosamalua (2017). Species marked * are regionally endemic to Fiji. Species indicated † are assessed as threatened or near-threatened by the IUCN (2019) and are further summarized in Appendix 1. Species indicated X in the 'Reserve' column have been detected within the boundaries of the Natewa forests study area. Species unmarked in this column have only been detected in habitats adjacent to the forested sections of the study area

Family	Scientific name	Population	Reserve
Helicindae	Orobophana musiva	Unknown	Х
	Pleuropoma beryllina	Unknown	Х
	Pleuropoma interna	Unknown	Х
	Pleuropoma jetschini	Unknown	Х
Hydrocenidae	*Georissa brevissima	Unknown	X
Diplommatinidae	*Diancta dilatata	Unknown	X
	†*Diancta macrostoma	Unknown	Х
	*Diancta martensi	Unknown	Х
	*Diancta quadrata	Unknown	Х
	*Palaina ascendens	Unknown	Х
	†*Palaina godeffroyana	Unknown	Х
	*Palaina glabella	Unknown	Х
	*Palaina tuberosa	Unknown	Х
	*Moussonia vitiana	Unknown	Х
Assimineidae	*†Omphalotropis circumlineata	Unknown	X
Truncatellidae	*Taheitia turricula	Unknown	X
Veronicellidae	(I)Sarasinula plebeius	Unknown	X

	(I)Semperula wallacei	Unknown	Х
	(I)Laevicaulis alte	Unknown	Х
Ellobiidae	Pythia scarabaeus	Unknown	Х
Achatinellidae	Elasmias apertum	Stable	Х
	Lamellidea oblonga	Unknown	Х
	Lamellidea pusilla	Stable	Х
Vertiginidae	(I)Gastrocopta pediculus	Unknown	X
	(I)Gastrocopta servilis	Unknown	X
	*Nesopupa vitiana	Unknown	Х
Bothriembryontidae	*Callistocharis elobatus	Unknown	Х
	*Callistocharis fulguratus	Unknown	X
Charopidae	Discocharopa aperta	Unknown	X
	*†Sinployea adposita	Unknown	X
	*†Sinployea monstrosa	Unknown	X
	Con avalanta anlaviana	I I al a a a a a a	
Euconulidae	Concuplecta calculosa	Unknown	X
	Coneuplecta microconus Disconulus sp.	Unknown	X
	Discondius sp.	Unknown	Λ
Microcystidae	*Diastole n. sp. 'Viti'	Unknown	X
<u> </u>	Lamprocystis ensifera	Unknown	Х
	Lamprocystis excrescens	Unknown	Х
	Lamprocystis oneataensis	Unknown	Х
	Liardetia samoensis	Unknown	Х
Helicarionidae	Orpiella (Halozonites) cookensis	Unknown	Х
	Orpiella fragillima	Unknown	X
	Orpiella (Irenella) pfeifferi	Unknown	X
	(I)Wilhelminaia mathildae	Unknown	Х
Ariophantidae	(I)Parmarion martensi	Unknown	X
	(I)Quantula striata	Unknown	X
Trochomorphides	*†Trochomornha ahrashraa	Halmanna	V
Trochomorphidae	*†Trochomorpha abrochroa *†Trochomorpha accurata	Unknown	X
	*†Trochomorpha lüdersi	Unknown Stable	X
	*Trochomorpha merzianoides	Unknown	X
	Trochomorpha merzianolaes	UIIKIIUWII	^
Subulinidae	(I)Allopeas clavulinum	Unknown	X
	(1) mopeus ciavamiam	CHRIOWII	^

Total – 23 Families	61 species		
Valloniidae	(I)Ptychopatula orcula	Unknown	X
Jacomerado	(i)Quienta correisa	OTIKITOWIT	
Succineidae	(I)Quickia concisa	Unknown	X
Ferussaciidae	(I)Geostilbia aperta	Unknown	Х
Zonitidae	(I)Hawaiia minuscula	Unknown	X
Camaenidae	(I)Bradybaena similaris	Unknown	X
Composition	(I) Duranto harrana a sina ilania	I I a lua a com	V
	(I)Streptostele musaecola	Unknown	X
Streptaxidae	(I)Gullella (Huttonella) bicolor	Unknown	Х
	(I)Subulina octona	Unknown	X
	(I)Paropeas achatinaceum	Unknown	X
	(I)Opeas mauritianus	Unknown	Х
	(I)Allopeas gracile	Unknown	Х

