LUKAOTEM GUD MAUNTEN
KASEM SOLWOTA

MALEKULA TERRESTRIAL BIODIVERSITY ASSESSMENT REPORT

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Disclaimer

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CHAPTER I

Flora Report (West Malekula)

1.1 INTRODUCTION

Unsustainable land management, climate change, agriculture development activities and loss of traditional relationships with nature are contributing factors that have led to the erosion of natural resources in most islands in Vanuatu. Most of the Key Biodiversity Areas (KBA) that are considered to have a high diversity of plant species are losing their value. Two of these KBAs are located in Malekula Island in the northern part of Vanuatu. One of them is Small Nambas (Bamboo Bay) in the southern part and Wiawi KBA in the northern part of the island.

The BIORAP survey was funded by SPREP working in partnership with different organizations in Vanuatu to undertake different taxonomic assessments in the KBA areas. One of the components is flora assessment. Our team set up temporary transects of 40x10 metres in different vegetation types, assessed species abundance, identified seedlings, saplings, collected the Diameter at Breast Height (DBH), identified bole height and total height of trees including the ground cover and canopy cover percentage. The team also assessed and noted any endemic species they observed and gave an estimated population. Also listed are all threats and invasive species that were observed in the KBAs.

1.2 ACKNOWLEDGEMENTS

Words of gratitude to the South Pacific Regional Environment Program (SPREP) for providing funds to BIEM project and BirdLife International to support this Rapid Biodiversity Assessment. Likewise, to the participants from the government agencies and non-government organisations that have expertise in conducting assessment components such as flora, birds, insects, reptiles and so forth. Finally, to the local expert in the community to assist and provide knowledge in identifying forest types, name of places and provide other significant information about their Forest.

1.3 METHODOLOGY & EQUIPMENT

The various vegetation types were identified using the base map provided at the onset of the project. Twelve sites were initially identified – but lack of time and inclement weather during the field survey season meant that only four sites were surveyed. Dates of field travel and data collection were July 6th to 31st July, 2022. The four sites surveyed were (see Figure 1):

The other sites identified (Figure 1) but not comprehensively surveyed during this project were:

- Cloud Forest, Meten Nawoi, Bamboo Bay/Small Nambas KBA
- Lowland forest, Munvet, Bamboo Bay/Small Nambas KBA
- Lowland Forest, Tsiri Lagoon
- Dry Forest, Wiawi KBA
- Forest Ridge, Webir, Tsiri Lagoon
- Lake Vegetation, Nemake, Bamboo Bay/Small Nambas KBA

- Upper Forest, Munvet, Bamboo Bay/Small Nambas KBA
- Secondary Forest, Powanmut, Bamboo Bay/Small Nambas KBA
- Dry Forest, Lama, Tsiri Lagoon
- Lake Vegetation, Wiawi KBA
- Thickets, Tsiri Lagoon
- Cloud/Montane Forest, Pineia, Wiawi KBA

Some further information on the species composition of these sites is included in Annex 1.

Figure 1: Map of Study areas, including Wiawi KBA, Bamboo Bay (Small Nambas KBA) and Tsiri Lagoon.

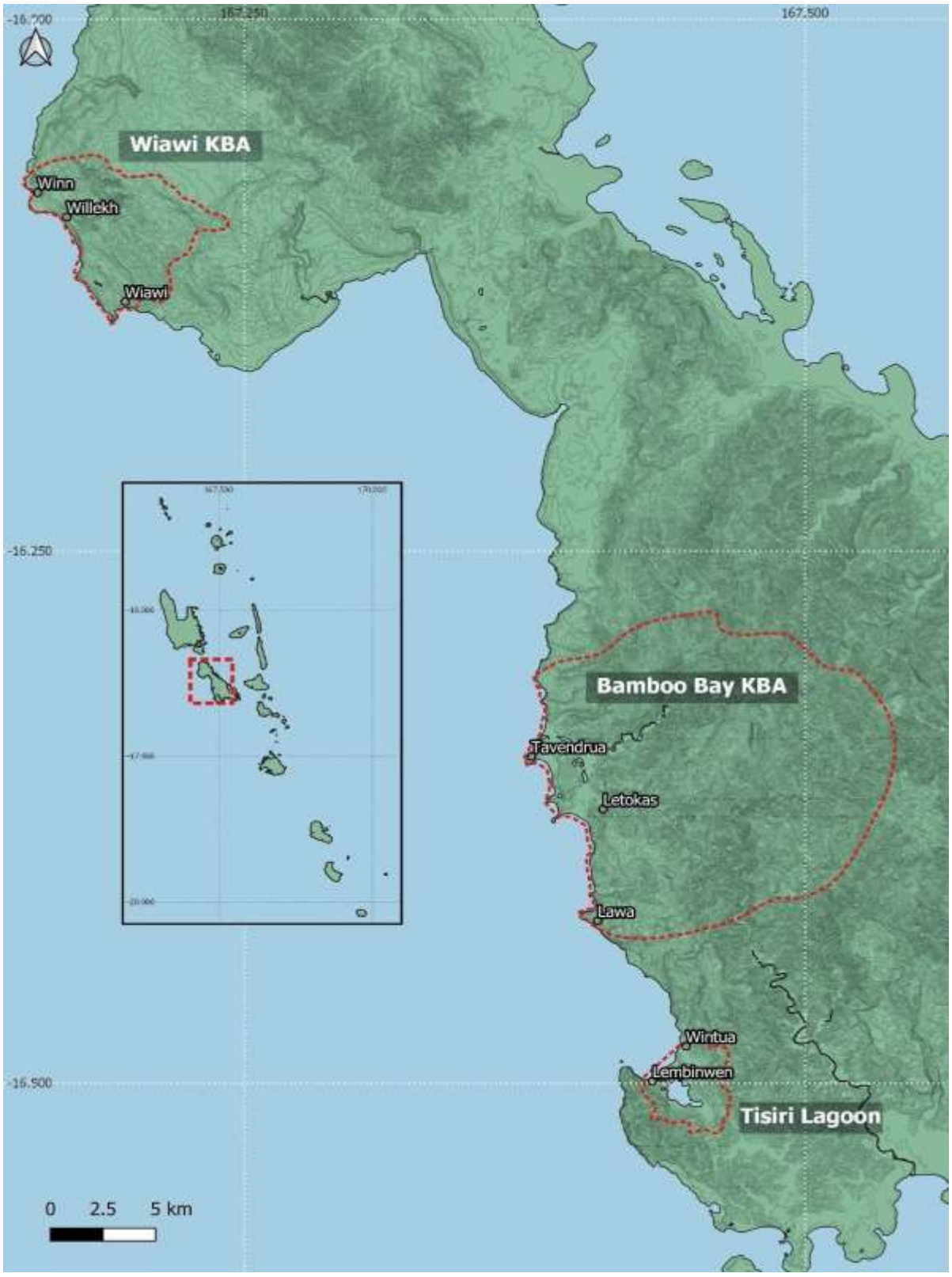


Figure 2: The map shows the number of all KBA and the number of transect established in different type of vegetation observe.

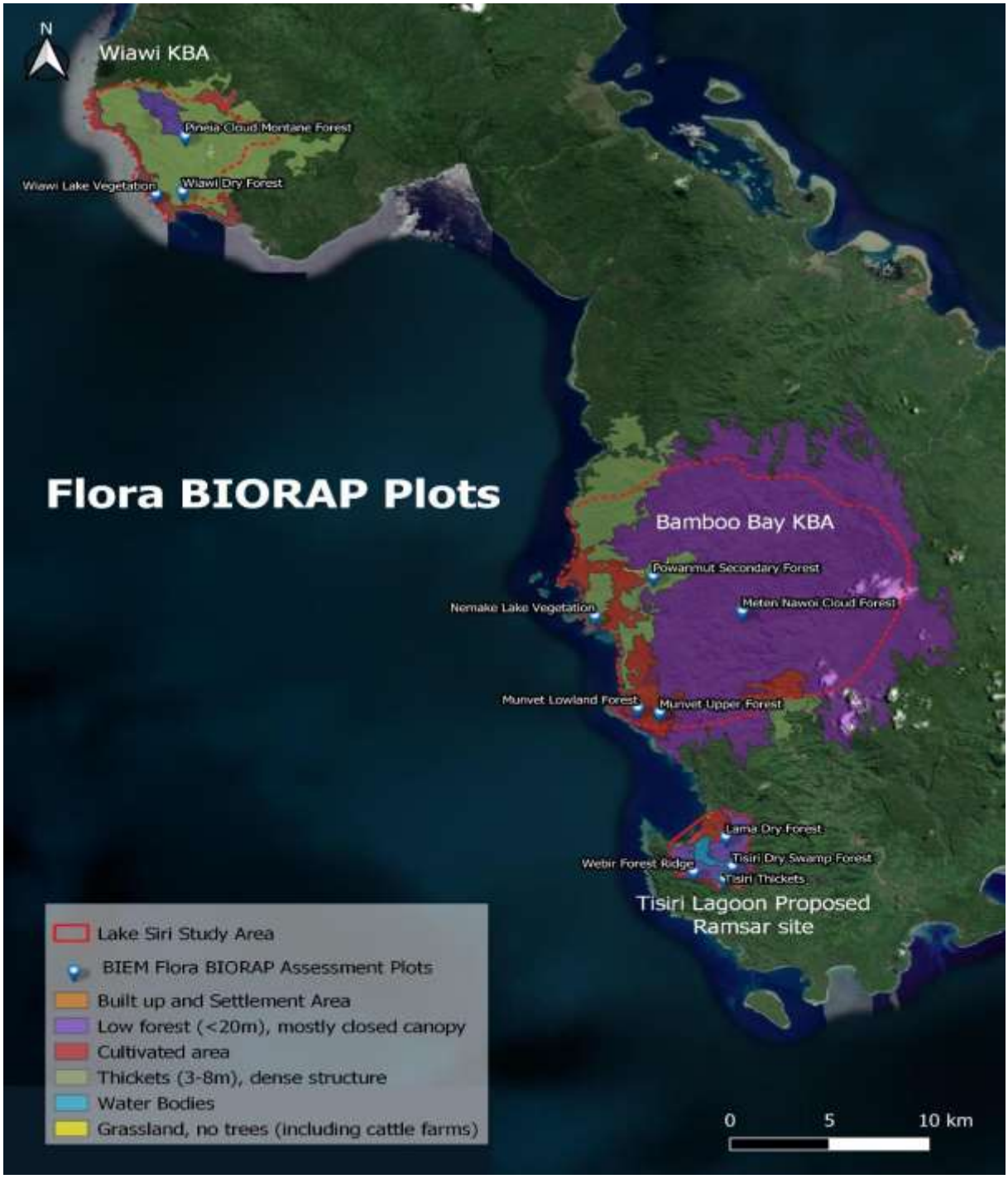
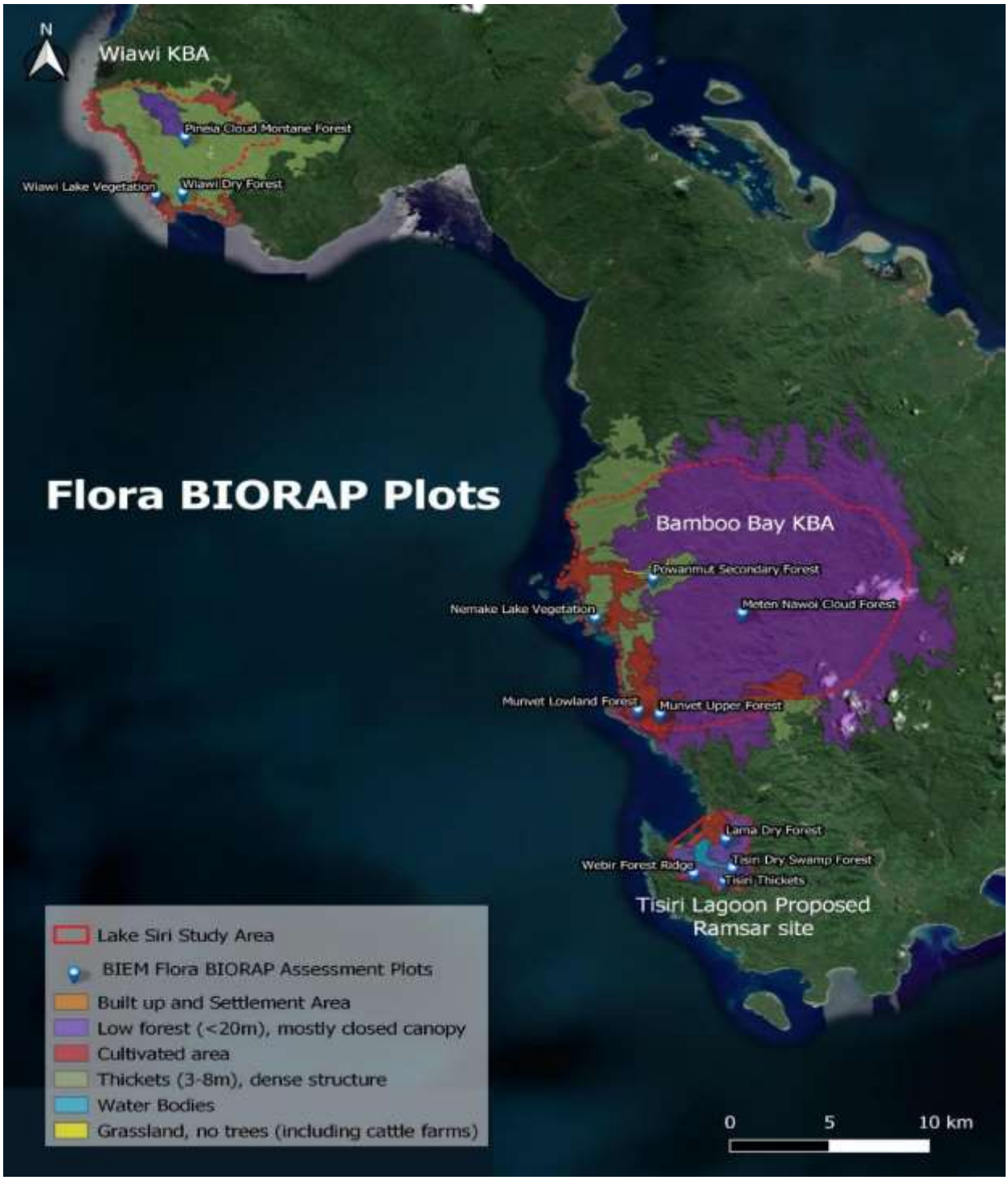


Figure 3: Map showing the 12 sites identified to undertake vegetation surveys in the three study areas.



Fieldworkers navigated to one of the coordinate points, identifying the key habitat at the site. They established a 40 m by 10 m transect at the location and compiled a checklist of species present in the transect. Some plants were collected for herbarium specimens – and are now deposited at the museum. Threats to the sites were noted and some recommendations as to how to conserve or, where necessary, rehabilitate the area were recorded.

Species information was then compared with the Vanuatu plant checklist (https://checklist.pvnh.net/#!/checklist). Information on the endemicity, the IUCN red list status and published data on the species present is listed in the Table below, along with the sites where each of the species are present. Note that this table sorts the species by Order (or class for ferns) in line with Key Biodiversity Area standards (each order or class for ferns) and are considered as a separate taxonomic unit – with a set numbers of species per taxonomic group per site being used as a Range-restricted (B2) criterion. Those species that are either listed as globally threatened (CR, EN or VU) in the IUCN red list or those that are considered endemic to Vanuatu are further considered for assessment.

1.4 RESULTS

The information collected is summarised for all species in Table 1.

Table 1: The species recorded during the Malekula Plant Survey in July 2022, the national status of these species, the IUCN Red List status and the sites at which the species were recorded.

Taxonomic Group, Order or Class (Ferns)	Scientific Name	Endemic/ Native/ Introduced	IUCN Red List	Cloud forest Small Nambas	Lowland Small Nambas	Tsiri Lagoon	Wiawi dry forest
Alismatales	*Amorphophallus paeoniifolius*	Introduced	NE	1			1
Alismatales	*Cyrtosperma merkusii*	Native	NE	1			1
Alismatales	*Epipremnum pinnatum*	Native	NE	1			1
Alismatales	*Lemna*			1			1
Alismatales	*Potamogeton tricarinatus*	Native	NE	1			1
Alismatales	*Stuckenia pectinata*	Native	NE	1			1
Apiales	*Delarbrea paradoxa*	Native	NE				1
Apiales	*Meryta neoebudica*	nr Endemic	NE		1		1
Apiales	*Pittosporum campbellii*	Native	NE				1
Apiales	*Polyscias*						
Apiales	*Polyscias cumingiana*	?Native	NE		1		1
Apiales	*Polyscias multijuga*	Native	NE		1		1
Apiales	*Polyscias scutellaria*	Native	NE		1	1	1
Apiales	*Schefflera neoebudica*	Endemic	NE		1		1
Arecales	*Cocos nucifera*	Native	NE	1	1		1
Arecales	*Hydriastele cylindrocarpa*	nr Endemic	NE	1			1
Arecales	*Licuala*			1			1
Arecales	*Licuala cabalionii*	Endemic	NE			1	
Arecales	*Licuala grandis*	nr Endemic	NE	1		1	1
Arecales	*Metroxylon warburgii*	Native	LC	1			1
Arecales	*Veitchia*			1			1
Arecales	*Veitchia winin*	Endemic	NE			1	1
Asparagales	*(=Anoectochilus) Goodyera subregularis*	Native	NE				
Asparagales	*(=Proiphys) Eurycles amboinensis*	Native	NE	1			1
Asparagales	*Bulbophyllum betchei*	Native	LC				
Asparagales	*Bulbophyllum membranaceum*	Native	NE				
Asparagales	*Bulbophyllum stenophyllum (=stenophyton)*	Native	NE				

Asparagales	*Chrysoglossum (ornatum?)*	Native	NE				
Asparagales	*Coelogyne macdonaldii*	Native	NE	1			1
Asparagales	*Cordyline fruticosa*	Native	LC	1		1	1
Asparagales	*Corymborkis veratrifolia*	Native	NE				
Asparagales	*Crepidium taurinum*	Native	NE				1
Asparagales	*Dendrobium calcaratum*	Native	NE	1			1
Asparagales	*Dendrobium involutum*	Native	NE				
Asparagales	*Dendrobium laevifolium*	Native	LC				
Asparagales	*Dendrobium mohlianum*	Native	NE	1			1
Asparagales	*Dendrobium mooreanum*	Endemic	NE				
Asparagales	*Dendrobium vagans*	Native	NE				
Asparagales	*Earina valida*	Native	NE				1
Asparagales	*Epipogium roseum*	Native	NE				1
Asparagales	*Glomera*			1			1
Asparagales	*Hetaeria oblongifolia*	Native	NE				1
Asparagales	*Liparis (=Blepharoglossum) condylobulbon*	Native	NE				1
Asparagales	*Oberonia imbricata*	Native	NE				1
Asparagales	*Peristylus novoebudarum*	Native	NE				1
Asparagales	*Pholidota imbricata*	Native	NE				1
Asparagales	*Phreatia matthewsii*	Native	NE				1
Asparagales	*Phreatia micrantha*	Native	NE				1
Asparagales	*Robiquetia bertholdii*	Native	NE	1			1
Asparagales	*Vrydagzynea argyrotaenia*	Native	NE				1
Asparagales	*Vrydagzynea vitiensis*	Native	NE				1
Asparagales	*Zeuxine vieillardii*	Native	NE				1
Asterales	*Mikania micrantha*	Introduced	NE	1	1		1
Asterales	*Nymphoides indica*	Native	NE				1
Asterales	*Scaevola taccada*	Native	NE	1			1
Asterales	*Wollastonia biflora*	Native	NE		1		1
Boraginales	*Cordia dichotoma*	Native	LC		1		1
Boraginales	*Cordia subcordata*	Native	LC	1	1		1
Boraginales	*Heliotropium foertherianum (=arboreum)*	Native	LC		1		1
Boraginales	*Heliotropium indicum*	Introduced	NE		1		1
Brassicales	*Capparis spinosa*	Native	NE		1		1
Brassicales	*Rorippa sarmentosa*	Native	NE		1		1
Caryophyllales	*Achyranthes aspera*	Introduced	NE	1	1		1
Caryophyllales	*Boerhavia diffusa*	Native	NE				1
Caryophyllales	*Ceodes umbellifera*	Native	LC				1
Caryophyllales	*Cyathula prostrata*	Native	NE	1	1		1
Caryophyllales	*Deeringia arborescens*	Introduced	NE	1	1		1
Caryophyllales	*Iresine diffusa f. herbstii*	Introduced	NE		1		1
Caryophyllales	*Monococcus (=echinophorus)*	Native	NE				1
Caryophyllales	*Persicaria attenuata*	Introduced	NE				1
Caryophyllales	*Persicaria minor*	Introduced	NE				1