Appendix 8 – Arachnid diversity in the Natewa Peninsula

Table showing a preliminary list of Arachnid species detected on the Natewa Peninsula. Species marked * are regionally endemic to Fiji. Species indicated † are assessed as threatened or nearthreatened by the IUCN (2019) and are further summarized in Appendix 1. Species indicated X in the 'Reserve' column have been detected within the boundaries of the Natewa forests study area. Species unmarked in this column have only been detected in habitats adjacent to the forested sections of the study area.

Family	Scientific name	Population	Reserve
Araneidae	*Argiope pentagona	Unknown	Х
Pholcidae	*Belisana fiji	Unknown	Х
Thomisidae	*Xysticus ictericus	Unknown	Х

Appendix 9 – Tree diversity in the Natewa Peninsula

Table showing Tree species detected on the Natewa Peninsula. Adapted from Powling (2018), including all taxonomy and nomenclature. Species marked * are regionally endemic to Fiji. Species indicated † are assessed as threatened or near-threatened by the IUCN (2019) and are further summarized in Appendix 1. Species indicated X in the 'Reserve' column have been detected within the boundaries of the Natewa forests study area. Species unmarked in this column have only been detected in habitats adjacent to the forested sections of the study area

Family	Local name	Scientific name	Population	Reserve
Anacardiaceae	Manawi	Rhus simarubifolia	Unknown	Х
	Tarawau	Dracontomelon vitiense	Unknown	
		(I)Mangifera indica	Unknown	
Annonaceae	Makosoi	Cananga odorata	Unknown	

Apocynaceae	Bulei	Alstonia costata	Unknown	X
	Drega ('Ndrenga')	*Alstonia vitiensis	Unknown	Х
	Vavaoia	(I)Alstonia macrophylla	Unknown	Х
	Vasa	Cerbera manghas	Unknown	Х
Araucariaceae	Dakua makadre ('makandre')	†Agathis macrophylla	Decreasing	Х
Bignoniaceae	Pisipisi	(I)Spathodea campanulata	Unknown	Х
Boraginaceae	Nawanawa	Cordia subcordata	Unknown	
Casuarinaceae	Caukuro ('Thaukuro')	*Gymnostoma vitiense	Unknown	Х
	Nokonoko	Casuarina equisetifolia	Unknown	
Chrysobalanaceae	Makita	Atuna racemosa	Unknown	Х
	Sea ('Seah')	Parinari insularum	Unknown	Х
Combretaceae	Tavola	Terminalia litoralis	Unknown	
	Tivi	*Terminalia sp.	Unknown	Х
		Lumnitzera littorea	Decreasing	
Cunoniaceae	Vure ('Vureh')	Geissios/Geissois ternata	Unknown	X
Cariomaccac	vare (varen)	Geissios, Geissois terriata	OTIKHOWII	^
Cyatheaceae		Cyathea lunulata (or medullaris)	Unknown	X
•		, , , ,		
Euphorbiaceae	Kauvula	*†Endospermum robbieanum	Stable	Х
	Rote ('Roteh')	Macaranga spp. (inc. harveyana,	Unknown	Х
		magna, seemannii)		
	- 4 4 4			
Gentianaceae	Buabua ('Mbumbua')	*†Fagraea gracilipes	Unknown	X
Cuttiforn	Domesey	*Code abouttone within a	Links access	V
Guttiferae	Damanu	*Calophyllum vitiense	Unknown	X
	Dilo	Calophyllum inophyllum *Calophyllum cf. cerasiferum	Unknown	
		Calophyliain cj. cerasijerain	Unknown	
Labiatae	Rosawa	*Gmelina vitiensis	Unknown	X
(Verbenaceae)	NOSawa	Gilletina vidensis	Ulikilowii	^
•				
Lauraceae	Macou ('Mathou')	*Cinnamomum spp.	Unknown	Х
Lecythidaceae	Vutu	Barringtonia asiatica	Unknown	
	Vutu	Barringtonia edulis	Unknown	Х
Leguminosae	Cibicibi ('Thibithibi')	*Maniltoa floribunda	Unknown	Х
	Vesi	†Intsia bijuga	Unknown	
	Vaivai / Vaivai ni viti	*Serianthes melanesica	Unknown	Х