Caryophyllales	*Persicaria orientalis*	Introduced	NE				1
Caryophyllales	*Pisonia aculeata*	Native	NE		1		1
Caryophyllales	*Rivina humilis*	Introduced	NE				1
Caryophyllales	*Sesuvium portulacastrum*	Native	LC		1		1
Commelinales	*Pollia secundiflora*	Native	NE				1
Cornales	*Alangium vitiense*	Native	LC		1		
Cucurbitales	*Corynocarpus similis*	Endemic	NE	1	1		1
Cucurbitales	*Cucurbitaceae*			1			1
Cucurbitales	*Diplocyclos palmatus*	Native	NE		1		1
Cucurbitales	*Trichosanthes dieniensis*	Introduced	NE		1		1
Cycadales	*Cycas seemannii*	Native	VU	1			1
Dilleniales	*Dillenia biflora*	Native	NE		1		1
Dioscoreales	*Dioscorea bulbifera*	?Native	NE		1		1
Ericales	*Barringtonia*						1
Ericales	*Barringtonia asiatica*	Native	LC		1		1
Ericales	*Barringtonia edulis*	Native	DD	1	1		1
Ericales	*Barringtonia novae-hiberniae*	Native	NE				1
Ericales	*Barringtonia procera*	Native	LC	1			1
Ericales	*Barringtonia racemosa*	Native	LC		1		1
Ericales	*Burckella obovata*	Native	LC		1		1
Ericales	*Diospyros samoensis*	Native	LC	1	1		1
Ericales	*Maesa*						1
Ericales	*Maesa aneiteensis*	Endemic	NE		1		1
Ericales	*Maesa bennettii*	Endemic	NE		1		1
Ericales	*Mimusops elengi*	Native	LC	1	1		1
Ericales	*Planchonella chartacea*	Native	LC	1	1		1
Ericales	*Tapeinosperma*			1			1
Fabales	*Acacia simplex*	Native	LC	1	1		1
Fabales	*Acacia spirorbis*	Native	LC	1	1		1
Fabales	*Adenanthera pavonina*	Native	NE	1	1		1
Fabales	*Albizia lebbeck*	Introduced	NE		1		1
Fabales	*Bauhinia monandra*	Introduced	NE	1			1
Fabales	*Bauhinia variegata*	Introduced	NE		1		1
Fabales	*Caesalpinia crista*	Native	NE		1		1
Fabales	*Cajanus cajan*	Introduced	NE		1		1
Fabales	*Castanospermum australe*	Native	NE	1			1
Fabales	*Dendrolobium umbellatum*	Native	NE		1		1
Fabales	*Derris elegans*	Native	NE	1			1
Fabales	*Derris trifoliata*	Native	NE		1		1
Fabales	*Desmodium incanum*	Introduced	NE		1		1
Fabales	*Entada phaseoloides*	Native	NE		1		1
Fabales	*Erythrina*			1			1
Fabales	*Erythrina fusca*	Native	NE		1		1
Fabales	*Erythrina variegata*	Native	LC		1		1
Fabales	*Flemingia strobilifera*	Introduced	NE		1		1

Fabales	*Hanslia ormocarpoides*	Native	NE		1		1
Fabales	*Indigofera zollingeriana*	Native	NE		1		1
Fabales	*Inocarpus fagifer*	Native	NE	1	1		1
Fabales	*Intsia bijuga*	Native	NT	1	1	1	1
Fabales	*Leucaena leucocephala*	Introduced	NE	1	1		1
Fabales	*Mimosa pudica*	Introduced	NE		1		1
Fabales	*Pongamia pinnata*	Native	NE		1		1
Fabales	*Pterocarpus indicus*	Native	EN	1	1	1	1
Fabales	*Pueraria montana var. lobata*	Introduced	NE	1	1		1
Fabales	*Senna obtusifolia*	Introduced	NE		1		1
Fabales	*Senna occidentalis*	Introduced	LC		1		1
Fabales	*Uraria (=lagopodioides)*	Native	NE		1		1
Fabales	*Vigna marina*	Native	LC		1		1
Fagales	*Casuarina equisetifolia*	Native	LC	1	1		1
Gentianales	*Alyxia efatensis*	Endemic	NE		1		1
Gentianales	*Amaracarpus (nematopodus?)*	Native	NE				1
Gentianales	*Antirhea (=Guettardella) inconspicua*	Native	LC	1			1
Gentianales	*Badusa corymbifera*	Native	NE				1
Gentianales	*Bikkia tetrandra*	Native	NE				1
Gentianales	*Cerbera odollam*	Native	LC		1		1
Gentianales	*Coffea arabica*	Introduced	NE			1	
Gentianales	*Dolicholobium aneityense*	Endemic	NE		1		1
Gentianales	*Eumachia aneityensis*	Endemic	NE	1			1
Gentianales	*Eumachia forsteriana*	Native	NE	1	1		1
Gentianales	*Eumachia trichostoma*	Native	NE	1	1		1
Gentianales	*Gardenia tannaensis*	Endemic	NE	1	1		1
Gentianales	*Geniostoma rupestre var. glaberrimum*	Native	NE				
Gentianales	*Geophila repens (=uniflora)*	Native	NE		1		1
Gentianales	*Guettarda speciosa*	Native	LC		1		1
Gentianales	*Hoya samoensis*	?			1		1
Gentianales	*Ixora asme*	Endemic	NE		1		1
Gentianales	*Ixora triflora*	Native	NE		1		1
Gentianales	*Kopsia flavida*	Native	NE		1		1
Gentianales	*Morinda citrifolia*	Native	NE	1	1		1
Gentianales	*Mussaenda cylindrocarpa*	Native	NE		1		1
Gentianales	*Neuburgia corynocarpa*	Native	NE				
Gentianales	*Ochrosia oppositifolia*	Native	NE		1		1
Gentianales	*Pavetta indica*	?				1	
Gentianales	*Pavetta opulina*	Native	NE		1		1
Gentianales	*Psychotria*				1		1
Gentianales	*Psychotria milnei*	Native	NE		1		1
Gentianales	*Psychotria nacdado*	Native	NE		1		1
Gentianales	*Psydrax odoratus*	Native	NE		1		1
Gentianales	*Rubiaceae*				1		1

Gentianales	*Spermacoce laevis*	Introduced	NE				1
Gentianales	*Tabernaemontana*					1	
Gentianales	*Tabernaemontana pandacaqui*	Native	LC	1	1		1
Gentianales	*Tarenna*				1		1
Gentianales	*Tarenna sambucina*	Native	LC		1		1
Gentianales	*Vincetoxicum biglandulosum*	Native	NE		1		1
Icacinales	*Merrilliodendron megacarpum*	Native	NE		1		1
Lamiales	*Acanthus ilicifolius*	Native	LC			1	1
Lamiales	*Avicennia marina*	Native	LC				
Lamiales	*Chionanthus (brachystachys?)*	Native	NE				1
Lamiales	*Coleus scutellarioides*	Native	NE	1	1		1
Lamiales	*Cyrtandra*				1		1
Lamiales	*Cyrtandra aneiteensis*	Endemic	NE		1		1
Lamiales	*Dolichandrone spathacea*	Native	NE		1	1	1
Lamiales	*Graptophyllum pictum*	Introduced	NE				
Lamiales	*Hemigraphis*					1	
Lamiales	*Jasminum simplicifolium*	Native	NE				1
Lamiales	*Lamiaceae*			1			1
Lamiales	*Ocimum tenuiflorum*	Native	NE				
Lamiales	*Phyla nodiflora*	Introduced	NE		1		1
Lamiales	*Premna serratifolia*	Native	LC			1	
Lamiales	*Pseuderanthemum*			1	1		1
Lamiales	*Pseuderanthemum aubertii*	Endemic	NE				
Lamiales	*Pseuderanthemum carruthersii*	Native	NE	1			1
Lamiales	*Pseuderanthemum repandum subsp. repandum*	Native	NE	1			1
Lamiales	*Ruellia prostrata*	Native	NE				
Lamiales	*Salvia occidentalis*	Introduced	NE				
Lamiales	*Strobilanthes reptans*	Native	NE	1			1
Lamiales	*Verbenaceae*				1		1
Lamiales	*Vitex negundo*	Introduced	NE				
Lamiales	*Volkameria inermis*	Native	NE		1		
Laurales	*Cassytha filiformis*	Native	NE				1
Laurales	*Cryptocarya tannaensis*	Endemic	NE				1
Laurales	*Cryptocarya turbinata*	Native	NE				1
Laurales	*Gyrocarpus americanus*	Native	LC	1	1		1
Laurales	*Hernandia nymphaeifolia*	Native	LC	1	1		1
Laurales	*Litsea aneityensis*	Endemic	NE				1
Laurales	*Persea americana*	Introduced	NE			1	
Liliales	*Smilax vitiensis*	Native	NE	1	1	1	1
Lycopodiopsida	*Palhinhaea cernua*	Native	NE				1
Lycopodiopsida	*Phlegmariurus balansae*	?					1
Lycopodiopsida	*Phlegmariurus nummulariifolius*	?					1
Lycopodiopsida	*Phlegmariurus phlegmaria*	Native	NE				1
Lycopodiopsida	*Phlegmariurus phlegmarioides*	Native	NE				1
Lycopodiopsida	*Phlegmariurus squarrosus*	Native	NE				1

Lycopodiopsida	*Selaginella*					1	
Lycopodiopsida	*Selaginella firmula*	Native	NE				1
Lycopodiopsida	*Selaginella plana*	Native	NE				1
Magnoliales	*Cananga odorata*	Introduced	LC	1	1		1
Magnoliales	*Myristica inutilis subsp. platyphylla*	Native	LC				1
Malpighiales	*Acalypha*				1	1	
Malpighiales	*Acalypha caturus*	Native	LC		1		1
Malpighiales	*Acalypha forsteriana*	Endemic	NE	1	1		1
Malpighiales	*Acalypha grandis*	Native	NE		1		
Malpighiales	*Aleurites moluccanus*	Native	LC	1	1		1
Malpighiales	*Antidesma ghaesembilla*	?Native	NE		1		1
Malpighiales	*Bischofia javanica*	Native	LC	1	1	1	1
Malpighiales	*Breynia disticha*	Native	NE		1		1
Malpighiales	*Bruguiera gymnorhiza*	Native	LC			1	
Malpighiales	*Bruguiera parviflora*	Native	LC			1	
Malpighiales	*Calophyllum inophyllum*	Native	NE		1		1
Malpighiales	*Casearia*	Native	NE		1		1
Malpighiales	*Ceriops tagal*	Native	LC	1		1	1
Malpighiales	*Claoxylon gillisonii*	Endemic	NE	1	1		1
Malpighiales	*Claoxylon psilogyne*	Endemic	NE		1		1
Malpighiales	*Cleidion javanicum*	Native	LC	1	1		1
Malpighiales	*Codiaeum variegatum*	Native	LC	1	1		1
Malpighiales	*Croton*			1			1
Malpighiales	*Croton levatii*	Endemic	NE		1		1
Malpighiales	*Dichapetalaceae*				1		1
Malpighiales	*Dichapetalum*			1			1
Malpighiales	*Dichapetalum vitiense (=timorense)*	Native	LC		1		1
Malpighiales	*Euphorbiaceae*			1			1
Malpighiales	*Excoecaria agallocha*	Native	LC	1	1	1	1
Malpighiales	*Flueggea flexuosa*	Native	LC				1
Malpighiales	*Garcinia pseudoguttifera*	Native	LC	1			1
Malpighiales	*Glochidion philippicum*	Native	NE				1
Malpighiales	*Glochidion ramiflorum*	Native	LC		1		1
Malpighiales	*Homalanthus nutans*	Native	LC		1		1
Malpighiales	*Homalium (aneityense?)*	Endemic	NE	1			1
Malpighiales	*Jatropha curcas*	Introduced	NE	1			1
Malpighiales	*Macaranga dioica*	Native	LC		1	1	1
Malpighiales	*Macaranga tanarius*	Native	LC	1	1		1
Malpighiales	*Pangium edule*	Native	LC		1		1
Malpighiales	*Passiflora foetida*	Introduced	NE		1		1
Malpighiales	*Passiflora maliformis*	Introduced	NE		1		1
Malpighiales	*Phyllanthus (=Kirganelia) ciccoides*	Native	LC	1			1
Malpighiales	*Phyllanthus (=Moeroris) amarus (=amara)*	Introduced	NE		1		1
Malpighiales	*Pimelodendron amboinicum*	Native	NE		1		1

Malpighiales	*Rhizophora apiculata*	?Native	LC			1	1
Malpighiales	*Rhizophora mucronata*	Native	LC	1			1
Malpighiales	*Rhizophora samoensis*	Native	NE			1	
Malpighiales	*Rhizophora stylosa*	Native	LC	1			1
Malpighiales	*Rhizophoraceae*			1			1
Malpighiales	*Stigmaphyllon grandifolium*	Native	NE				
Malpighiales	*Stigmaphyllon timoriense (=grandifolium)*	Native	NE				
Malvales	*Abelmoschus manihot*	Native	NE				
Malvales	*Abelmoschus moschatus*	Native	LC				
Malvales	*Abutilon (indicum?)*	Native	NE				
Malvales	*Bixa orellana*	Introduced	LC	1			1
Malvales	*Ceiba pentandra*	Introduced	NE				
Malvales	*Gossypium hirsutum*	Introduced	NE				
Malvales	*Grewia prunifolia*	Native	LC				1
Malvales	*Heritiera littoralis*	Native	LC			1	1
Malvales	*Hibiscus rosa-sinensis*	Introduced	NE				1
Malvales	*Hibiscus tiliaceus*	Native	LC	1		1	1
Malvales	*Kleinhovia hospita*	Native	LC	1	1	1	1
Malvales	*Melochia odorata*	Native	LC	1	1		1
Malvales	*Phaleria (pentecostalis?)*	Endemic	NE	1			1
Malvales	*Sida rhombifolia*	Introduced	NE	1	1		1
Malvales	*Theobroma cacao*	Introduced	NE		1	1	1
Malvales	*Thespesia populnea*	Native	LC		1		1
Malvales	*Urena lobata*	Introduced	NE		1		1
Myrtales	*Lumnitzera littorea*	Native	LC			1	
Myrtales	*Lumnitzera racemosa*	Native	NE			1	
Myrtales	*Medinilla heteromorphophylla*	Endemic	NE	1			1
Myrtales	*Pemphis acidula*	Native	NE				
Myrtales	*Psidium guajava*	Introduced	LC				1
Myrtales	*Sonneratia × gulngai*	Native	NE			1	
Myrtales	*Sonneratia alba*	Native	LC			1	
Myrtales	*Sonneratia caseolaris*	Native	LC			1	
Myrtales	*Syzygium*			1			1
Myrtales	*Syzygium clusiifolium*	Native	LC				1
Myrtales	*Syzygium insulare*	Native	VU				1
Myrtales	*Syzygium kajewskii*	Endemic	NE				1
Myrtales	*Syzygium malaccense*	Native	LC	1	1	1	1
Myrtales	*Terminalia catappa*	Native	LC	1	1	1	1
Myrtales	*Terminalia samoensis*	Native	NE	1			1
Myrtales	*Terminalia sepicana*	Native	NE	1	1		1
Oxalidales	*Elaeocarpus*					1	
Pandanales	*Pandanus*					1	1
Piperales	*Aristolochia*				1		1
Piperales	*Macropiper (=Piper) latifolium*	Native	NE	1	1		1
Piperales	*Peperomia pallidinervis*	Endemic	NE				1

Piperales	*Piper*					1	1
Piperales	*Piper macropiper*	Native	NE		1		1
Piperales	*Piper mestonii*	Introduced	NE		1		1
Poales	*Arundo donax*	Introduced	LC			1	
Poales	*Bambusa (vulgaris?)*	Introduced	NE	1			1
Poales	*Bambusa vulgaris*	Introduced	NE				
Poales	*Centosteca (=Centotheca?) lappacea*	Native	NE	1			1
Poales	*Chloris barbata*	Introduced	NE	1			1
Poales	*Chrysopogon aciculatus*	Native	NE	1			1
Poales	*Cyperus brevifolius*	Native	NE				1
Poales	*Cyperus javanicus*	Native	NE	1			1
Poales	*Cyperus nutans*	Native	NE				1
Poales	*Cyperus odoratus*	Native	NE				1
Poales	*Cyperus rotundus*	Native	NE				1
Poales	*Cyrtococcum trigonum*	Native	NE	1			1
Poales	*Eleusine indica*	Introduced	NE	1			1
Poales	*Eragrostis tenella*	Introduced	NE	1			1
Poales	*Eragrostis virescens*	Introduced	NE	1			1
Poales	*Fimbristylis cymosa*	Native	LC	1			1
Poales	*Flagellaria indica*	Native	NE				1
Poales	*Imperata conferta*	Native	NE	1			1
Poales	*Ischaemum foliosum*	Native	NE				1
Poales	*Megathyrsus maximus*	Introduced	NE				1
Poales	*Miscanthus (=floridulus)*	Native	NE	1			1
Poales	*Paspalum scrobiculatum*	Introduced	LC				1
Poales	*Scleria brownii*	Native	NE				1
Poales	*Scleria polycarpa*	Native	NE				1
Polypodiopsida	*Acrostichum aureum*	Native	NE			1	1
Polypodiopsida	*Adiantum ciliatum*	?Native	NE				1
Polypodiopsida	*Adiantum diaphanum*	Native	NE				1
Polypodiopsida	*Adiantum hispidulum*	Native	NE				1
Polypodiopsida	*Adiantum philippense*	Native	NE				1
Polypodiopsida	*Angiopteris evecta*	Native	NE	1			1
Polypodiopsida	*Antrophyum callifolium*	Native	NE	1		1	1
Polypodiopsida	*Antrophyum plantagineum*	Native	NE	1			1
Polypodiopsida	*Antrophyum semicostatum*	?		1			1
Polypodiopsida	*Asplenium*					1	
Polypodiopsida	*Asplenium aethiopicum*	Native	NE				1
Polypodiopsida	*Asplenium bipinnatifidum*	Native	NE				1
Polypodiopsida	*Asplenium gibberosum*	Native	NE				1
Polypodiopsida	*Asplenium laserpitiifolium*	Native	NE				1
Polypodiopsida	*Asplenium marattioides*	Native	NE				1
Polypodiopsida	*Asplenium nidus*	Native	NE				1
Polypodiopsida	*Bolbitis quoyana*	Native	NE	1			1
Polypodiopsida	*Christella*					1	

Polypodiopsida	*Christella dentata*	Native	NE				1
Polypodiopsida	*Christella harveyi*	Native	NE				1
Polypodiopsida	*Cranfillia vulcanica*	?					1
Polypodiopsida	*Cyathea*					1	
Polypodiopsida	*Davallia solida*	Native	NE			1	
Polypodiopsida	*Dennstaedtia samoensis*	?Native	NE			1	
Polypodiopsida	*Diplazium*					1	
Polypodiopsida	*diplazium esculentum*	Native	NE			1	
Polypodiopsida	*Diplazium harpeodes*	Native	NE				1
Polypodiopsida	*Diplazium proliferum*	Native	NE				
Polypodiopsida	*Diplazium sylvaticum*	Native	NE				1
Polypodiopsida	*Drynaria quercifolia*	?				1	
Polypodiopsida	*Drynaria rigidula*	Native	NE				1
Polypodiopsida	*Equisetum ramosissimum*	Native	NE				1
Polypodiopsida	*Haplopteris elongata*	Native	NE	1			1
Polypodiopsida	*Hymenasplenium unilaterale*	?		1			1
Polypodiopsida	*Lepisorus mucronatus*	Native	NE				1
Polypodiopsida	*Lindsaea repens*	?Native	NE	1			1
Polypodiopsida	*Lomagramma polyphylla*	Native	NE	1			1
Polypodiopsida	*Lomagramma sinuata*	?		1			1
Polypodiopsida	*Macrothelypteris torresiana*	Native	NE				1
Polypodiopsida	*Microlepia speluncae*	Native	NE				
Polypodiopsida	*Microlepia strigosa*	?Native	NE				
Polypodiopsida	*Microsorum grossum*	Native	NE	1			1
Polypodiopsida	*Microsorum punctatum*	Native	NE	1			1
Polypodiopsida	*Microsorum scolopendria*	Native	NE	1			1
Polypodiopsida	*Nephrolepis*			1			1
Polypodiopsida	*Nephrolepis biserrata*	Native	NE	1			1
Polypodiopsida	*Nephrolepis hirsutula*	Native	NE	1			1
Polypodiopsida	*Oleandra neriiformis*	Native	NE				1
Polypodiopsida	*Ophioderma pendula*	Native	NE				1
Polypodiopsida	*Pneumatopteris glandulifera*	Native	NE				1
Polypodiopsida	*Pneumatopteris rodigasiana*	Native	NE				1
Polypodiopsida	*Pronephrium*				1		1
Polypodiopsida	*Psilotum nudum*	Native	NE	1			1
Polypodiopsida	*Pteris biaurita*	Native	NE	1			1
Polypodiopsida	*Pteris comans*	Native	NE	1			1
Polypodiopsida	*Pteris cretica*	Introduced	NE	1		1	1
Polypodiopsida	*Pteris ensiformis*	Native	NE	1			1
Polypodiopsida	*Pteris tripartita*	Native	NE	1			1
Polypodiopsida	*Pteris vittata*	Native	NE	1			1
Polypodiopsida	*Ptisana smithii*	Native	NE				1
Polypodiopsida	*Pyrrosia adnascens*	Introduced	NE	1			1
Polypodiopsida	*Saccoloma campylurum*	Native	NE				
Polypodiopsida	*Sphaerostephanos (=Strophocaulon) invisum*	Native	NE				1

Polypodiopsida	*Tectaria latifolia*	Native	NE	1			1
Polypodiopsida	*Tectaria polymorpha*	?				1	
Polypodiopsida	*Tectaria sinuata*	Native	NE	1			1
Polypodiopsida	*Zealandia powellii*	Native	NE	1			1
Ranunculales	*Pycnarrhena (=ozantha?)*	Native	NE				1
Ranunculales	*Stephania japonica var. japonica*	Native	NE				1
Rosales	*Antiaris toxicaria*	Native	LC	1	1		1
Rosales	*Artocarpus Altilis*	Introduced	NE	1		1	1
Rosales	*Boehmeria heterophylla*	?			1		1
Rosales	*Castilla elastica*	Introduced	NE	1			1
Rosales	*Celtis paniculata*	Native	NE		1		1
Rosales	*Colubrina asiatica*	Native	LC				1
Rosales	*Dendrocnide*					1	
Rosales	*Dendrocnide harveyi (?latifolia?)*	Native	NE		1		1
Rosales	*Dendrocnide latifolia*	Native	NE		1		1
Rosales	*Elatostema beccarii*	Native	NE		1		1
Rosales	*Elatostema macrophyllum*	Native	NE		1		1
Rosales	*Elatostema novae-britanniae*	Native	NE		1		1
Rosales	*Elatostema salomonense*	Native	NE		1	1	1
Rosales	*Ficus*			1			1
Rosales	*Ficus adenosperma*	Native	LC	1	1	1	1
Rosales	*Ficus aspera*	Endemic	NT		1	1	1
Rosales	*Ficus elastica*	Introduced	NE			1	1
Rosales	*Ficus glandifera*	Native	NE			1	1
Rosales	*Ficus obliqua*	Native	LC		1	1	1
Rosales	*Ficus prolixa*	Native	LC			1	1
Rosales	*Ficus scabra*	Native	LC	1		1	1
Rosales	*Ficus septica*	Native	LC			1	1
Rosales	*Ficus smithii*	Native	NE			1	1
Rosales	*Ficus storckii var. storckii*	Native	NE	1			1
Rosales	*Ficus subcordata*	Native	LC	1		1	1
Rosales	*Ficus tinctoria*	Native	LC			1	1
Rosales	*Ficus wassa*	Native	NE				1
Rosales	*Laportea interrupta*	Native	NE		1		1
Rosales	*Leucosyke australis (=capitellata)*	Native	LC		1	1	1
Rosales	*Leucosyke corymbulosa*	Native	NE		1		1
Rosales	*Nothocnide repanda*	Native	NE		1		1
Rosales	*Pipturus argenteus*	Native	NE		1	1	1
Rosales	*Rhamnaceae*						1
Rosales	*Rubus rosifolius*	Introduced	NE				1
Rosales	*Streblus (=Paratrophis) pendulina*	Native	NE				1
Rosales	*Trema cannabina*	Native	NE	1	1		1
Rosales	*Trophis scandens*	Native	NE	1			1
Rosales	*Ventilago*						1
Rosales	*Ventilago vanuatuana*	Endemic	VU				1

Santalales	*Amyema (artensis?)*	Native	NE				
Santalales	*Amylotheca dictyophleba*	Native	NE				
Sapindales	*(=Didymocheton) Dysoxylum aneityensis*	Endemic	NE		1		1
Sapindales	*(=Didymocheton) Dysoxylum bijugus*	Native	NE				1
Sapindales	*(=Goniocheton) Dysoxylum arborescens*			1			1
Sapindales	*Allophylus cobbe (=ternatus)*	Native	NE				1
Sapindales	*Allophylus ternatus*	Native	NE			1	
Sapindales	*Anacardiaceae*						1
Sapindales	*Arytera (=Neoarytera) neoebudensis*	Native	NE				1
Sapindales	*Canarium*						
Sapindales	*Canarium harveyi*	Native	NE	1			1
Sapindales	*Canarium Indicum*	Native	LC	1	1	1	1
Sapindales	*Chisocheton (rex?)*	Endemic	EN	1			1
Sapindales	*Citrus × sinensis (=aurantium)*	Introduced	NE		1		1
Sapindales	*Cupaniopsis (leptobotrys?)*	Native	NE	1			1
Sapindales	*Dracontomelon vitiense*	Native	NE	1	1	1	1
Sapindales	*Dysoxylum*			1			1
Sapindales	*Dysoxylum densiflorum*	?				1	
Sapindales	*Dysoxylum gaudichaudianus*	Native	NE				1
Sapindales	*Elattostachys apetala*	Native	LC		1	1	1
Sapindales	*Euodia hortensis*	Native	NE		1	1	1
Sapindales	*Garuga floribunda*	Native	LC	1	1		1
Sapindales	*Harpullia arborea*	Native	NE	1	1		1
Sapindales	*Melia azedarach*	Introduced	NE				1
Sapindales	*Melicope elleryana (=forbesii)*			1	1	1	1
Sapindales	*Melicope forbesii*	Native	NE		1		1
Sapindales	*Micromelum minutum*	Native	LC	1	1		1
Sapindales	*Murraya paniculata*	Native	NE	1	1		1
Sapindales	*Pleiogynium timoriense*	Native	NE	1	1		1
Sapindales	*Pometia pinnata*	Native	LC		1		1
Sapindales	*Quassia indica*	Native	NE		1		1
Sapindales	*Semecarpus vitiensis*	Native	NE	1	1	1	1
Sapindales	*Soulamea amara*	Native	NE	1			1
Sapindales	*Spondias dulcis*	Introduced	NE	1	1		1
Sapindales	*Vavaea amicorum*	Native	NE	1			1
Sapindales	*Xylocarpus granatum*	Native	NE			1	1
Sapindales	*Xylocarpus moluccensis*	Native	NE				1
Solanales	*Aniseia martinicensis*	Introduced	LC		1		
Solanales	*Capsicum frutescens*	Introduced	LC		1		1
Solanales	*Decalobanthus peltatus*	Native	NE	1	1		1
Solanales	*Ipomoea indica*	Introduced	NE	1	1		1
Solanales	*Ipomoea pes-caprae*	Native	LC		1		
Solanales	*Ipomoea quamoclit*	Introduced	NE		1		
Solanales	*Merremia*					1	

Solanales	*Physalis angulata*	Introduced	NE		1		1
Solanales	*Solanum lycopersicum*	Introduced	NE		1		1
Solanales	*Solanum nodiflorum (americanum)*	Introduced	NE		1		1
Solanales	*Solanum seaforthianum*	Introduced	NE		1		1
Solanales	*Stictocardia tiliifolia*	Native	NE		1		
Vitales	*Cayratia trifolia*	Native	NE		1		1
Vitales	*Leea indica*	Native	LC		1	1	1
Vitales	*Tetrastigma vitiense*	Native	NE		1		1
Zingiberales	*Alpinia novae-pommeraniae*	Native	NE	1			1
Zingiberales	*Alpinia purpurata*	Native	NE	1			1
Zingiberales	*Alpinia zerumbet*	?Native	NE	1			1
Zingiberales	*Donax canniformis*	Native	NE	1		1	1
Zingiberales	*Etlingera cevuga*	Introduced	NE	1			1
Zingiberales	*Heliconia*			1			1
Zingiberales	*Heliconia indica*	Native	NE				1
Zingiberales	*Hellenia speciosa*	Introduced	NE	1			1
Zingiberales	*Hornstedtia scottiana*	Native	NE	1			1
Zingiberales	*Phrynium giganteum*	Native	NE	1			1
Zingiberales	*Tapeinochilos (=?novaebudaenis)*	Endemic	NE	1			1
Zingiberales	*Zingiber zerumbet*	Introduced	NE	1			1
	Indet.			1			1
Grand Total				**176**	**191**	**81**	**419**

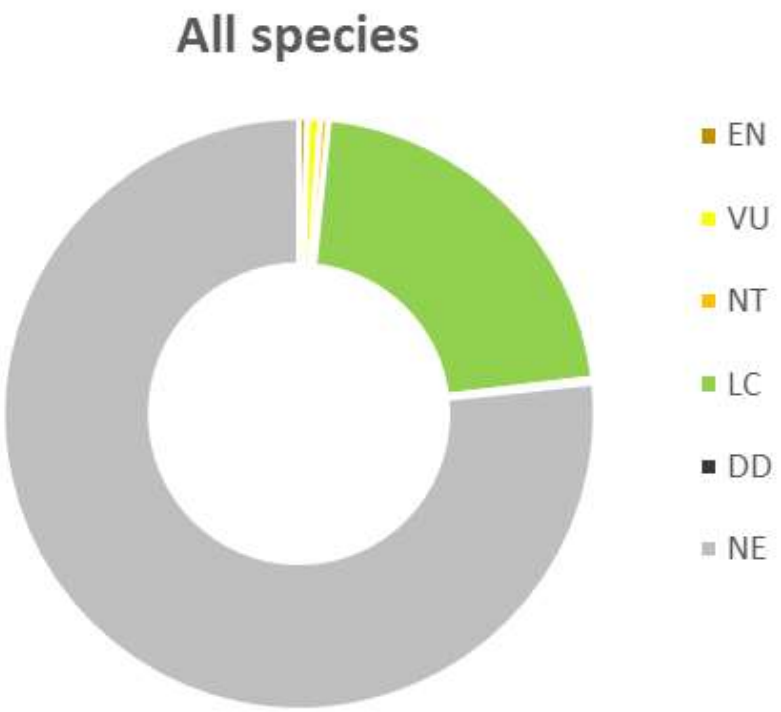
1.4.1 PRIORITISING THE PLANT SPECIES RECORDED ON MALEKULA

A. IUCN RED LIST SPECIES RECORDED ON MALEKULA

433 species of plant were recorded during the BIORAP of the three sites on Malekula. Of these just 101 have been assessed under the IUCN Red List for species (at the time of writing – March 2024). And of these, only five are considered to be globally-threatened species (ie. CR, EN or VU).

Globally threatened species are considered as trigger species for Key Biodiversity Areas under Criteria 1a-e. The extent to which these five species qualify as trigger species within either of the KBAs on Malekula will be further discussed below.

Figure 4: The number of species assessed under the IUCN Red List, and the distribution of species across the Red List criteria.



EN – Endangered, VU – Vulnerable (these are considered to be Globally-threatened species). NT – Near-threatened, LC – Least Concern, DD – Data Deficient, NE – Not evaluated.

B. THE NUMBER OF ENDEMIC AND INTRODUCED PLANT SPECIES RECORDED IN MALEKULA

361 of the species surveyed in Malekula were considered to be Native, or likely to be native. 33 of these are considered to be endemic or near-endemic. A further 72 species surveyed were considered to be introduced to Vanuatu. The number of species recorded in each taxonomic group is listed in Table 2, along with the number required for the species group to be considered Range-Restricted at a site.

Table 2: The number of species in each plant taxonomic group recorded in Malekula that are endemic to Vanuatu.

Taxonomic Group	Number of species	Endemic or Near-endemic	Number required for B2
Apiales	7	2	2
Arecales	6	4	2
Asparagales	29	1	7
Cucurbitales	3	1	2
Ericales	11	2	2
Gentianales	30	5	4
Lamiales	19	2	4

Laurales	7	2	2
Malpighiales	40	5	3
Malvales	17	1	2
Myrtales	15	2	2
Piperales	4	1	2
Rosales	34	2	2
Sapindales	29	2	2
Zingiberales	11	1	2
Grand Total	**433**	**33**	

Species that have not been assessed under the IUCN Red List can still be considered as trigger species for KBAs under the criteria B1 and B2. Under B1, 10% of the species population (by number or by range) occurs on the proposed KBA. Under B2 1% or more of a number of species within a taxonomic group, with a Global Range of less than 10,000 km^2, are required to trigger this criterion.

The taxonomic group is based on the Plant orders for monocot- and dicotyledenous plants, and class for Ferns. The actual number of each Taxonomic group is a fraction (0.02%) of the global number of species in the group, with 2 being the minimum number. Table 1 provides the data indicated the group used, and the number of species from that group required to trigger the B2 criterion. For example, just 2 species of Ericales (n=10,300 species globally) will trigger criterion B2, while 4 species of Lamiales (n=23,800 species globally) are required.

Endemicity follows the Vanuatu Plant checklist website https://pvnh.net/. Three species, listed as possibly endemic in the checklist, are considered to be endemic in the following review. The land area of Vanuatu is 12,189 km^2 – so a species that occurs on all islands in Vanuatu will not be considered to be geographically restricted in range. We have used the maps in the Vanuatu Plant Checklist alongside the distribution maps on GBIF to consider whether the currently known range of the endemic species is likely to be less than 10,000 km^2.

Table 2 indicates that there are 9 taxonomic groups that may have enough species to qualify under criterion B2, ie the number of endemic species recorded in the survey is at least as many as the number required to trigger criterion B2. These groups will be assessed in more detail below.

C. THE TAXONOMIC GROUPS

1. Apiales. c5,500 species globally. As 0.02% of this is less than 2 the number of species from this group is rounded up to 2 in order to qualify under KBA Criterion B2.

A] Meryta neoebudica

- Survey 2022. Recorded on transects at both Bamboo Bay (lowland site only) and Wiawi.
- Vanuatu Plant Checklist. Listed as 'Near Endemic', this species has been recorded, in Vanuatu from Santo to Aneityum. Of 124 observations of the species recorded on GBIF all but one are listed as from Vanuatu. The one record, listed as from Cook Islands, is known to be an error, indeed the species is listed as being collected from Tanna. There

are, however, records from the Torres group, at the north of the Torba province down to Aneityum and so the whole of Vanuatu can be considered to be within range. Accordingly the range is, as a minimum, the entire terrestrial area of Vanuatu, and so exceeds the 10,000 km^2 upper limit.

Mertya neoebudica does not, therefore, qualify as a Geographically restricted-range species.

B] Schefflera neoebudica

- Survey 2022. Recorded on transects at both Bamboo Bay (lowland site only) and Wiawi.
- Vanuatu Plant Checklist. Specimens have been collected from the TAFEA province, in the south to the TORBA province in the north. This covers all of Vanuatu. Accordingly, the species range approximates to the area of terrestrial in Vanuatu, which is in excess of 10,000km^2.

Schefflera neoebudica does not, therefore, qualify as a Geographically restricted-range species.

In summary neither of the endemic species of Apiales qualify as Geographically Restricted-Range species so this taxonomic group will not be considered as a trigger for KBA criterion B2.

2. Arecales. 2,600 species globally. As 0.02% of this is less than 2, the number of species needed to qualify under KBA criteria B2 from this group is rounded up to two.

A] Hydriastele cylindriocarpa

- Survey 2022. Recorded on transects at both Bamboo Bay (cloud forest site only) and Wiawi.
- Vanuatu Plant Checklist. In Vanuatu, this species has been recorded from Ureparapara to Erromango, including Malekula. In addition, it has been recorded on Vanikoro Island in Temotu Province, Solomon Islands. Overall range is, therefore, likely to be around 12,000 km^2 – and so this does not qualify as Restricted-Range species.

Hydriastele cylindriocarpa does not, therefore, qualify as a Geographically restricted-range species.

B] Licuala cabalionii

- Survey 2022. Only recorded at the Tsiri Lagoon site.
- Vanuatu Plant Checklist. This species has, to date, only been recorded from Vanua Lava (Torba province), Pentecost (Penama province) and Malakula (Malampa province). Assuming that it also occurs in Sanma then the range is around 9,850 km^2 – ie just within the criterion for a Restricted-range species.

Licuala cabalionii does, therefore, qualify as a Geographically restricted-range species.

C] Licuala grandis

- Survey 2022. Recorded on transects at both Bamboo Bay (cloud forest site only) and Wiawi.
- Vanuatu Plant Checklist. Near endemic – this species has been recorded on most island from Efate to the Banks. The only record outside of Vanuatu, on GBIF, is of one at the Tropical Botanical Gardens in Kauai, Hawaii – which can be discounted. However, even

if Tafea province is excluded – the range of the species is estimated at around 10,500 km^2 – and so exceeds the 10,000 km^2 upper limit. Note that GBIF has no records of this species in Efate – which, if true, would mean that it qualified.

Licuala grandis does not, therefore, qualify as a Geographically restricted-range species.

D] Veitchia winin

- Survey 2022. Recorded on transects at Tsiri Lagoon and Wiawi.
- Vanuatu Plant Checklist. Endemic tree restricted to Malekula, Santo, Pentecost and Ambae. If so, then the range of this species is around 8,225 km^2 – ie within the criterion for a Restricted-range species. Note that GBIF lists records from Fiji and the Marquesas, French Polynesia – although there are no geo-refences for these sites.

Veitchia winin does, therefore qualify as a Geographically Restricted-ange species.

In summary, two of the species recorded during this survey can be considered to be Geographically restricted-range species. Both species were recorded at the Tsiri Lagoon site, while *V. winin*, but not *L. cabalionii*, was also present at Wiawi. Confirmation of the presence of these species at Tsiri Lagoon may justify proposing the site as a Key Biodiversity Area. Further searches to determine whether *L. cabalionii* occurs at Wiawi should also be a priority.

3. Ericales. 10,300 species globally. 0.02% of this is 2.1 – therefore, there needs to be at least 2 species from this taxonomic group to qualify under KBA Criterion B2.

A] Maesa aneiteensis

- Survey 2022: Recorded on lowland areas at Bamboo Bay and also at Wiawi.
- Vanuatu Plant Checklist. Plants collected only from Malekula, Efate and Erromango. There is a recent report of possible presence at North Pentecost (Doro et al 2022). If we presumed that the range was from Malampa and Penama provinces south to Erromango then we can estimate the range to be 6,320 km^2. Accordingly, this qualifies as a Geographically Restricted-ange species.

B] Maesa bennettii

- Survey 2022. Recorded on lowland areas at Bamboo Bay and also at Wiawi.
- Vanuatu Plant Checklist. Only collected from Malekula. Possible recent record in north Pentecost (Doro et al. 2022). If this species is considered restricted to Malampa and Penama provinces, a combined terrestrial area of 3,977 km^2, then it would clearly qualify as Geographically Restricted in Range.

Maesa bennettii does, therefore, qualify as a Geographically Restricted-Range species.

In summary both Endemic species of Ericales recorded during this survey would, if identification is confirmed, qualify as Geographically Restricted-range species – and so trigger the B2 criterion for Ericales. Both species were recorded at Bamboo Bay/Small Nambas KBA and on Wiawi KBA.

4. Gentianales. c20,000 species globally, 0.02% is 4 species, the number of species required to trigger the KBA B2 criterion.

A] Alyxia efatensis

- Survey 2022. Recorded on lowland transects at Bamboo Bay/Small Nambas KBA and also on transects at Wiawi.
- Vanuatu Plant Checklist data. Collected from Santo to Aneityum. Not collected from the Torba Province (882km^2) but otherwise can be considered to be present throughout Vanuatu. The species range can, therefore, be estimated at c11,300 km^2 – too high for the species to qualify as Geographically Range-restricted.

B] Dolicholobium aneityum

- Survey 2022. Recorded on lowland transects at Bamboo Bay/Small Nambas KBA and also on transects at Wiawi.
- Vanuatu Plant checklist. Collected from Santo and Malekula, also Ambae, down to Tanna and Aneityum. Not reported from the Maewo/Pentecost/Ambrym chain or Torba province (although Doro et al 2022 reported the species on Pentecost). The species would have a Range of less than 10,000 km^2 if the Maewo, Pentecost chain was excluded – so the veracity of the Pentecost records need to be confirmed.

Dolicholobium aneityense currently can be considered to be a Geographically Range-Restricted species – pending confirmation of its presence on Pentecost.

C] Eumachia aneityensis

- Survey 2022. Recorded on cloud forest transects at Bamboo Bay/Small Nambas KBA and also on transects at Wiawi.
- Vanuatu Plant Checklist. Reported as collected from the Banks Islands, in the north to Aneityum in the south – including on Malekula. The range of this species is therefore likely to be the same as the land area of Vanuatu – c12,189 km^2.

Accordingly, *Eumachia aneityensis* does not qualify as a Geographically Range-restricted species.

D] Gardenia tannaensis

- Survey 2022. Recorded on both cloud forest and lowland transects at Bamboo Bay/Small Nambas KBA and also on transects at Wiawi.
- Vanuatu Plant checklist Collected from all island groups from the Torres Islands to Aneityum. Absent only from Epi. Range therefore likely to be in excess of 10,000 km^2.

Gardenia tannaensis does not, therefore, qualify as a Range-Restricted species.

E] Ixora asme

- Survey 2022. Recorded on lowland transects at Bamboo Bay/Small Nambas KBA and also on transects at Wiawi.
- Vanuatu Plant checklist. This species has been recorded from the Torres Islands and Banks Islands south to Erromango. The land area of TAFEA minus Erromango is 740

km^2. 12,189-740 is 11,449 which is higher than the 10,000 km^2 upper limit for Range-restricted species.