	Vaivai ni vavalagi, Mocemoce ('Mothemothe')	(I)Samanea saman	Unknown	
	lvi	Inocarpus fagifer	Unknown	
	Vesivesi	Millettia pinnata	Unknown	
Malvaceae	Vau	Hibiscus tiliaceus	Unknown	
		Thespesia populnea	Stable	
		Kleinhovia hospita	Unknown	
	Siti	Grewia crenata	Stable	Х
Meliaceae	Mahogany (large leaf)	(I)Swietenia macrophylla	Unknown	
	Mahogany (small leaf)	(I)Swietenia mahogani	Unknown	
	*Tarawaukeikaka	Dysoxylum lenticellare	Unknown	X
			+	+
Moraceae	Uto	(I)Artocarpus altilis	Unknown	+
	(Lolo)	(I)Ficus benjamina	Unknown	+
	(Lolo)	(I)Ficus elastica	Unknown	
	(Lolo)	*Ficus fulvo-pilosa	Unknown	X
	(Lolo)	*Ficus greenwoodii	Unknown	X
	(Lolo)	*Ficus masonii	Unknown	X
	(Lolo)	Ficus obliqua	Stable	X
	(Lolo)	Ficus smithii var. robusta	Unknown	X
	(Lolo)	*Ficus vitiensis	Unknown	X
	1			+
Myristicaceae	Male ('Maleh')	*Myristica grandifolia	Unknown	X
<u>· , </u>	, ,	1 , 3 ,		
Myrtaceae	Guava	(I)Psidium guajava	Unknown	+
	Kavika	(I)Syzygium malaccense	Unknown	X
	Leba ('Lemba')	Syzygium neurocalyx	Unknown	X
	Yasiyasi / Yasimoli	*Syzygium wolfii	Unknown	X
	Nuqanuqa ('Nunganunga')	*Decaspermum vitiense	Unknown	X
	Vuga ('Vunga')	Metrosideros collina var. collina	Stable	X
Palmae	Niu	(I)Cocos nucifera	Unknown	+
	Seiki / Masei	(I)Pritchardia pacifica	Unknown	+
		†*Balaka macrocarpa	Unknown	X
_		Balaka seemannii	Stable	X
		(I)Elaeis guineensis	Unknown	X
		*Veitchia filifera	Unknown	X
		*Veitchia joannis	Stable	X
	 			
Pandanaceae	Vadra ('Vandra')	Pandanus tectorius s.l.	Unknown	+
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	,			+
Phyllanthaceae	Koka	Bischofia javanica	Unknown	X
Thynanalacas	Molau	*Glochidion seemannii	Unknown	X
	Molau tagane	*Glochidion cf. amentuligerum	Unknown	X
	World tagaire	Glocinalon ej. amentangeram	Ulikilowii	^

Pinaceae		(I)Pinus caribaea	Unknown	
Piperaceae	Yaqoyaqona ('Yangoyangona')	(I)Piper aduncum	Unknown	X
Podocarpaceae	Dakua salusalu	Retrophyllum vitiense	Unknown	X
	Kuasi	Podocarpus neriifolius	Unknown	X
	Yaka	Dacrydium nidulum	Unknown	Х
Rubiaceae	Bobo	Mussaenda raiateensis	Unknown	X
	Kadaba ('Kandamba')	(I)Neolamarckia cadamba	Unknown	
	Kura	Morinda citrifolia	Unknown	
	Vacea ('Vathea')	Neonauclea forsteri	Unknown	Х
Sapindaceae	Dawa	Pometia pinnata	Unknown	X
Sapotaceae	Bauvudi ('Bauvundi')	*Palquium porphryeum	Unknown	X
	Bulu	*Burckiella cf. fijiensis	Unknown	Х
	Sacau ('Sathau')	*Palaquium hornei	Unknown	Х
Urticaceae	Salato / Silato	(I)Dendrocnide harveyi	Unknown	X
Total – 33 Families	84 species			