Ixora asme, therefore, does not qualify as a Range-restricted species.

In summary, only one of the five endemic Gentianales species is likely to have a range of less than 10,000 km^2 – and even that depends on whether recent records from Pentecost are valid or not. As 4 species are required to trigger KBA criterion B2 – this is not likely to affect KBA assessments.

5. Laurales. C2,900 species globally. 0.02% is low – so the number of species required to trigger the KBA B2 criterion is 2.

A] Cryptocarya tannaensis

- Survey 2022. Only recorded at Wiawi.
- Vanuatu Plant Checklist. Recorded from Santo, in the north to Tanna in the south. Not recorded in the Torba group, or in Shefa. If these two provinces are excluded, then the range of the species is 9,852 km^2. It is surprising that Shefa is not included – being in the middle of the known range. Against that, Efate is likely the most observed island in the group.

Cryptocarya tannaensis may qualify as a Geographically Range-restricted species. Confirmation that it is absent from the Shefa province would be a pre-requisite for this.

B] Litsea aneityensis

- Survey 2022. Only recorded at Wiawi.
- Vanuatu Plant Checklist. Recorded from the Banks Islands, in Torba, south to Erromango. Not recorded in Shefa, Ambrym or Pentecost. Bizarrely, given the scientific name, not known from Aneityum. If the species range is considered not to include Shefa, or Tafea other than Erromango, then it comes to c9,994 km^2 – just within the criterion for a Geographically Restricted-range species.

There is some discussion regarding the global range of the two Laurales species. IF the assessment above is accepted then both species are Geographically Restricted-range species and both occur on Wiawi. A more detailed assessment, such as of the Area of Occupancy, or Extent of Suitable Habitat, of the species may be required – to derive both a global and a local estimate for the species to determine whether these species trigger B2 Geographically Restricted Range criterion.

6. Malpighiales. c16,000 species globally. 0.02% of this is 3.2 – there needs to be at least three Geographically-restricted species from this taxonomic group to qualify under KBA Criterion B2.

A] Acalypha forsteriana

- Survey 2022. Recorded on both cloud forest and lowland transects at Bamboo Bay/Small Nambas KBA and also on transects at Wiawi.

- Vanuatu Plant checklist recorded from Santo in the north to Tanna in the South. The range of the species comes to around 11,150 km^2 ie not less than 10,000 km^2, the upper limit for Range-restricted species. Accordingly, this species does not qualify as a Geographically Restricted-range species.

B] Claoxylon gillisonii

- Survey 2022. Recorded on both cloud forest and lowland transects at Bamboo Bay/Small Nambas KBA, and also on transects at Wiawi.
- Vanuatu Plant Checklist. From Malekula and Ambrym, in the north, to Erromango in the south. The range for this species, if Torba Province, Santo and Tanna and adjacent islands are excluded would approximate to 6,610 km^2 – it would qualify as a Geographically Restricted Range species.

C] Claoxylon psilogyne

- Survey 2022. Recorded on lowland transects at Bamboo Bay/Small Nambas KBA, and also on transects at Wiawi.
- Vanuatu Plant checklist. From Santo south to Tanna. The range of this species is likely to exceed the 10,000 km^2 upper limit for Restricted Range species.

Claoxylon psilogyne, therefore, does not qualify as a range-restricted species.

D] Croton levatii

- Survey 2022. Recorded on lowland transects at Bamboo Bay/Small Nambas KBA and also on transects at Wiawi.
- Vanuatu Plant Checklist: Recorded from Malekula, Ambrym and Efate only. Clearly a restricted-range species. Tentative report from Pentecost (Doro 2022). IF we assume that the range is, indeed, the three named islands plus PENAMA province then the species range sums to 4,815 km^2.

Croton levatii qualifies as a Geographically Range-restricted species.

E] Homalium (aneityense?)

- Survey 2022. Recorded on the cloud forest transects at Bamboo Bay/Small Nambas KBA and also on the transects at Wiawi.
- Vanuatu Plant Checklist: Recorded from Pentecost, Erromango and Aneityum. No previous records from Malekula. If we were to presume that the species occurs only in Penama, Malampa, Erromango and Aneityum then the range would be c5,000 km^2.

Homalium aneityense qualifies as a Geographically-restricted species. Confirmation of its presence at the sites on Malekula would be a priority.

In summary, three of the five endemic *Malpighiales* species are likely to have a range of less than 10,000 km^2. All three of these species were recorded at both Bamboo Bay/Small Nambas KBA and Wiawi KBA. As three species are required to trigger KBA criterion B2 – then confirming the presence of *H. aneityense* is required for these to qualify and affect KBA assessments.

7. Myrtales. c13,000 species globally. 0.02% of this is 2.6 – there needs to be at least 2 species from this taxonomic group to qualify under KBA Criterion B2.

A] Medinilla heteromorphophylla

- Survey 2022. Recorded on the cloud forest transects at Bamboo Bay/Small Nambas KBA and at Wiawi.
- Vanuatu Plant Checklist. Recorded from the Banks Islands, in the north to Efate in the south. No records from Tafea. This puts the range of the species at around 10,500 km2 – just in excess of the criterion required to trigger Geographically restricted range.

B] Syzygium kajewskii

- Survey 2022. Recorded only at Wiawi KBA.
- Vanuatu Plant Checklist. Recorded from Santo and Malekula in the north down to Aneityum (but not Erromango) in the south – not recorded from Maewo, Pentecost, Ambrym or Epi. The range of this species is around 10,000 km2 – depending on which island groups are included/excluded within the range. Further assessment would be required prior to making that decision.

In summary one of the 2 endemic Myrtales species does not qualify as a Geographically Range-restricted species – and so this taxonomic group will not contribute to the KBA assessment for any of these sites.

8. Rosales. A plant order of more than 7,700 species. 0.02% of 7,700 is 1.5 so the there needs to be at least 2 species from this taxonomic group to qualify under KBA criterion B2.

A] Ficus aspera. NT B2ab(iii) (near-threatened) IUCN Red List (2021).

- Survey 2022. Recorded on lowland transects on Bamboo Bay, Small Nambas KBA, at Tsiri Lagoon and on Wiawi KBA
- Vanuatu Plant Checklist: Recorded from Santo and Maewo in the north to Aneityum in the south. The global range of the species is likely to be around 11,300 km^2 – too high for the species to qualify as a Geographically Restricted-range species.
- IUCN Red List. This species has been listed as occurring at 14 locations on at least 10 islands around Vanuatu. It is considered rare by local botanists and appears to be restricted to forests on limestone substrates, which are among the most heavily impacted habitats in the archipelago.

B] Ventilago vanuatuana VU B2ab(i,ii,iii,iv) (Vulnerable) IUCN Red List (2021).

- Survey 2022. Only recorded on transects at Wiawi.
- Vanuatu Plant Checklist. Recorded only from Malekula, Pentecost and Efate. Summing the land area of these three provinces gives a species range of just 5,432 km^2. This species qualifies as a Geographically Restricted-range species.
- IUCN Red List. The number of locations that this species is considered to occur at is between five and ten, with records from Santo and Aneityum, in addition to those listed above. It is thought likely to occur on other islands.

In summary, only one of the Endemic species of Rosales can be considered to be Geographically restricted in range. So, KBA criterion B2 is not relevant. However, *V. vanuatuana* is listed as Vulnerable and so may qualify under criterion A1b. This survey records its presence at Wiawi. Information on the number of standing plants (and so the number of Reproductive Units) is not available. This is one of between 5 and 10 localities for the species – and therefore qualifies, under that population estimate, as more than 1% of the global population. More information on the distribution, and number of individuals involved, would be required for further KBA assessment.

9. Sapindales. A plant order of around 5,700 species. 0.02% of 5,700 is 1.1 – so there needs to be at least 2 species from this taxonomic group to qualify under KBA criterion B2.

A] Chisocheton rex. EN B2ab(i,ii,iii,iv) (Endangered) IUCN Red List (2021)

- Survey 2022. Recorded on the transects in Cloud Forest at Bamboo Bay/Small Nambas KBA and at Wiawi.
- Vanuatu Plant Checklist. Present in Torba province, Ambae and also the Tafea Group. The land area of these three provinces comes to c3,600 km^2. This species would, therefore, qualify as a Geographically Restricted-range species.
- IUCN Red List. Listed as being recorded at six locations –on Malekula and Santo, as well as the locations listed above.

B] Didymocheton (Dysoxylum) aneityensis

- Survey 2022. Recorded on transects on lowland sites at Bamboo Bay/Small Nambas KBA and on Wiawi.
- Vanuatu Plant Checklist. No distribution mapped. The holotype was collected from Anelghat Bay, Aneityum. GBIF lists the species as being present throughout Vanuatu – from Torba to Tafea. Accordingly, this species is unlikely to qualify as a Geographically Range-restricted species.

In summary this taxonomic group does not qualify under KBA B2 Geographically restricted range species. *C. rex* was recorded at both KBAs. The number of Reproductive units or any other measure of numbers of individuals/distribution are not available. If confirmed, then this would be sufficient to qualify *Chisocheton rex* as a trigger species at both Small Nambas and Wiawi KBAs under KBA Criterion A1a.

D. NON-ENDEMIC TREES LISTED AS GLOBALLY THREATENED

In addition to *Ventilago vanuatuana* and *Chisocheton rex*, above, three other plant species recorded on these surveys are listed as globally threatened in the most recent IUCN Red List. These species are:

A] Cycas seemannii, Cycadales. VU A4cd (Vulnerable IUCN Red List 2020)

- Survey 2022. Recorded on transects in the cloud forest at Bamboo Bay/Small Nambas KBA and on transects at Wiawi.

- Vanuatu Plant Checklist. Specimens collected from Santo, Malekula, Maewo and Tanna. GBIF includes records from Efate.
- IUCN Red List. The species occurs on several of the Fijian Islands, in Vanuatu, the Tonga Island group and in New Caledonia. It has been recorded from sea level up to 600 m asl. Population estimated as 10,000 to 12,000 mature individuals. Estimated Extent of Occurrence 1,333,715 km^2.

In summary, if there are 50 or more standing mature individuals of this tree in either of the KBAs, then this species would qualify as a trigger species under KBA criterion A1d.

B] *Pterocarpus indicus, Fabales*. EN A3cd+A4cd (Endangered) IUCN Red List (2018)

- Survey 2022. Recorded on transects in all habitats, from cloud forest and lowland forest at Bamboo Bay/Small Nambas KBA, Tsiri Lagoon and Wiawi KBA.
- Vanuatu Plant Checklist. Present from the Banks Islands to Erromango including Malekula.
- IUCN Red List. Present from S.E. Asia and Taiwan to Vanuatu. Occurs from 600-1300 m asl. There are no population estimates.

In summary, it seems unlikely that these sites will qualify as globally important for this species.

C] *Syzygium insulare, Myrtales*. VU A4cd (Vulnerable) IUCN Red List (2019).

- Survey 2022. Recorded only on transects at Wiawi KBA.
- Vanuatu plant Checklist. From the Banks Islands to Efate, including Malekula.
- IUCN Red List. Present in New Britain and Bougainville PNG, Solomon Islands and Vanuatu, from coastal areas up to 140 m asl. In total, ten location points are mapped – five of which are clustered in around one site on New Britain. This species is only known from 2 records in Vanuatu (one of which is Malekula). Estimated extent of occurrence is 427,534 km^2.

In summary, the only global data that would enable this species to qualify as a trigger species might be that this represents more than 0.5% of the global number of known locations for the species. Confirmation of the identification of the species, and its distribution at the Wiawi KBA should be a priority.

1.4.2 SUMMARY AND NEXT STEPS FOR PRIORITISING THE PLANT SPECIES RECORDED ON MALEKULA

A number of plant taxonomic groups may contribute to the validation of the current KBAs, and even the establishment of a new KBA at Tsiri Lagoon.

The presence of *Chisocheton rex* at both Small Nambas and Wiawi KBAs should be confirmed, and the presence of at least five reproductive units confirmed. This species is globally endangered and endemic to Vanuatu with a known range restricted to just a few islands in Vanuatu – although the distribution extends from Aneityum to the Banks Islands. The range of the species on the KBAs would be insufficient to qualify the sites – but more detailed information on the number of localities where the species occurs, and/or the Area of Occupancy or Extent of Suitable Habitat, of the species globally and also within the two

KBAs should be a high priority. If confirmed, this species would qualify under KBA criterion A1a.

The presence of, and number of mature individuals of *Cycas seemannii* should be confirmed at both Wiawi and Small Nambas KBAs. This species has a global population estimate and is considered Vulnerable with a currently declining population. Accordingly, there needs to be at least ten reproductive units and at least 22 mature individuals in each population. This species could qualify under A1b and A1d.

Confirming the presence of, and at least 10 reproductive units of *Syzygium insulare* at Wiawi would also be a priority. This is a Vulnerable species subject to a declining population. Accordingly, just 0.2% of whichever population estimate is used would be required. Currently, only ten locations are mapped on the IUCN Red List for the species – more information is required to confirm whether these localities qualify under KBA criteria. In addition, further information on habitat requirements etc. may help to assess the species global and site distribution using either Area of Occupancy or Extent of Suitable Habitat measures. *S. insulare* may qualify under KBA criterion A1b and A1d.

Ventilago vanuatuana is an Endemic species considered to be Vulnerable under the IUCN Red List programme. Confirmation of its presence, and the occurrence of at least five mature individuals at Wiawi would be a high priority. The species is only listed for 6 localities on the IUCN Red List. Improved knowledge of those localities and whether they qualify under KBA criteria is required. In addition, this may give improved information on habitat requirements which would allow assessments under Area of Occupancy or Extent of Suitable Habitat. *V. vanuatuana* may qualify under KBA criterion A1b.

For the following taxonomic groups, there are enough endemic plant species recorded on each of the sites to qualify as trigger species for the Geographically Restricted Range group. The next steps for these species should be confirmation of their presence and distribution across the site, and better assessment of the current, known, population size of each of the species, both in Vanuatu as a whole, and at the relevant sites in particular. If any one of these species fails to qualify then the whole taxonomic group fails to qualify as a trigger under KBA criterion B2.

At the Small Nambas KBA, we should consider

- *Maesa aneiteensis* and *M. bennettii* from the Ericales group.
- *Homalium aneiteense*, *Croton levatii* and *Claoxylon gillisonii* from the Malpighiales group.

At the Wiawi KBA, we should consider

- *Maesa aneiteensis* and *M. bennettii* from the Ericales group.
- *Cryptocarya tannaensis* and *Litsea aneityensis* from the Laurales group.
- *Homalium aneiteense*, *Croton levatii* and *Claoxylon gillisonii* from the Malpighiales group.

At Tsiri Lagoon we should consider

- *Licuala cabalionii* and *Veitchia winin* from the Arecales group.

This analysis has prioritised the species that are most likely to be included as trigger species for KBA criteria. The majority of species surveyed have not gone through the IUCN red list criteria. Of those that have the four most likely to impact on these sites are included for

further assessment, above. Confirmation of the presence of these species at the sites should be considered the highest of priorities.

Of those that haven't gone through the IUCN red list criteria the endemic species that are most likely to qualify as Restricted Range species are included above. A second priority should be to attempt to put these species through the IUCN Red List process. This should be undertaken to ensure that the data required to confirm, or otherwise, these species as triggers under criterion B2 and/or potentially under the relevant criterion A should be completed. A third priority would be to incorporate all the other endemic species in Vanuatu into the IUCN Red List. This may add further species to the list that could become trigger species for these and/or other KBAs.

Figure 5: Some common native species identified in key biodiversity area.

Licuala cabalionia

Intsia bijuga

Didymocheton Aneityensi

Pterocarpus indicus

Ficus wassa

Licuala grandis

Ground orchid

Licuala grandis

Pandanus

Asplenium antiquum

Didymocheton aneityensi

Licuala

1.5 RESULTS & DISCUSSION

We arrived at Southwest Bay, Malekula on Friday 8 July and camped at Lorlow village. The next day, the flora team organised our field equipment to begin the task on Monday 11th July. Again, we undertook some consultation with communities of Lorlow and Lenbenweng on the methodology of the flora assessment to make the goal understandable and then find individuals with local expertise of plants to guide us in their forest.

SITE SURVEY

The BIORAP team chose three study sites to undertake the assessment Tsiri (Lenbenweng) lakeLakeas one critical wet land ecosystem, Bamboo Bay (Small Nambas) and Wiawi as the existing Key Biodiversity Areas (KBAs). Moreover, those sites are considered to be hot spots of flora diversity due to the structure and uniqueness of the forest types.

HABITAT AND VEGETATION

Licuala grandis

The habitat and vegetation are described based on assessment and observation for each site accordingly.

Tsiri (Lenbenweng) wet land or lake had four forest types observed in the area: thicket vegetation disturbed primary forest, secondary forest and dry forest. Four quadrats of 40x10 metres were set up in the four different vegetation types. In the thicket forest, the dominant species are *Cocos nucifera, Kleinhovia hospita* and other fruit trees while *Selaginella spp.* and *Merremia peltata* covered the ground surface. The area was considered to be cultivated according to the species composition.

Next was the wet land disturbed primary forest which was located close to the swampy area. The abiotic factors found in the area determined the structure of plant species that grow there along the muddy site moving 200 metres inland. There were four different species of mangrove plants that grow at the muddy site, *Pandanus sp., Artocarpus altilis, Ficus wassa, Bischovia javanica* and other native species. Most importantly, two endemic species, *Licuala cabalionia* and *Didymocheton aneityensis*, were observed.

Another quadrat was set up in a lowland primary forest where there was a very large population of *Licuala cabalionia* seedlings and saplings. Again, the dominant species observed are: Se*mecarpus vitiensis, Psycotria milnei, Polycias samoensis, Pisonia umbellifera* and other significant native species that typically inhabitat the area.

For dry forest vegetation, there was a high diversity of hardwood species specifically the *Intsia bijuga, Pongamia pinnata, Burkella obovata, Cupaniopsis sp* and other shrubby plants. Those plants are well adapted to dry soil and ridge conditions that are created by warm temperatures and very strong winds along the coastline.

Bamboo Bay KBA Site consisted of five forest types*:* the lowland dry forest, lowland primary forest, thicket forest, disturbed secondary forest and montane cloud forest. Again, the plant survey team set up 4 quadrats within the area of study. The structure of the forest and species diversity range was unique beginning from the coastal forest up to 600-metre altitude and different bamboo varieties covers a range of 100-500 metres towards the interior forest. It was most interesting that there were four species of bamboo observed within the Bamboo Bay area.

Kleinhovia hospita, *Leucaena leucocephala, Bambusa sp, Gyrocarpus americanus*, and shrubby plants were the dominant species n the thicket forest. Lowland dry forest was very dense with an abundance of hardwood trees that are usually used for timber purposes. There was a high abundance of *Castanospermum australe, Canarium indicum, Intsia bijuga, Dracontomelon vitiensis, Pongamia pinnata,* and two endemic species the *Licuala grandis* and *Geissois denhamii.*

The low wetland forest is the ideal habitat for a few taxonomic groups such as *Sapotaceae, Sapindaceae, Araliaceae* and other specific groups of species. Again, disturbed secondary forest is also common in most of the new settlements and farming areas. Moving inland towards the high altitudes of 500-700 metres, there was a change in vegetation, temperature, and the forest became more humid. Assessment of the cloud montane forest provided very interesting data, where most epiphytes (orchids) and climbers were found, as well as species that adapted to cooler areas. The dominant species were: *Hedycarya dorsteniodes, Cryptocarya tannaensis, Glochidion ramiflorum, Mimusops elengi, Neonauclea forsteri, Elattostachys falcata* and *Palaqium sp.*

Wiawi KBA also had four different types of vegetation: dry forest, thickets, lowland primary forest and secondary forest. The flora team managed to set up 4 transects that provided clear information of species diversity, distribution and taxonomic group. Eventually, the results of plant species composition are less similar compared to the two first sites due to soil type, climate, abiotic and biotic factors.

The thicket mostly consisted of the same species as the other site, with *Leucaena leucocephala* also covering most of the area. In the cases of dry and wet lowland forest, *Adenanthera pavonina*, *Intsia bijuga, Pongamia pinnata* and *Castanospermum australe* are the most dominating species and also considered to be the best hardwood timber. Again, there were changes observed in the montane cloud forest in regards to vegetation type, but this habitat was very disturbed by big leaf rope *(Merremia peltata)* and big banyan tree *(Ficus prolixa)* as the common weeds growing on and killing off trees.

1.6 DISCUSSION

Comparing the status of the three priority assessment sites showed that the Tsiri (Lenbenweng), the Lake forest was highly disturbed as when the agricultural land use (with coconut plantations) was abandoned, the area became overgrown with weedy plants, such as *Merremia peltata* and other invasive weeds. The plantations occupied the back of mangrove forest vegetation to the ridge which had disturbed secondary forest. In the case of Bamboo Bay, the forest is unique beginning from the littoral forest with stands of *Hibiscus tiliaceus* and *Pandanus tectorius*, and this was then followed generally by a mixed tree species. Likewise, there is a high diversity of flora and fauna species. econdary species such as *Harpullia arborea, Dracontomelon vitiense, Macaranga tanarius* and other familiar species were found only in the settlements. Finally, for Wiawi, only patches of diverse forest were found due to agricultural land use in the area, which included cattle farming that likely hindered the regeneration of forest tree species. Another major issue was the dispersal of invasive weeds by cattle roaming across the conservation area and also inland where the forest was very rich in terms of plant diversity.

1.7 CHALLENGES

- People were concerned about the Coconut Rhinoceros Beetle on Malekula, the study spotted signs of Coconut Rhinoceros Beetle on Metroxylon palms and coconut trees. The information was later relayed to BioSecurity Vanuatu, which positively and timely responded to confirm the presence of the Coconut Rhinoceros Beetle in South Malekula. It is also thought that climate change is impacting its range and it is now affecting local palm trees.
- People were also concerned about land use changes in the area as majority of the families have an average 2 ha of land cleared for kava farming.
- Some of the challenges the team faced was timing and not enough battery power on the tablets to complete questionnaires.
- Some of the questions in the section of Biodiversity on plants used for traditional medicine and special plants were really hard to get answers to as most of the people interviewed did not want to share that information. So we understood maybe it was confidential and did not have answers to most of those questions.
- A lot of disturbance have been happening in areas as a result there are a lot of secondary forest in the sites.
- They have less knowledge of local names of the plant species
- This is due to agricultural development, cattle grazing and feral cattle's have greatly infected the sites. Invasive species two main ones include solanum and big leaf.

1.8 RECOMMENDATIONS

- We recommend that in the future teams doing the questionnaires leave early to do questionnaires to be able to talk to the people before they leave for gardening in the morning. Power banks need to be purchased to ensure tablets can be charged during

the interview sessions so that the questionnaires may be effectively completed in a timely manner.

- A general recommendation is for the team to have more than a day break between sites.
- Personal protective equipment is needed for the field team members, as well as other technical tools that may assist with efficient and effective data collection.

Chapter II

Reptile Assessment

2.1 INTRODUCTION

The island of Malekula is the second largest island in Vanuatu that has the shape of a sitting dog with various ecosystems that provide a wide range of biodiversity. Measuring approximately 120 km by 20 km, it is one of the most linguistically diverse places on earth. The territory ranges from a densely forested and rugged interior to coral fringing reefs and experiences a wet climate. These factors contributed to the selection of Malekula Island for the project's Key Biodiversity Area (KBA) assessment. This project was funded by SPREP to explore and confirm the previously marked KBA, and to update the dataset for terrestrial floral and faunal species. Additionally, this report provides data for various reptiles, with priority on the endemic skink species located in the island's KBA. This included confirming the presence of endemic skinks that have been reported on other islands, such as *Emoia nigromaginata.*

2.2 METHODS

Two methods were used:

A] Plastic bottle trap - 1.5 L plastic bottles were cut open on the top and the plastic top was inverted back into the half-plastic bottle to avoid the escape of the lizard. Baits of tuna cane were placed at the bottom of the plastic bottle trap.

Transects of 500 m and 1,000 m were used, with three quadrants in each transect:

- 500 m transect: the first traps were set at 0 m and made Quadrant 1, Quadrant 2 at 250 m, and Quadrant 3 at 500 m.
- 1,000 m transect: Quadrant 1 was at 0 m, Quadrant 2 at 500 m, and Quadrant 3 at 1000 m.

In each quadrant, four plastic bottle traps were put in a square 10 m from the transect line. Geospatial data was collected for each trap site to record the vegetation type and environmental factors, besides the contents of the traps.

The traps were set up for an hour in each quadrant, then checked for lizards. Photos were also taken if possible. The surveys were conducted while the skinks were most active during the day; however, after three transacts, the plastic bottle traps were found to be wholly ineffective to catch any skinks, and hence the systematic search method was suggested.

B] Systematic search - the same transect and quadrants with four observation points organised in a square 10 m on each side the transect line were used, but without the plastic bottle trap.

Geospatial quantitative data was also collected for any lizards and other interesting species observed between the quadrants and transects, as well as changes in vegetation types. Further information on this can be found in the Annex.

2.3 RESULTS

Surveys were undertaken at three sites on Malekula – Wiawi KBA (22nd to 26th July, 2022), Small Nambas KBA (aka Bamboo Bay) (14th to 18th July, 2022) and Tsiri Lagoon (11th and

12th July, 2022). 17 quadrats and a further 51 plots were surveyed at Wiawi, 22 quadrats and 37 plots were surveyed at Bamboo Bay, 10 quadrats and 25 plots were surveyed at Tsiri Lagoon. Nine species of skink/gecko and one species of frog were recorded during the survey. The information is presented in the results on a species by species case. Additional information on habitat preference, etc, can be found in the Annexes for each site.

Vanuatu Snake-eyed Skink (Cryptoblepharus novohebridicus) Least Concern (2017)

IUCN Red List Distribution

- Endemic to Vanuatu, from Espiritu Santo in the north to Aneityum in the south. It occurs between 0 and 20m asl. This species is not a Range-restricted species.

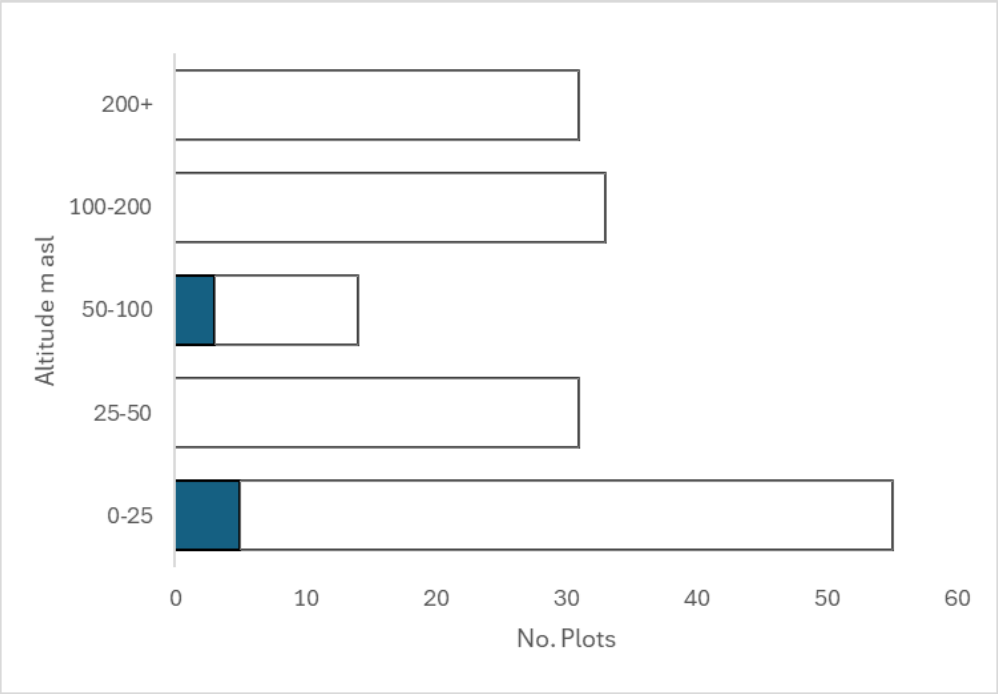
Survey Malekula, 2022

- *C. novohebridicus* was only recorded at Wiawi,
- All individuals were found on the 22nd July between 10.42 and 11.56.
- 31 individuals were recorded at 10 locations, 2 of which were quadrats, Wiawi T1Q2 and Wiawi T1Q3.
- The species was restricted to low altitude sites close to the coast and not above 70m asl.

Figure 6: Map showing the distribution of Cryptoblepharus novohebridicus on Wiawi KBA.

The species was not recorded at either Small Nambas KBA or Tsiri Lagoon (all survey plots are shown as circles – the plots filled, in red, are the plots where the species was recorded).

Figure 7: Distribution of Cryptoblepharus novohebridicus by altitude.



Pacific Bluetail Skink (Emoia caeruleocauda) Least Concern (2021)

IUCN Red List Distribution

- Recorded from Palau and Northern Mariana Islands in the west through to Fiji and Marshall Islands in the east. This is not a range-restricted species. It occurs between 0 and 1500m asl.

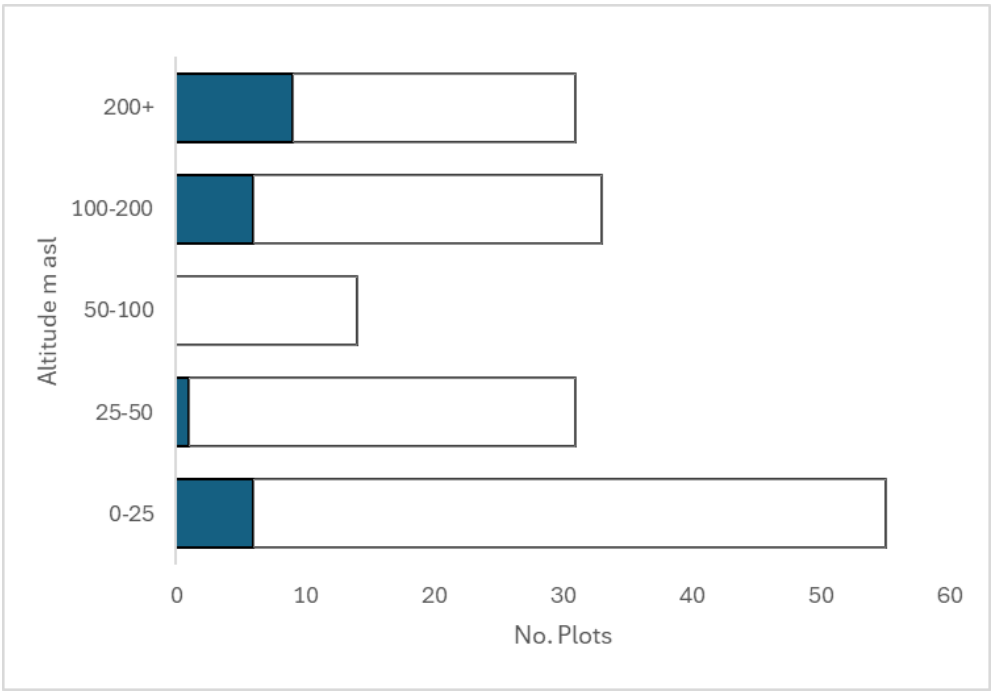
Survey Malekula, 2022

- *E. caeruleocauda* was recorded at all 3 survey sites.
- 57 individuals were recorded at 10 plots, 4 of which were quadrats, 2 individuals at Wiawi T6Q1, 2 individuals at Wiawi T6Q2, 3 individuals at Tsiri Lagoon T1Q2 and 2 individuals at Tsiri LagoonT4Q3.
- A maximum of 5 individuals were recorded at any one plot.
- Fairly evenly distributed between the lowest altitude range and the two higher altitudinal ranges – a slight hint that it was more likely to be seen above 100m asl.

Figure 8: Map showing the distribution of Emoia caeruleocauda (all survey plots are shown as circles – the plots filled, in red, are the plots where the species was recorded).

A. Wiawi KBA
B. Small Nambas KBA
C. Tsiri Lagoon

Figure 9: Distribution of Emoia caeruleocauda by altitude.



Teal Emo Skink (Emoia cyanogaster) Least Concern (2013)

IUCN Red List Distribution

- From Bismarck Archipelago in the west through to Vanuatu in the east. This is not a range-restricted species. Between 0 and 600m asl.

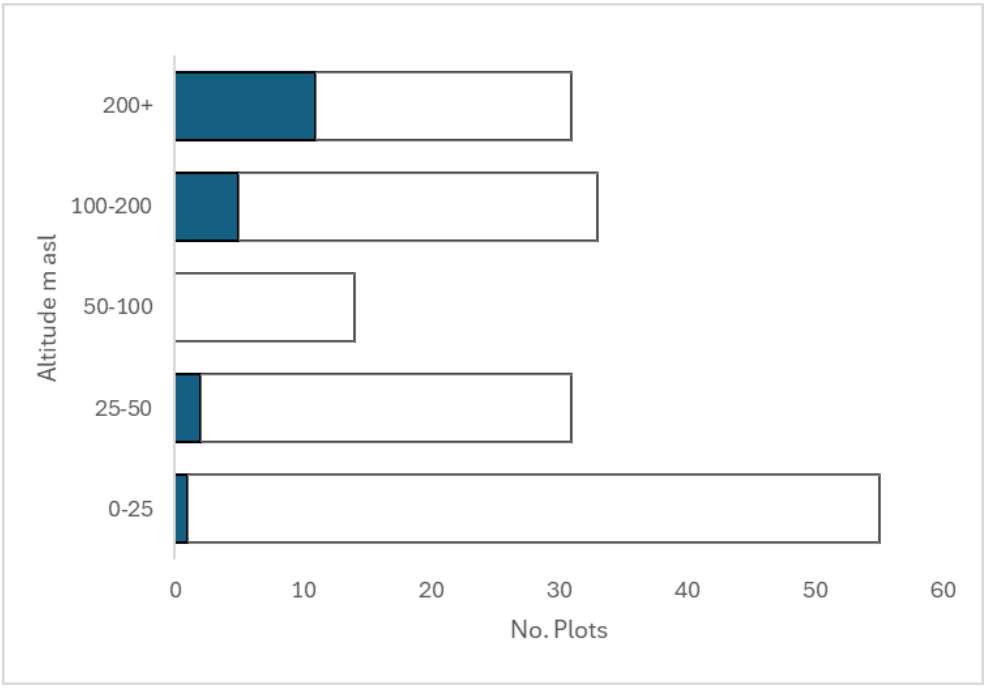
Survey, Malekula, 2022

- E. cyanogaster was recorded at all three survey sites.
- 49 individuals were recorded at 19 locations, 1 at Wiawi T6Q2, 4 at Tsiri Lagoon T1Q1, 2 at Small Nambas T3Q1 and 5 at Small Nambas T4Q2.
- A maximum of 7 individuals were recorded at any one plot.
- Recorded more frequently at altitudes above 100m asl.

Figure 10: Map showing the distribution of Emoia cyanogaster (all survey plots are shown as circles – the plots filled, in red, are the plots where the species was recorded).

A. Wiawi KBA
B. Small Nambas KBA
C. Tsiri Lagoon

Figure 11: Distribution of Emoia cyanogaster by altitude.



White-bellied Copper-striped Skink (Emoia cyanura) Least Concern (2021)

IUCN Red List Distribution

- From Guam and Northern Marianas Islands, in the west, through to Pitcairn, Samoa and Marshall Islands in the east. This is not a Range-restricted species. Between 0 and 800m asl.

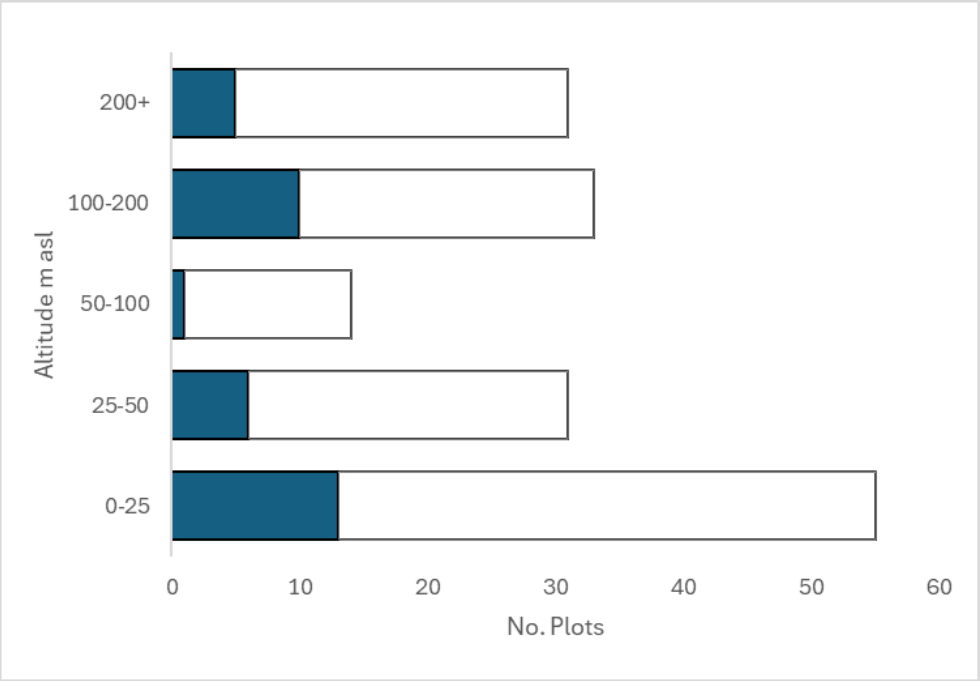
Survey, Malekula, 2022

- E. cyanura was recorded at all 3 survey sites.
- 54 individuals were recorded at 23 sites, 9 of which were quadrats. 3 individuals at Wiawi T2Q1, 3 at Wiawi T2Q2, 3 at Wiawi T4Q1, 4 at Tsiri Lagoon T2Q1, 1 at Tsiri Lagoon T4Q3, 3 at Small Nambas T2Q2, 2 at Small Nambas T3Q1, 5 at Small Nambas T4Q2 and 1 individual at Small Nambas T6Q3.
- Up to six individuals were recorded at any one plot.
- Fairly evenly distributed through the altitudinal range.

Figure 12: Map showing the distribution of Emoia cyanura (all survey plots are shown as circles – the plots filled, in red, are the plots where the species was recorded).

A. Wiawi KBA
B. Small Nambas KBA
C. Tsiri Lagoon

Figure 13: Distribution of Emoia cyanura by altitude.



Azure-tailed Skink, Dark-bellied Copper-striped Skink (Emoia impar) Least Concern (2022)

IUCN Red List Distribution

- Recorded from Bismarck Archipelago (PNG), Solomon Islands and Vanuatu east to American Samoa, Samoa and Marshall Islands. This is not a range-restricted species. No altitudinal range recorded.

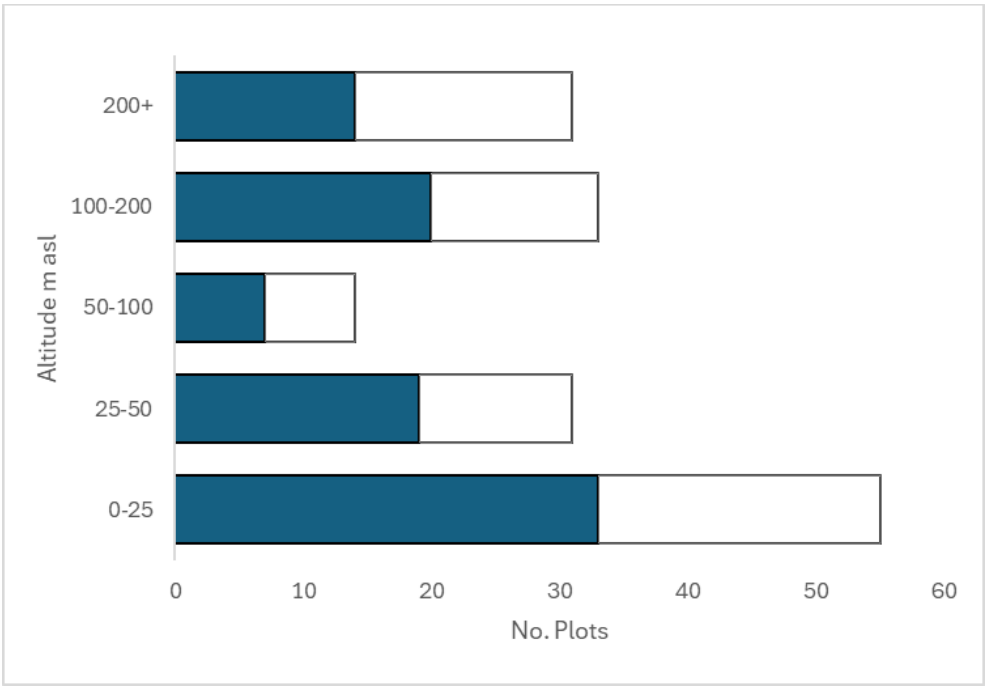
Survey 2022

- The most common species recorded across all three sites.
- 231 individuals were recorded at 54 locations, 77 individuals were at 19 of the quadrats.
- Up to 11 individuals were recorded on any one plot.
- Recorded at all altitudes, with no evidence of any preference.

Figure 14: Map showing the distribution of Emoia impar (all survey plots are shown as circles – the plots filled, in red, are the plots where the species was recorded).

A. Wiawi KBA
B. Small Nambas KBA
C. Tsiri Lagoon

Figure 15: Distribution of Emoia impar by altitude.



Vanuatu Silver Vineskink (Emoia nigromarginata) Least Concern (2013)

IUCN Red List Distribution

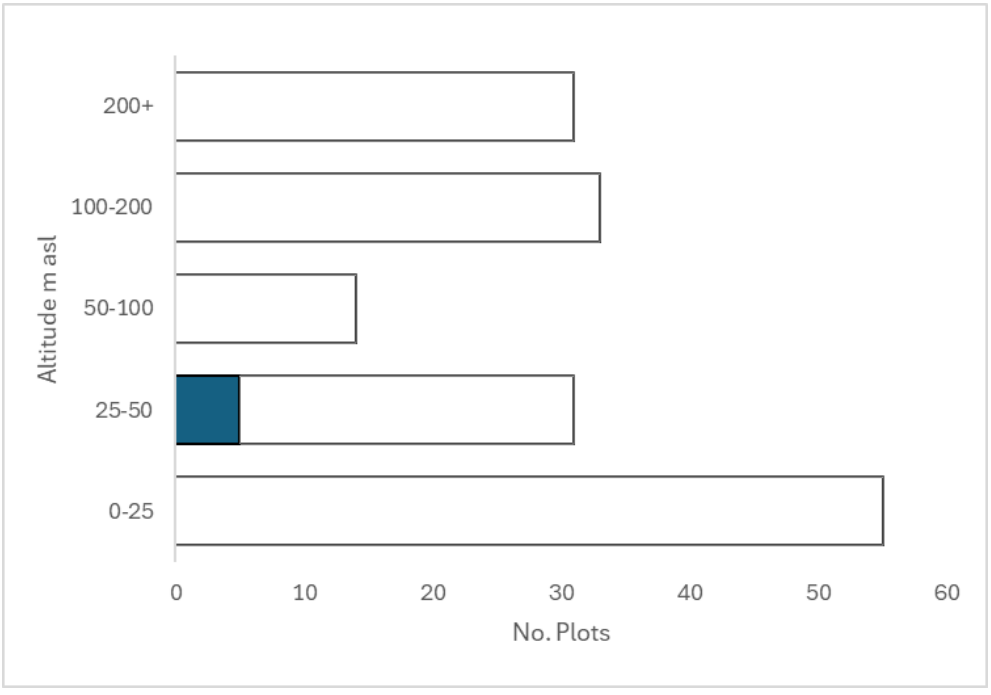
- Endemic to Vanuatu, with range restricted from Espiritu Santo south to Efate, with populations on Malekula, Pentecost and Ambrym. This is a range-restricted species. Altitudinal range 0 to 650m asl.

Survey, Malekula, 2022

- *E. nigromarginata* was only recorded at Wiawi.
- Single individuals were recorded at each of 5 plots at Wiawi.
- All individuals were recorded in the 25-50m asl range between 32m and 45m asl.

Figure 16: Map showing the distribution of Emoia nigromarginata on Wiawi KBA (all survey plots are shown as circles – the plots filled, in red, are the plots where the species was recorded).

Figure 17: Distribution of Emoia nigromarginata by altitude.



Sanford's Tree Skink (Emoia sanfordi) Least Concern (2013)

IUCN Red List Distribution

- Endemic to Vanuatu, from the Banks and Torres Islands, in the north to Efate. This is not a Range-restricted species. It occurs in the altitudinal Range of 0 to 1500m asl.

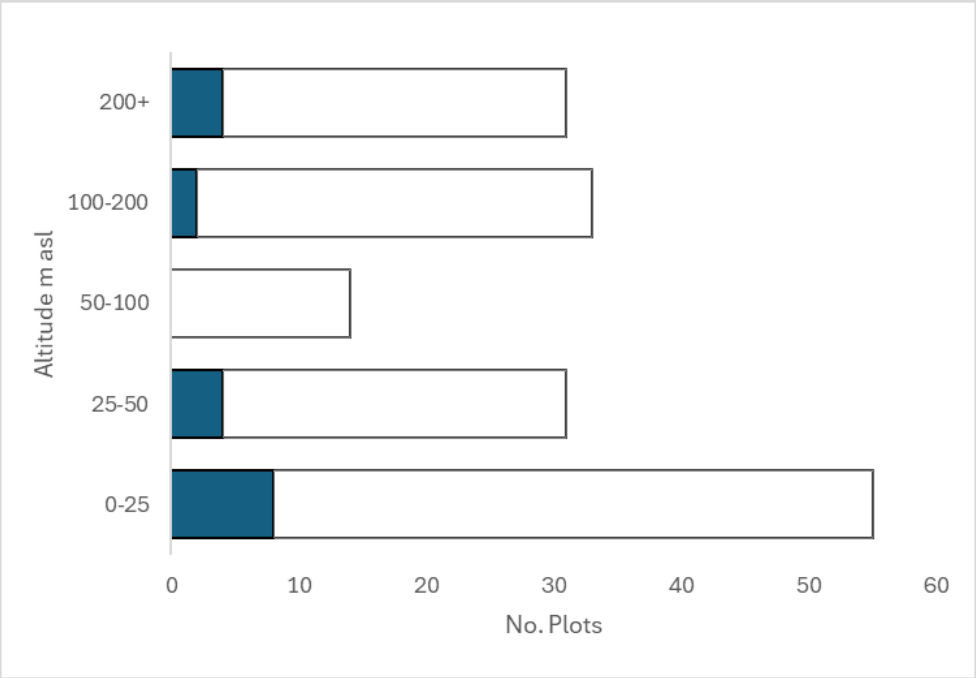
Survey, Malekula, 2022

- E. sanfordi was recorded on all 3 survey sites.
- 26 individuals were recorded on 18 plots, 3 of which were quadrats, a single individual at each of Wiawi T1Q1, Wiawi T5Q1 and Small Nambas T4Q1
- Up to 4 individuals were recorded at any one plot.
- The species was fairly evenly distributed across the altitudinal range.

Figure 18: Map showing the distribution of Emoia sanfordi (all survey plots are shown as circles – the plots filled, in red, are the plots where the species was recorded).

A. Wiawi KBA
B. Small Nambas KBA
C. Tsiri Lagoon

Figure 19: Distribution of Emoia sanfordi by altitude.



Sago Gecko? (Gehyra sp, vittatus?) Least Concern (2022)

IUCN Red List Distribution

- Taxonomic status uncertain. This may be the species identified as *G. oceanica* in the field. If it is then this species occurs from Palau and West Papua through to Solomon Islands and Vanuatu. Its distribution covers an altitudinal range of 0 to 200m asl. It is not a Range-restricted species.

Survey, Malekula, 2022

- Two individuals were recorded, a single at 11m asl on Small Nambas and a single at Tsiri Lagoon at 90m asl.
- Neither plot was a quadrat.

Figure 20: Map showing the distribution of Gehyra vittatus (?) at Tsiri Lagoon (all survey plots are shown as circles – the plots filled, in red, are the plots where the species was recorded).

Solomons Slender-toed Gecko (Nactus multicarinus) Least Concern (2013)

IUCN Red List Distribution

- From Bougainville (PNG) through Solomon Islands to Vanuatu as far south as Aneityum. This is not a Range-restricted species. No altitudinal range provided.

Survey, Malekula, 2022

- *N. multicarinus* was recorded on all 3 survey sites.
- 14 individuals were recorded on 9 plots, 2 of which were quadrats. A single individual was recorded at both Small Nambas T4Q1 and Small Nambas T8Q3.
- Up to 5 individuals were recorded on any one plot.
- The species is sparsely, but evenly, distributed across the altitudinal range surveyed.

Figure 21: Map showing the distribution of Nactus multicarinus (all survey plots are shown as circles – the plots filled, in red, are the plots where the species was recorded).

A. Wiawi KBA
B. Tsiri Lagoon

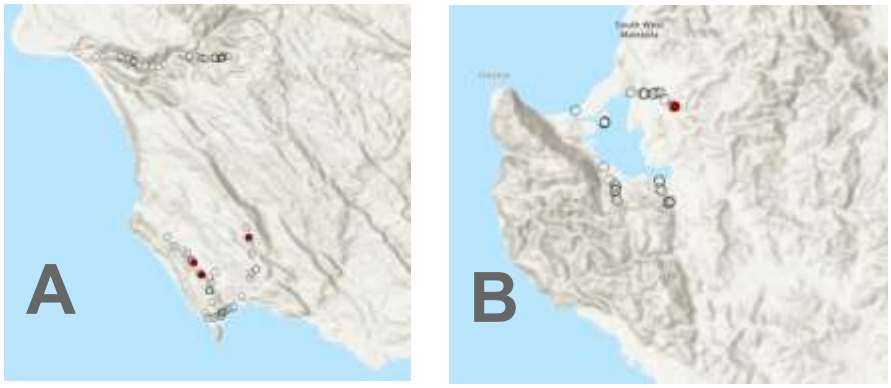
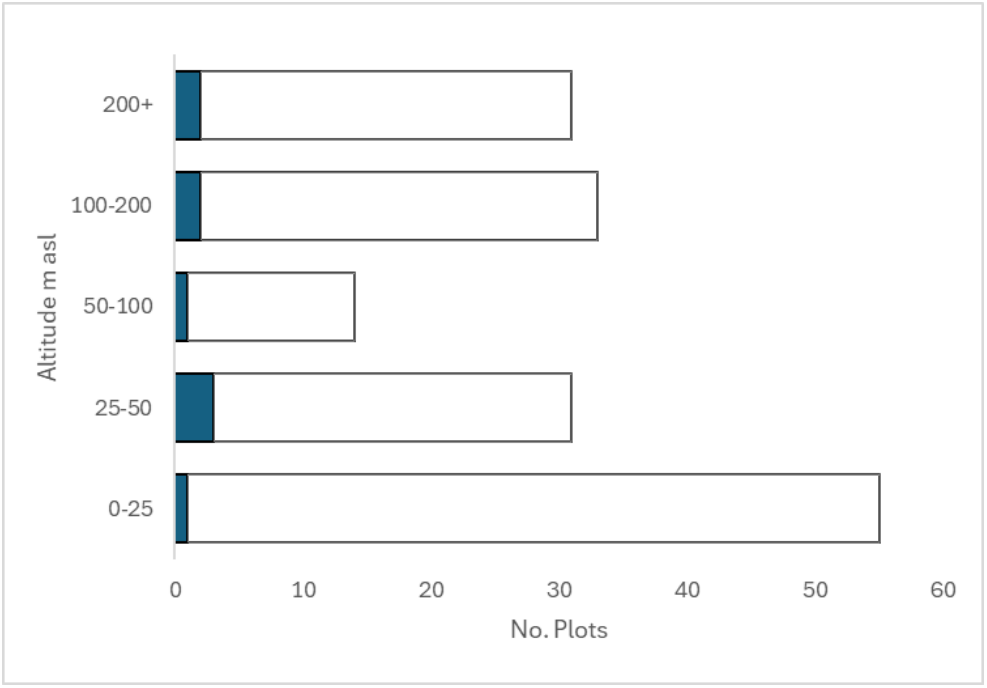


Figure 22: Distribution of Nactus multicarinus by altitude.



Green Frog (Litoria aurea) Near-threatened (2021)

IUCN Red List Distribution

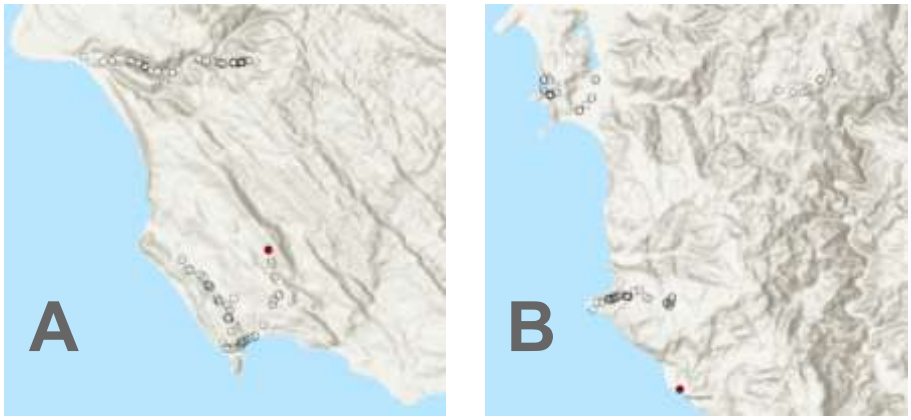
- Endemic to Australia. Introduced and extant in New Caledonia, New Zealand and Vanuatu. Altitudinal range 0 to 800m asl.

Survey, Malekula, 2022

- *L. aurea* was recorded on Wiawi and Small Nambas KBA.
- Single individuals were recorded on each site, the Wiawi plot was a quadrat at T4Q3 at 173m asl, while the Small Nambas plot was at 12m asl.

Figure 23: Map showing the distribution of Litoria aurea (all survey plots are shown as circles – the plots filled, in red, are the plots where the species was recorded).

A. Wiawi KBA
B. Small Nambas



IMPLICATIONS OF SURVEYS FOR ASSESSMENT OF KBA STATUS

Key Biodiversity Areas provide a means of assessing the extent to which a site ranks as globally important for biodiversity. The process applies 3 separate criteria to species-based information.

1. **Threatened Biodiversity (KBA Criteria A1a-e)**
   This set of 5 criteria indicates how globally threatened species can be used to determine whether a particular site can be considered a globally important Key Biodiversity Area. It is applied to any species that are considered as Critically Endangered, Endangered or Vulnerable under the IUCN Red List. None of the species considered in this assessment of reptiles in Malekula are considered to be globally threatened.
2. **Geographically restricted Biodiversity (KBA Criteria B1, B2, B3b)**
   This set of three criteria consider whether a species or a group of species of a taxon are considered to be geographically restricted.

Under criterion B1, Individual geographically restricted species, 10% or more of the global population of a species needs to occur on the site. None of the species considered here have a global population estimate – so we can only use a mapped parameter, such as species range, to apply this criterion. 8 of the 10 species considered occur in countries in addition to Vanuatu – so their range is likely to be large c/w the area of the sites considered in this review (Wiawi is 42.7 km^2 while Small Nambas is 213 km^2). If the species occurred across the site, and the site was 10% or more of the global range then the species global range would have to be 213*10 km^2 or less. This is not the case for any of the species.

Under criterion B2, Co-occurring geographically restricted species, two or more species from any taxon have to be considered as Range-restricted and for more than 1% of their global population to occur on the site. Only 1 species surveyed is considered to be Range-restricted – *Emoia nigromarginata*. The global range for this species is estimated at 8,627 km^2. The species was only recorded, during this survey, at Wiawi KBA – which is 42.7 km^2 – ie less than 0.5% of the global range. Accordingly, this criterion cannot be achieved, both because only one species qualifies and because that one species is not present as more than 1% of its global population (estimated by range).

Under criterion B3a, geographically restricted assemblages of ecoregion-restricted species. This considers reptiles that are restricted to the ecoregion of 'Vanuatu Rain Forests' – which covers Vanuatu and the Temotu Province of Solomon Islands. It requires 0.5% of the population of 5 or more species that are restricted to the ecoregion. Of the species surveyed *Cryptoblepharus novohebridicus*, *Emoia nigromarginata* and E. sanfordi are the only Ecoregion-restricted species recorded on the survey. As this is only 3 potential species then this global criterion will not be achieved.

It has been proposed that a reduced criterion of more than 2 (or 5%) of the species restricted to the ecoregion, may qualify the site as a Regionally Important site for this criterion. *C. novohebridicus* only occurred on Wiawi KBA, and the site is just less than 0.5% of the species global range. This species would not be included for this site, as it stands. There may be a case for expanding the KBA to include the species – although the distribution of the species within the KBA appears to be quite restricted. The global range of *E. sanfordi* is estimated at 10,856 km^2. Small Nambas KBA, at 213 km^2, is >0.5% of the species global range. Similarly, the global range of *Cryptoblepharus novohebridicus* is estimated as 11,616 km^2. Small Nambas KBA, at 213 km^2, is >0.5% of the species global range. Two species of reptile that occurred on Small Nambas KBA qualify, but three species are required for the site to qualify as of regional importance for Ecoregion-restricted reptile species.

3. Biological Processes. Demographic aggregations

Demographic assemblages are where high aggregations of species occur. Terrestrial reptiles are not considered to form these kind of biological processes and, so, are not considered under demographic assemblages.

MARINE TURTLES

Another group of reptiles, the marine turtles, were not surveyed as part of this project. Survey monitoring requires regular visits throughout the breeding season (which, traditionally is between November and March). There is historical data on marine turtle use of both Bamboo Bay (ie. the Small Nambas KBA) and Wiawi KBA.

The Central Pacific Regional Management Unit for the Critically Endangered Hawksbill Turtles includes nesting colonies in Vanuatu. This regional population is considered to be around 900-1000 nesting females. Within Vanuatu there are estimated as c16 (between 1 and 32) nests per year on Bamboo Bay (between 2004 and 2014) and 8 nests per year on Wiawi (between 2007 and 2019) (Work et al, 2020). Although this represents no more than 5 females a year at Bamboo Bay and 2 or 3 at Wiawi (females lay between 3 and 5 clutches per season) females only nest every 1 to 5 years. So, the minimum number of females per site exceeds 5 – and the species qualifies as Regionally Important trigger species under the Threatened species criteria A1a and A1c.

Similarly, for Green Turtles (EN) the South Central Pacific Regional Management Unit includes green turtles nesting in Vanuatu. It has been estimated that there are c7,500 nesting attempts per year in this RMU. Bamboo Bay has recorded 13 (between 2 and 27 females nesting per year between 2006 and 2014) while Wiawi has recorded between 2 and 111 nests per year between 2011 and 2013 (data from Work et al (2020) other than the Wiawi estimates that derived from the TREDS data. The species qualifies as Regionally important trigger species for both sites under the Threatened species criteria A1a and A1c.

Table 3: Species recorded at quadrats and plots at Tsiri Lagoon.

Plot	Y (Lat.)	X (Long.)	Elev,n (m asl)	Date	Time	Species name	Count
T1Q1	-16.508653	167.440584	26	11/07/2022	09:31	*Emoia cyanogaster*	4
T1Q1	-16.508653	167.440584	26	11/07/2022	09:31	*Emoia impar*	5
603	-16.511267	167.44177	14	11/07/2022	10:05	*Emoia cyanura*	3
603	-16.511267	167.44177	14	11/07/2022	10:05	*Emoia impar*	5
604	-16.511248	167.441774	14	11/07/2022	10:05	*Emoia impar*	2
605	-16.512209	167.442894	10	11/07/2022	10:28	*Emoia cyanogaster*	4
606	-16.512782	167.44302	28	11/07/2022	10:40	*Emoia cyanura*	2
606	-16.512782	167.44302	28	11/07/2022	10:40	*Emoia impar*	6
607	-16.512765	167.443015	28	11/07/2022	10:40	*Emoia cyanogaster*	1
608	-16.513336	167.442913	47	11/07/2022	10:52	*Emoia sanfordi*	4
T1Q2	-16.513488	167.442934	48	11/07/2022	10:59	*Emoia caeruleocauda*	3
T1Q2	-16.513488	167.442934	48	11/07/2022	10:59	*Emoia impar*	2
610	-16.515399	167.443217	90	11/07/2022	14:26	*Gehyra vittatus*	1
T2Q1	-16.51145	167.451891	4	12/07/2022	09:34	*Emoia impar*	4
T2Q1	-16.51145	167.451891	4	12/07/2022	09:34	*Emoia cyanura*	4
613	-16.511537	167.451935	4	12/07/2022	09:46	*Emoia impar*	4
613	-16.511537	167.451935	4	12/07/2022	09:46	*Emoia cyanura*	3
613	-16.511537	167.451935	4	12/07/2022	09:46	*Emoia caeruleocauda*	4
614	-16.513074	167.452054	15	12/07/2022	10:05	*Emoia impar*	6
615	-16.513633	167.452452	15	12/07/2022	10:08	*Emoia cyanura*	2
T2Q2	-16.51363	167.452444	15	12/07/2022	10:08	*Emoia impar*	4
T2Q3	-16.515543	167.454116	11	12/07/2022	11:14	*Emoia impar*	3
618	-16.51594	167.453889	23	12/07/2022	11:23	*Emoia sanfordi*	1
619	-16.515756	167.453889	25	12/07/2022	11:29	*Emoia sanfordi*	1
620	-16.51574	167.453807	30	12/07/2022	11:35	*Emoia sanfordi*	2
621	-16.499601	167.440799	6	12/07/2022	13:08	*Emoia impar*	1
T3Q1	-16.49968	167.440682	6	12/07/2022	13:09	*Emoia impar*	3
623	-16.499517	167.440746	6	12/07/2022	13:12	*Emoia impar*	5
T3Q2	-16.493544	167.446021	9	12/07/2022	13:34	*Emoia impar*	4
T3Q3	-16.493812	167.448413	4	12/07/2022	13:44	*Emoia impar*	3
627	-16.493837	167.448815	3	12/07/2022	13:51	*Emoia impar*	4
628	-16.493781	167.448958	3	12/07/2022	13:54	*CRB*	1
T4Q1	-16.493786	167.450577	5	12/07/2022	14:02	*UnID*	
632	-16.493713	167.450967	7	12/07/2022	14:18	*CRB*	6
633	-16.493518	167.451665	11	12/07/2022	14:22	*Emoia impar*	6
634	-16.493629	167.452121	12	12/07/2022	14:28	*Emoia impar*	3
634	-16.493629	167.452121	12	12/07/2022	14:28	*Emoia sanfordi*	1
635	-16.494889	167.452935	11	12/07/2022	14:36	*Emoia sanfordi*	1
636	-16.496325	167.454503	17	12/07/2022	14:44	*Emoia impar*	3
636	-16.496325	167.454503	17	12/07/2022	14:44	*Emoia cyanura*	1
636	-16.496325	167.454503	17	12/07/2022	14:44	*Emoia caeruleocauda*	2
638	-16.496402	167.455023	20	12/07/2022	15:10	*Emoia cyanura*	2

638	-16.496402	167.455023	20	12/07/2022	15:10	*Emoia caeruleocauda*	3
638	-16.496402	167.455023	20	12/07/2022	15:10	*Nactus multicarinatus*	2
638	-16.496402	167.455023	20	12/07/2022	15:10	*Emoia impar*	5
639	-16.493807	167.450595	7	12/07/2022	15:39	*Emoia caeruleocauda*	1
639	-16.493807	167.450595	7	12/07/2022	15:39	*Emoia impar*	1
640	-16.499682	167.440742	3	12/07/2022	16:46	*Emoia impar*	3
640	-16.499682	167.440742	3	12/07/2022	16:46	*Emoia caeruleocauda*	2
640	-16.499682	167.440742	3	12/07/2022	16:46	*Emoia cyanura*	1
T4Q3	-16.497167	167.434783	3	12/07/2022	18:17	*Emoia impar*	3
T4Q3	-16.497167	167.434783	3	12/07/2022	18:17	*Emoia cyanura*	1
T4Q3	-16.497167	167.434783	3	12/07/2022	18:17	*Emoia caeruleocauda*	2

Table 4: Species recorded at quadrats and plots at Small Nambas (Bamboo Bay).

Plot	Y (Lat.)	X (Long.)	Elev (m asl)	Date	Time	Species name	Count
T1Q1	-16.422964	167.401514	21	14/07/2022	09:17		
T1Q2	-16.42102	167.402747	46	14/07/2022	09:30	*Emoia impar*	5
644	-16.421023	167.404017	36	14/07/2022	09:46	*Emoia impar*	4
T1Q3	-16.420365	167.405676	57	14/07/2022	10:02	*Emoia impar*	4
646	-16.420297	167.405581	58	14/07/2022	10:06	*Emoia impar*	6
647	-16.420195	167.406071	70	14/07/2022	10:22	*Emoia impar*	3
648	-16.419979	167.406156	77	14/07/2022	10:26	*Nactus multicarinatus*	1
T2Q1	-16.420302	167.406775	93	14/07/2022	10:32	*Emoia impar*	1
650	-16.420307	167.406789	92	14/07/2022	10:34	*Emoia impar*	3
651	-16.420152	167.407107	98	14/07/2022	10:37	*Emoia impar*	5
652	-16.419802	167.407317	101	14/07/2022	10:44	*Emoia impar*	5
653	-16.419636	167.407496	101	14/07/2022	10:51	*Nactus multicarinatus*	1
654	-16.419601	167.408258	107	14/07/2022	10:59	*Emoia impar*	4
T2Q2	-16.419412	167.408492	108	14/07/2022	11:05	*Emoia impar*	2
T2Q2	-16.419412	167.408492	108	14/07/2022	11:05	*Emoia cyanura*	3
656	-16.418795	167.408968	120	14/07/2022	11:15	*Emoia impar*	5
658	-16.419249	167.410388	143	14/07/2022	11:25	*Emoia cyanura*	2
658	-16.419249	167.410388	143	14/07/2022	11:25	*Emoia impar*	6
659	-16.419387	167.410472	145	14/07/2022	11:30	*Emoia cyanogaster*	2
660	-16.419546	167.410734	149	14/07/2022	11:34	*Emoia cyanogaster*	2
T3Q1	-16.419528	167.410915	150	14/07/2022	11:39	*Emoia impar*	5
T3Q1	-16.419528	167.410915	150	14/07/2022	11:39	*Emoia cyanura*	2
T3Q1	-16.419528	167.410915	150	14/07/2022	11:39	*Emoia cyanogaster*	2
662	-16.419548	167.411137	153	14/07/2022	11:44	*Emoia impar*	9
T3Q2	-16.418085	167.412578	161	14/07/2022	12:03		
T2Q3	-16.417732	167.414002	189	14/07/2022	12:46	*Emoia impar*	11
665	-16.41968	167.41556	215	14/07/2022	12:52	*Emoia impar*	3
666	-16.420133	167.416466	234	14/07/2022	12:57	*Emoia impar*	9
T4Q1	-16.420895	167.421126	268	14/07/2022	13:20	*Nactus multicarinatus*	1

T4Q1	-16.420895	167.421126	268	14/07/2022	13:20	*Emoia sanfordi*	1
669	-16.421328	167.421198	271	14/07/2022	13:22	*Emoia cyanogaster*	1
670	-16.421445	167.421266	275	14/07/2022	13:23		
671	-16.422162	167.421773	281	14/07/2022	13:28	*Emoia cyanogaster*	2
671	-16.422162	167.421773	281	14/07/2022	13:28	*Emoia impar*	6
672	-16.421518	167.422054	294	14/07/2022	14:22	*Emoia cyanogaster*	5
672	-16.421518	167.422054	294	14/07/2022	14:22	*Emoia impar*	12
673	-16.42149	167.422223	295	14/07/2022	14:25	*Emoia cyanura*	3
673	-16.42149	167.422223	295	14/07/2022	14:25	*Emoia caeruleocauda*	2
T4Q2	-16.419833	167.422559	281	14/07/2022	14:46	*Emoia cyanogaster*	5
T4Q2	-16.419833	167.422559	281	14/07/2022	14:46	*Emoia cyanura*	5
T4Q2	-16.419833	167.422559	281	14/07/2022	14:46	*Emoia impar*	8
675	-16.419846	167.422396	284	14/07/2022	15:04	*Emoia cyanogaster*	7
675	-16.419846	167.422396	284	14/07/2022	15:04	*Emoia cyanura*	3
675	-16.419846	167.422396	284	14/07/2022	15:04	*Emoia caeruleocauda*	2
675	-16.419846	167.422396	284	14/07/2022	15:04	*Emoia impar*	8
676	-16.420752	167.422367	306	14/07/2022	15:57	*Emoia sanfordi*	1
T5Q1	-16.366208	167.390548	9	15/07/2022	10:44	*Emoia impar*	3
678	-16.366214	167.390346	11	15/07/2022	10:51	*Emoia impar*	4
679	-16.366257	167.390485	3	15/07/2022	10:54	*Emoia impar*	2
681	-16.366372	167.390378	11	15/07/2022	10:56	*Gehyra vittatus*	1
682	-16.36593	167.39009	7	15/07/2022	11:07	*Emoia impar*	4
683	-16.365331	167.388797	13	15/07/2022	11:17	*Emoia impar*	6
684	-16.364429	167.388467	14	15/07/2022	11:23	*Emoia cyanura*	5
T5Q2	-16.362238	167.388552	14	15/07/2022	11:30	*Emoia impar*	2
687	-16.362173	167.388801	15	15/07/2022	11:32	*Emoia impar*	2
688	-16.36226	167.390005	14	15/07/2022	11:39	*Emoia impar*	4
688	-16.36226	167.390005	14	15/07/2022	11:39	*Emoia cyanura*	1
T5Q3	-16.365613	167.391955	16	15/07/2022	12:00	*Emoia impar*	2
BANGA MAOES	-16.370319	167.397996		15/07/2022	14:02	*Emoia impar*	4
T6Q1	-16.370375	167.398042	21	15/07/2022	14:04	*Emoia impar*	2
692	-16.370323	167.398101	22	15/07/2022	14:05	*Emoia impar*	4
693	-16.368928	167.399788	27	15/07/2022	14:11	*Emoia impar*	9
T6Q2	-16.366992	167.401312	32	15/07/2022	14:17	*Emoia impar*	2
695	-16.36698	167.401396	31	15/07/2022	14:18	*Emoia impar*	5
695	-16.36698	167.401396	31	15/07/2022	14:18	*Emoia cyanura*	1
T6Q3	-16.362376	167.402388	34	15/07/2022	14:37	*Emoia cyanura*	1
T6Q3	-16.362376	167.402388	34	15/07/2022	14:37	*Emoia impar*	2
697	-16.361884	167.402178	32	15/07/2022	14:46	*Emoia impar*	5
697	-16.361884	167.402178	32	15/07/2022	14:46	*Emoia cyanura*	3
T7Q1	-16.36499	167.458604	440	18/07/2022	11:02	*Emoia impar*	2
698	-16.362266	167.461652	467	18/07/2022	11:35	*Emoia impar*	1
T7Q2	-16.362	167.462096	466	18/07/2022	11:39	*Emoia impar*	4
T7Q3	-16.360193	167.464385	512	18/07/2022	12:13	*Emoia impar*	2

LAWA	-16.443992	167.424639	12	18/07/2022	12:57	*Frog*	1
T8Q1	-16.365366	167.457499	450	18/07/2022	13:58	*Emoia impar*	2
T8Q2	-16.365537	167.454694	396	18/07/2022	14:12	*Emoia impar*	3
T8Q3	-16.36504	167.450629	260	18/07/2022	14:36	*Nactus multicarinatus*	1
699	-16.367071	167.443316	185	18/07/2022	14:58	*Emoia impar*	2

Table 5: Species recorded at quadrats and plots at Wiawi.

Plot	Y (Lat.)	X (Long.)	Elev (m asl)	Date	Time	Species name	Count
T1Q1	-16.135667	167.195004	28	22/07/2022	10:17	*Emoia sanfordi*	1
728	-16.135846	167.194356	21	22/07/2022	10:28	*Emoia sanfordi*	2
728	-16.135846	167.194356	21	22/07/2022	10:28	*Emoia cyanura*	6
728	-16.135846	167.194356	21	22/07/2022	10:28	*Emoia impar*	2
729	-16.136191	167.193618	22	22/07/2022	10:33	*Emoia impar*	6
729	-16.136191	167.193618	22	22/07/2022	10:33	*Emoia cyanura*	6
730	-16.136533	167.193171	18	22/07/2022	10:42	*UnID*	2
730	-16.136533	167.193171	18	22/07/2022	10:42	*Cryptoblepharus novohebridicus*	3
731	-16.136618	167.192845	17	22/07/2022	10:56	*UnID*	3
731	-16.136618	167.192845	17	22/07/2022	10:56	*Cryptoblepharus novohebridicus*	5
732	-16.136667	167.192761	17	22/07/2022	11:00	*Emoia impar*	3
733	-16.137044	167.192472	16	22/07/2022	11:03	*Cryptoblepharus novohebridicus*	3
733	-16.137044	167.192472	16	22/07/2022	11:03	*Emoia sanfordi*	1
734	-16.137434	167.192474	15	22/07/2022	11:13	*Cryptoblepharus novohebridicus*	4
734	-16.137434	167.192474	15	22/07/2022	11:13	*Emoia cyanura*	2
735	-16.137574	167.191517	16	22/07/2022	11:19	*Emoia impar*	6
T1Q2	-16.137682	167.190809	16	22/07/2022	11:21	*Cryptoblepharus novohebridicus*	4
T1Q2	-16.137682	167.190809	16	22/07/2022	11:21	*Emoia impar*	3
736	-16.137517	167.190253	17	22/07/2022	11:25	*Emoia sanfordi*	1
737	-16.136749	167.189675	20	22/07/2022	11:30	*Emoia impar*	5
737	-16.136749	167.189675	20	22/07/2022	11:30	*UnID*	3
738	-16.134814	167.19104	59	22/07/2022	11:40	*Cryptoblepharus novohebridicus*	3
T1Q3	-16.132717	167.190643	68	22/07/2022	11:49	*Cryptoblepharus novohebridicus*	3
739	-16.132713	167.19049	70	22/07/2022	11:55	*Emoia cyanura*	6
739	-16.132713	167.19049	70	22/07/2022	11:55	*L. noctua*	1
740	-16.132676	167.190572	69	22/07/2022	11:56	*Cryptoblepharus novohebridicus*	6
T2Q1	-16.131283	167.190851	48	22/07/2022	12:08	*Emoia impar*	4
T2Q1	-16.131283	167.190851	48	22/07/2022	12:08	*Emoia cyanura*	3
T2Q1	-16.131283	167.190851	48	22/07/2022	12:08	*UnID*	1
741	-16.129478	167.191468	60	22/07/2022	12:26	*Emoia impar*	4
742	-16.129893	167.189185	48	22/07/2022	12:36	*Nactus multicarinatus*	5
T2Q2	-16.129835	167.189007	49	22/07/2022	12:37	*Emoia cyanura*	3
T2Q2	-16.129835	167.189007	49	22/07/2022	12:37	*UnID*	2

744	-44764.035	167.188127	47	22/07/2022	12:42	*Nactus multicarinatus*	1
T2Q3	-16.127553	167.187525	41	22/07/2022	12:45	*Emoia impar*	3
T3Q1	-16.126032	167.186543	38	22/07/2022	12:50	*Emoia impar*	4
745	-16.125664	167.185963	38	22/07/2022	12:54	*Emoia impar*	1
T3Q2	-16.124894	167.184467	37	22/07/2022	12:59	*Emoia impar*	4
746	-16.124756	167.184044	37	22/07/2022	13:03	*Emoia impar*	3
T3Q3	-16.123125	167.183001	37	22/07/2022	13:10	*Emoia impar*	6
747	-16.127276	167.187316	40	22/07/2022	13:42	*Emoia nigromarginata*	1
748	-16.127248	167.187227	40	22/07/2022	13:53	*Emoia nigromarginata*	1
749	-16.127723	167.187743	39	22/07/2022	14:07	*Emoia nigromarginata*	1
749	-16.127723	167.187743	39	22/07/2022	14:07	*Nactus multicarinatus*	1
750	-16.129488	167.188726	45	22/07/2022	14:19	*Emoia nigromarginata*	1
750	-16.129488	167.188726	45	22/07/2022	14:19	*Emoia impar*	3
751	-16.130605	167.190496	32	22/07/2022	14:27	*Emoia sanfordi*	3
751	-16.130605	167.190496	32	22/07/2022	14:27	*Emoia nigromarginata*	1
T5Q1	-16.090045	167.166903	19	25/07/2022	11:19	*Emoia sanfordi*	1
752	-16.090772	167.170126	35	25/07/2022	11:27		
T5Q2	-16.090782	167.171545	41	25/07/2022	11:31	*Emoia impar*	3
753	-16.090626	167.174492	128	25/07/2022	11:36	*Emoia impar*	2
754	-16.090818	167.174776	148	25/07/2022	11:38	*Emoia cyanura*	2
T5Q3	-16.091144	167.1762	160	25/07/2022	11:41	*Emoia impar*	2
756	-16.091536	167.176829	156	25/07/2022	11:46	*Emoia impar*	3
757	-16.091622	167.176898	155	25/07/2022	11:47	*Emoia caeruleocauda*	1
758	-16.091735	167.176949	146	25/07/2022	11:51	*Emoia cyanogaster*	1
758	-16.091735	167.176949	146	25/07/2022	11:51	*Emoia caeruleocauda*	1
758	-16.091735	167.176949	146	25/07/2022	11:51	*Emoia impar*	3
759	-16.092367	167.179013	137	25/07/2022	11:58	*Emoia cyanura*	2
759	-16.092367	167.179013	137	25/07/2022	11:58	*Emoia caeruleocauda*	2
759	-16.092367	167.179013	137	25/07/2022	11:58	*Emoia impar*	2
760	-16.092385	167.180349	135	25/07/2022	12:02	*Emoia cyanura*	1
760	-16.092385	167.180349	135	25/07/2022	12:02	*Emoia caeruleocauda*	4
760	-16.092385	167.180349	135	25/07/2022	12:02	*Emoia impar*	6
761	-16.092593	167.181441	132	25/07/2022	12:06	*Emoia caeruleocauda*	2
761	-16.092593	167.181441	132	25/07/2022	12:06	*Emoia impar*	3
762	-16.091989	167.182316	130	25/07/2022	12:11	*UnID*	3
762	-16.091989	167.182316	130	25/07/2022	12:11	*Emoia cyanura*	3
763	-16.090219	167.185732	140	25/07/2022	12:29	*Emoia cyanogaster*	1
763	-16.090219	167.185732	140	25/07/2022	12:29	*Emoia cyanura*	1
764	-16.090737	167.186943	144	25/07/2022	12:35	*Emoia caeruleocauda*	5
764	-16.090737	167.186943	144	25/07/2022	12:35	*Emoia cyanura*	3
T6Q1	-16.091129	167.189168	231	25/07/2022	12:48	*Emoia impar*	5
T6Q1	-16.091129	167.189168	231	25/07/2022	12:48	*Emoia caeruleocauda*	2
765	-16.091175	167.189854	245	25/07/2022	13:27	*UnID*	2
765	-16.091175	167.189854	245	25/07/2022	13:27	*Emoia caeruleocauda*	2
765	-16.091175	167.189854	245	25/07/2022	13:27	*Emoia impar*	3

766	-16.090999	167.191421	279	25/07/2022	13:41	*Emoia cyanogaster*	1
T6Q2	-16.091008	167.191528	279	25/07/2022	13:42	*Emoia caeruleocauda*	2
T6Q2	-16.091008	167.191528	279	25/07/2022	13:42	*Emoia cyanogaster*	1
767	-16.090993	167.191676	281	25/07/2022	13:44	*Emoia caeruleocauda*	5
768	-16.09096	167.192686	292	25/07/2022	13:47	*Emoia cyanogaster*	1
768	-16.09096	167.192686	292	25/07/2022	13:47	*Emoia caeruleocauda*	4
769	-16.090748	167.19299	313	25/07/2022	14:20	*Emoia caeruleocauda*	3
769	-16.090748	167.19299	313	25/07/2022	14:20	*Emoia cyanura*	1
770	-16.090662	167.193857	344	25/07/2022	14:32	*Emoia caeruleocauda*	3
770	-16.090662	167.193857	344	25/07/2022	14:32	*Emoia cyanura*	3
770	-16.090662	167.193857	344	25/07/2022	14:32	*UnID*	2
771	-16.090933	167.192915	308	25/07/2022	14:47	*Emoia cyanogaster*	4
772	-16.090995	167.192629	304	25/07/2022	14:50	*Emoia sanfordi*	1
773	-16.091059	167.192509	304	25/07/2022	14:52	*Emoia cyanogaster*	4
774	-16.091071	167.189606	252	25/07/2022	15:14	*Emoia sanfordi*	1
775	-16.090767	167.188121	220	25/07/2022	15:22	*Emoia cyanogaster*	1
T4Q1	-16.130481	167.197856	141	26/07/2022	14:21	*Emoia cyanura*	3
T4Q1	-16.130481	167.197856	141	26/07/2022	14:21	*Emoia impar*	4
776	-16.129731	167.198028	156	26/07/2022	14:24	*Emoia sanfordi*	2
776	-16.129731	167.198028	156	26/07/2022	14:24	*Emoia impar*	1
T4Q2	-16.126013	167.198198	166	26/07/2022	14:38	*Emoia impar*	1
778	-16.123198	167.197615	156	26/07/2022	14:50	*Nactus multicarinatus*	1
T4Q3	-16.121541	167.197165	173	26/07/2022	15:03	*Frog*	1
779	-16.123771	167.197712	155	26/07/2022	16:23	*Emoia sanfordi*	1
780	-16.128917	167.198957	154	26/07/2022	16:52	*Emoia impar*	2
781	-16.128971	167.198836	154	26/07/2022	16:52	*UnID*	1
LAMU	-16.133784	167.196291	55	26/07/2022	17:07		

2.4 DISCUSSION

2.4.1 CONSERVATION STATUS OF SPECIES SURVEYED

Of the nine species of skink/gecko recorded during this survey, one was considered a Restricted Range species (ie. its global range is less than 10,000 km^2), three were endemic to Vanuatu and all nine are listed as of Least Concern. The frog is listed as Near-threatened, but is considered endemic to Australia, and to have been introduced to Vanuatu (and elsewhere in the region). Only the Hawksbill and Green Turtles, not surveyed during this project but known from historical data to breed on the coastline at both Wiawi and Bamboo Bay, are the only Globally threatened reptiles at the site.

None of the criteria for identifying trigger species for KBAs at either the global or the regional level, are attained by the species surveyed in this project – although one more species could trigger the Small Nambas KBA as regionally important for Ecoregion-restricted species of reptile. The two turtles trigger regional importance for both sites.

2.4.2 SURVEY METHODS

Prior to the survey there was much discussion about the methods used to monitor skink/gecko populations. The most effective method, and used in many Pacific Island countries, is to use sticky traps. These capture skinks/geckos as they walk over the trap. The traps can be visited on a regular basis and the captured animals released (using cooking oil). A second advantage of these traps is that they work equally well at night as during the day. Sticky traps are, however, banned in many countries, including Australia and Europe. The IUCN SSC Skink Specialist Group also object to the use of sticky traps, except under strictly controlled situations. Previous experience with sticky traps and the removal of specimens is that survival rates of specimens released from sticky traps will vary depending on the effectiveness of removal of the sticky solution. This requires considerable expertise. That expertise was not available in Vanuatu – and the ongoing restrictions on travel into the country meant that overseas experts were unable to enter the country and provide training. Any future surveys should consider sticky traps, but only when individuals in country have received appropriate training.

The bottle traps were trialled, based on information from social media. They proved both cumbersome and ineffective. The surveyors trialled these at the quadrats at Tsiri Lagoon but found that far more individuals were located by observation. Subsequently, all records were restricted to observations – with photographs to back up/support the identification (see Annex). One major flaw of this approach is that nocturnal species were not surveyed. It is apparent that comparing numbers across species would be flawed. The most frequently recorded species *Emoia impar*, may merely be the species whose behaviour makes it most easily seen by the surveyors. However, comparing numbers within species is likely to provide useful information on the most densely versus the most sparsely populated areas for each species.

2.4.3 DATA ANALYSIS

Data was collected from two different KBAs (Small Nambas/Bamboo Bay and Wiawi) and a Site of National Importance (Tsiri Lagoon). Tsiri lagoon and Bamboo Bay are in the southwest bay of Malekula while Wiawi/Weilak are in the northwest of Malekula. The data collection location depended on permission to access the land area with the aim of assessing different types of vegetation to have good data of the distribution of each species within a KBA. Southwest Malekula consists mostly of inland water resources such as lagoons, streams, and swamps. This area was moist at all times, particularly with the rainy weather conditions. This may have affected the number of different species living in that area. Comparing Tsiri lagoon with the other 2 KBA, Tsiri had the lowest number of species. Only five species were found, *E. impar, E. cyanura, E, caeruleocuada, E. cyanogaster* and *E. sanfordi. E. imper* was the most abundant and the least abundant was *E. sanfordi*, shown on the represented graph in Figure 1 of population density maybe due to relatively limited variety of habitats. Figure 1 shows the distribution of the different species within the Tsiri lagoon. This shows that *E. impar* and *E. caeruleocauda* are the most widely distributed species throughout the KBA with the other three species more restricted in range.

In comparison, two additional species are found at Bamboo Bay (Small Nambas KBA), *Nactus multicarunatus* and *Gehyra oceanica*, possibly a result of in the change of environmental conditions and the weather. Bamboo Bay had comparatively less inland water-based ecosystems, but was still moist mostly due to a large area of grassland (bamboo) covering the KBA base line. Bamboo bay has primary forest which resulted in some transects having less species found, possibly due to the large trees through which only a little sunlight penetrated. On the other hand, these conditions were suitable habitat for *Nactus multicarinatus* and *Gehyra* oceanica which were found there on rotten, moist logs and in tree bark. This KBA had the highest densities of these two species, compared with the other two KBAs. Figure 2 shows that the most abundant species was E. impar and the least abundant was *Gehyra oceanica*, as shown in the population density graph. Figure 2 also shows the distribution of the different species that were found in the Bamboo Bay KBA, the most widely distributed species was *E. impar* and *E. cyanura*, and the least distributed species was *Nactus multicarinatus.*

Northwest Malekula was quite different from the southwest Malekula area, which was much drier and hotter. Therefore, more species were found due to the good source of direct sunlight which also provided the advantage of easy observation. More individual species are found there than in the southwest KBA and Bamboo Bay. This resulted in three more species being found in this particular KBA. With the goal achieved by finding the tricker species such as *Emoia nigromarginata*. The *E. nigromarginata* was found on a single transect and not found anywhere else within a distribution of 200 m shown on map (Figure 3). The species was very rare to find with a very small population, which can be defined by its population density in Figure 3. *Cryptoblepharus sp. (pulcher?novohebridicus?)* was the second most abundant species, found on the coastal zone, with a very large number in one transect. Reef skinks were found only in the northwest due to the weather conditions there. The map (Figure 3) shows the distribution of the species found on Wiawi KBA. The map shows that the most widely distributed species was *E. sanfordi* and the *E. impar* and the least distributed species was the trickier species, *E. nigromarginata*.

The overall data analysis provides the results of ten different species altogether found throughout the three different priority site assessments. Figure 4 highlights the relative

abundance of different species based on the percent of the total number of reptiles seen. *E. impar* doesn't have a complex habitat requirement, thus the species was most abundant and the most widely distributed of the species. The least abundant was the trigger species E. *nigromarginata* due to its preferred weather conditions and specific habitat.

Apart from different skink species, a frog species was also found and species of snake as well. Therefore, a total of 12 different reptile species were found, 9 in Southwest and 12 in northwest Malekula. In addition, the raw data shows different digits of different species found between the transects in the 3 different KBAs as shown in the geospatial maps without analysis.

2.5 CHALLENGES

- Bad weather – there was too much rain, or it was too cloudy, resulting in less sunlight which are the ideal conditions for visually recording reptiles.
- Time – the time is too short to collect good dataset. This is due to the trip schedule and the limited amount of time spent on each KBA
- Data was not collected at every point of KBA as shown on the Maps – and was not targeted at 'known reptile sites' because there were none. The method, visual observation, is known to be a poor estimate of true reptile densities – and also probably misrepresents the relative densities of different species – *E. impar* is a much more easily detectable reptile than *D. oceanica* – for example.

2.6 RECOMMENDATIONS

- More time is required to obtain a more complete picture of the reptile/herptile fauna at the sites.
- Weather should be checked before the field work as skinks, lizards, etc are much more mobile, and so detectable, in sunny conditions than in overcast or rainy conditions.
- A more effective survey method should be deployed. The use of sticky traps, while not condoned in many countries, can provide very useful information on the numbers of species, and distribution of species across a range of tracks. The deployment of sticky traps should only be used when an experienced collector is available (however was not available for this survey due to restrictions on travel at the time of the survey). Training in the removal of skinks/reptiles from sticky traps should be undertaken and the method judiciously deployed where appropriate to confirm priority species. There are numerous videos on YouTube showing how this can be undertaken. Sticky traps can be deployed for a 24-hour period to get a better estimate of the number and distribution of nocturnal species that are particularly difficult to record during daytime observation studies.
- Confirmation of the identification of some of these.
- Some areas are yet to be discovered.

2.7 TSIRI LAGOON

Table 6: Consists of species' observations collected in the Tsiri Lagoon, southwest Malekula. Three transects (totalling 2,000 m) were established for data collection and only five species were found. These transects ran from 3.8 m to 47.6 m asl.

Scientific & common name	Way points for minimum & maximum elevation	Vegetation & habitats	No. of individuals	Species picture
Azure-tailed Skink (Dark-bellied Copper-striped Skink) *Emoia impar*	Min Elevation: 3.8m asl 167.451891, -16.51145 Max Elevation: 47.6m asl 167.442934, -16.51349	Found in different vegetation - new settlement, Plantations (coconut and cocoa), thickets, dry bushes, muddy or moist soils and swamps. Living in trees and dry logs, dry and green vines as well as running on muddy soil.	55	
Copper-tailed Skink *Emoa cyanura*	Min Elevation: 3.8m asl 167.45189, -16.51145 Max Elevation: 28.4 m asl 167.44302, -16.512782	Vegetation - Cocoa and the coconut plantation, cultivated lands (gardens), and thickets. Usually found on dry bushes and logs.	13	

Pacific bluetail Skink *Emoa caeruleocauda,*	Min Elevation: 4.0m asl 167.451935, -16.51154 Max Elevation 47.6m asl 167.442934, -16.51349	Cocoa and the coconut plantation, cultivated lands (gardens) and thickets. Found on dry and green bushes (vines and branches) and on the muddy soil. Also spotted in the swamps and on the lagoon shore.	11	
Emoa cyanogaster	Min Elevation: 9.6m asl 167.442894, -16.51221 Max Elevation: 26.3m asl 167.440584, -16.50865	Found in thickets mostly green bushes, new settlements and cultivated lands. Spotted in bush houses and on trees near new settlements as well on crops in gardens.	5	 Image 4: *E.Cyanogaster*
Sanford's Emo Skink (Green Skink) *Emoa sanfordi*	Elevation: 46.9m asl 167.442913, -16.51334	Usually seen in Plantations and green tickets with tall shrubs. Spotted on tall tree trunk and branches.	2	 Image 5: *E. Sanfordi*

2.8 BAMBOO BAY KBA

Table 7: Provides the analytic data for Bamboo Bay KBA, southwest Malekula in 6 transects (3000 m in length). Transects ranged from 7.5 m asl to 510 m asl. Only 7 species were recorded.

Scientific & common name	Way points for minimum & maximum elevation	Vegetation & habitats	No. of individuals	Species picture
Azure-tailed Skink *Emoia impar*	Min Elevation 7.5m asl 167.39009, -16.3659 Max Elevation 511.7m asl 167.464385, -16.36019	Grass land, primary and secondary forest, cultivated lands, thickets, lakeside, rivers and coastal beach. The species was observed on dry and green bamboos, small bushes and near the swamps on muddy soil.	134	
Copper-tailed Skink *Emoa cyanura*	Elevation 13.5m asl 167.388552, -16.36224 Elevation 294.8m asl 167.422223, -16.42149	Grass land, primary and secondary forest, thickets, lake, rivers, cultivated lands and coastal beach. Species mostly found on the dry bamboos, dry wood's bucks, and on trees or plants near the swamps and on the crawling plants and dry logs on the beach.	23	

Pacific Bluetail Skink *Emoa caeruleocuada*	Min Elevation 283.8m asl 167.422396, -16.41985 Max Elevation 294.9 167.422223, -16.42149	Grass land, primary and secondary forest, plantation, thickets, cultivated lands, rivers and lake. Found in small green bushes or thickets, on bamboos and on the soil with crawling plants.	11	
Emoa cyanogaster	Min Elevation 270.9m asl 167.421198, -16.42133 Max Elevation 294.5m asl 167.422054, -16.42152	Cultivated land, river side and new settlements. *E. cynogaster* live on crops leaves and stems, trees near cultivated land and small green bushes (vines and tree leaves) on the river side.	20	
Sanford's Emo Skink (Green Skink) *Emoa sanfordi*	Min. Elevation 267.8m asl 167.421126, -16.42090 Max Elevation 305.8m asl 167.422367, -16.42075	Grass land, primary and secondary forest, plantation, thickets, cultivated lands, rivers and lake. The species was observed on tall tree trunks and coconut trunks.	4	

Melanesian Hook-toed Gecko *Nactus multicarinatus*	Min Elevation 161.0m asl 167.412578 -16.418085 Max Elevation 267.8m asl 167.421126, -16.42090	Grass land, cultivated land, primary, secondary forest and plantation. Found on dead logs and dry woods with moist material. Also found on crops like banana plant and on short trees that have lots of leaves with veins.	4	
Pacific Dtella *Gehyra oceanica (?vittatus?)*	Elevation 11.3 m asl 167.390378, -16.36637	Cultivated land. Found on dead logs, banana leaves, on crops like banana and on short trees with lots of leaves with veins.	1	

2.9 WIAWI KBA

Table 8: Data analysis for north west Malekula (Wiawi & Weilak) showing each species information within 6 transects (3,000 m in length). Nine different species are found in this KBA.

Scientific & common name	Way points for minimum & maximum elevation	Vegetation & habitats	No. of individuals	Species picture
Azure-tailed Skink *Emoia impar*	Min Elevation 16.0m asl 167.190809, -16.13768 Max Elevation 160.0m asl 167.1762, -16.091144	Plantation (dry coconut plantation) thickets, grassland (bamboo) dry forest (cassis), Rivers and creeks, cultivated lands and lake. Found on all plants, on the ground and on the stones near the river	57	
Copper-tailed Skink *Emoia cyanura*	Min Elevation 15.3m asl 167.192474, -16.13743 Max Elevation 148.4m asl 167.174776, -16.09082	Plantation (dry coconut plantation) thickets, grassland (bamboo) dry forest (cassis), Rivers and creeks, cultivated lands and lake. Found on all plants, on the ground and on the stones near the river	19	

Pacific bluetail Skink *Emoia caeruleocauda*		Plantation (dry coconut plantation) thickets, grassland (bamboo) dry forest (cassis). Found on green and dry logs, small plant bushes	8	
Teal Emo Skink *Emoia cyanogaster*		Cultivated land, river side and new settlement. *E. cyanogaster* live on crops, leaves and stems, trees near the cultivated land and small green pushes (vines and tree leaves) on the river side	6	
Sanford's Emo Skink (Green Skink) *Emoia sanfordi*	Min Elevation 16.4m asl 167.192472, -16.13704 Max Elevation 32.3m asl 167.190496, -16.13061	Plantation (dry coconut plantation) tickets, grass land (bamboo) dry forest (cassis), Rivers and creeks, cultivated lands and lake. Seen on the tall trees stem and on coconuts	5	

Nactus multicarinatus	Min elevation 47.4m asl 167.188127, -16.12863 Max Elevation 155.6m asl 167.197615, -16.12320	Lake, dry forest, plantation and tickets. Found on dry moist logs near the lake and in the coconut plantation and small wet pushes	5	
Pacific Dtella *Gehyra oceanica? vittatus?*		Lake, dry forest, plantation and tickets. Found on dry moist logs near the lake and in the coconut plantation and small wet pushes	3	
Snake-eyed Skink *Cryptoblepharus sp (pulcher?/* *novohebridicus?)*	Min Elevation 16.8m asl 167.192845, -16.13662 Max Elevation 48.8m asl 167.18901, -16.129835	Sea coast and coconut plantation near the sea. They were found on rocks, grass, coconut stems, dry logs and plants/trees near the sea.	31	

Black-bordered emo Skink, or Vanuatu Silver Vineskink *Emoia nigromarginata*	Min Elevation 32.3m asl 167.190496, -16.13061 Max Elevation 44.6m asl 167.188726, -16.12949	Dry forest. *E. nigromarginata* was observed on dry and green trees with brown bark color and dry brown vines	5	

Chapter III

Malekula Bird Survey Report

3.1 SUMMARY

A bird survey, led by Toara Andrew Morris of EcoLifelihood Development Association, took place in July 2022 on Malekula as part of a broader Biodiversity Rapid Assessment Programme (BIORAP). The survey was undertaken in two Key Biodiversity Areas, Small Nambas (KBA ID 44721 – subsequently referred to, in this report as Bamboo Bay) and Wiawi (KBA ID 44726) and a third site, adjacent to Small Nambas, Tsiri. The legacy trigger species for both Small Nambas and Wiawi are the Dark-brown Honeyeater, Yellow-fronted White-eye, Vanuatu Kingfisher and Fan-tailed Gerygone. In addition, the Vanuatu Flying Fox is listed as the sole, non-avian, trigger species. Currently the World Database for Key Biodiversity Areas lists these species as 'not triggering KBA criteria'. This project aims to determine whether this is valid.

The purpose of the survey was to collect information to assist the chiefs and communities of Malekula to confirm the presence of these trigger species for the Legacy KBAs and to determine if the KBAs should be modified in any way.

The Wiawi KBA is located at the north-western end of Malekula and occupies just under 43 km^2 of land (4,297 ha) that rises from sea level to the top of the ridge (575m asl). The legacy KBA was identified in 2012, with the Dark-brown Honeyeater, Vanuatu kingfisher, Fan-tailed Gerygone and Yellow-fronted White-eye as the four avian trigger species listed. The more quantitative, and rigorous set of standards for KBAs, established in 2016, means that, of these species only the Kingfisher is likely to persist as a trigger. Further improved data on these, and other bird species, is required to confirm Global KBA status of the site.

The Small Nambas KBA at the south-western end of Malekula Island is a slightly larger site, occupying just over 215 km^2 (21,511 ha). This site rises from sea level to a ridge at 620 m asl. The legacy KBA was identified in 2012, with the Dark Brown Honeyeater, Vanuatu Kingfisher, Fan-tailed Gerygone and Yellow-fronted White-eye all listed as avian trigger species for the site. These, and a number of other species should, if present on the site, qualify under the 2016 KBA Standard. The present study will confirm if these species are, indeed, present.

The third site, Tsiri, was identified by the field team as an interesting site to include in the survey. It is located immediately south of the Small Nambas KBA and covers c15 km^2 of land, from sea level to c150m asl. It is located around the Tsiri Lagoon which is a large extension of water inland and includes the villages of Lembinwen and Wintua on the coast. The size of the site means that there are unlikely to be any avian trigger species. It is possible that the Small

Nambas KBA and the Tsiri site could be merged – although this would depend on whether the combined site could be managed as a single unit, which is a decision that would need to be made locally.

The bird identification team spent approximately ten days undertaking 83 point counts at stations each 200 m apart, 40 at Bamboo Bay, 23 at Tsiri and 20 at Wiawi. Each station was assessed to landuse type, of which five types were recognised: Cultivated Land and Pastures (31 stations), Sub/Tropical Forests (37 stations), Littoral Zones, Water Areas and Lagoons (7 stations), Rocky Areas (1 station) and Sub/Tropical Grasslands and Savannas (7 stations). Bird survey forms were used to collect information on bird species, location, time and type of identification (recordings were by sight, or by sound) and the number of a species at each station as well as the vegetation type and other observations. Cameras were used to obtain photos, sounds were recorded and a GPS unit was used to determine the coordinates for identification waypoints.

This survey identified 40 bird species and all but three of the species were associated with the bush (Australasian Grebe, Pacific Black Duck and Pacific Reef-egret were all on, or adjacent to, the lagoon). This represented some 43% of Vanuatu's 87 species, or 77% of Vanuatu landbirds. Five endemic species: the Vanuatu Scrubfowl, Tanna Fruit Dove, Buff-bellied Monarch, Vanuatu Streaked Fantail and Yellow-bellied White-eye were confirmed as present in the KBA and were widespread across all habitats surveyed. One of these species, the Vanuatu Scrubfowl, is globally threatened.

Our analysis of potential KBA trigger species concluded that the Wiawi KBA is too small to hold large enough populations of any of the proposed bird trigger species.

3.2 BACKGROUND

Malekula Island is in the MALAMPA province of the Vanuatu Archipelago. The MALAMPA province comprises 3 main islands, Malekula, Ambrym and Paama. Malekula is the second largest island in Vanuatu. Total area of the island is 2,041 km2 – with the highest point, Mt Liambele, being 879 m asl. It is separated from Espiritu Santo, to the north, by the Bougainville Straits. The interior of Malekula is mountainous, rugged and forest-covered. It forms part of 'the Western Belt' group of islands (Espiritu Santo, Malekula and the Torres Islands group) – that are geologically older than the rest of Vanuatu.

The 2009 census estimated the total Malekula population to be around 23,000 individuals. There are two towns on Malekula, Norsup in the north and Lakatoro in the south. Most people live in small, rural, villages surviving on subsistence agriculture and cash crops. The island has extensive copra plantations around the eastern coastal towns, with the largest copra plantation in Vanuatu is in Norsup. Lakatoro is the site of the islands main wharf, and the administration centre of the MALAMPA province.

Carrying out this survey was vital to the local community as they are working towards conserving some parts of their land for water catchment purposes. Making such information available to the local communities would help them to make better decisions towards protecting and conserving their natural resources.

3.3 METHODS

The bird survey team used the ORNITO mobile application to assist with carrying out bird identification as well as relying on expert local knowledge of the Malekula team members. The team members were briefed about the survey procedures prior to and during the actual survey.

The surveyors used standard forms (Annex 1) to record the species of bird they directly heard or saw for five minutes and used a recorder (Zoom H5) to record the sounds of birds they were unsure about for later validation. 83 point counts were taken at intervals between 200 and 500 metres along the tracks. The timing of surveys was during early morning, between 5:30 am and 10:00 am, and during the late afternoon and early evening between 3 pm and 5:30 pm. Bird sounds could be recorded up to 200 metres away from each waypoint.

If we assume that this is the case, we can calculate that the area surveyed at each waypoint station is πr^2 – where π=22/7, r=0.2 km, therefore area is 0.126 km^2.

a) We surveyed 40 waypoint stations in the Small Nambas KBA in total, representing 5.01 km^2 of land surveyed, c2.3% of the total land area of the KBA.

b) We surveyed 20 waypoint stations in the Wiawi KBA representing 2.51 km^2 of land surveyed, 5.9% of the total area of land in the KBA.

c) We surveyed 23 waypoint stations in the Tsiri site, representing 2.89 km^2 of land surveyed, some 19% of the total area of the site.

Note that this is likely to be an overestimate as many of the species were unlikely to been heard far as 200 m from the recorder. In these circumstances, the area actually surveyed per station would be reduced, and so the proportion of the KBA covered likewise reduced. Therefore, this would result in an underestimation of the total number of birds considered to be present in the KBA. Until better distance-sampling data is obtained, this kind of calculation is needed to derive a population estimate for the site.

The latitude/longitude and altitude at all waypoints for each station were recorded using a GPS unit and transferred to paper and Excel worksheet. The waypoints were mapped (Figures 2 to 4) to show the distribution.

Figure 24: Map of bird survey locations at Bamboo Bay.

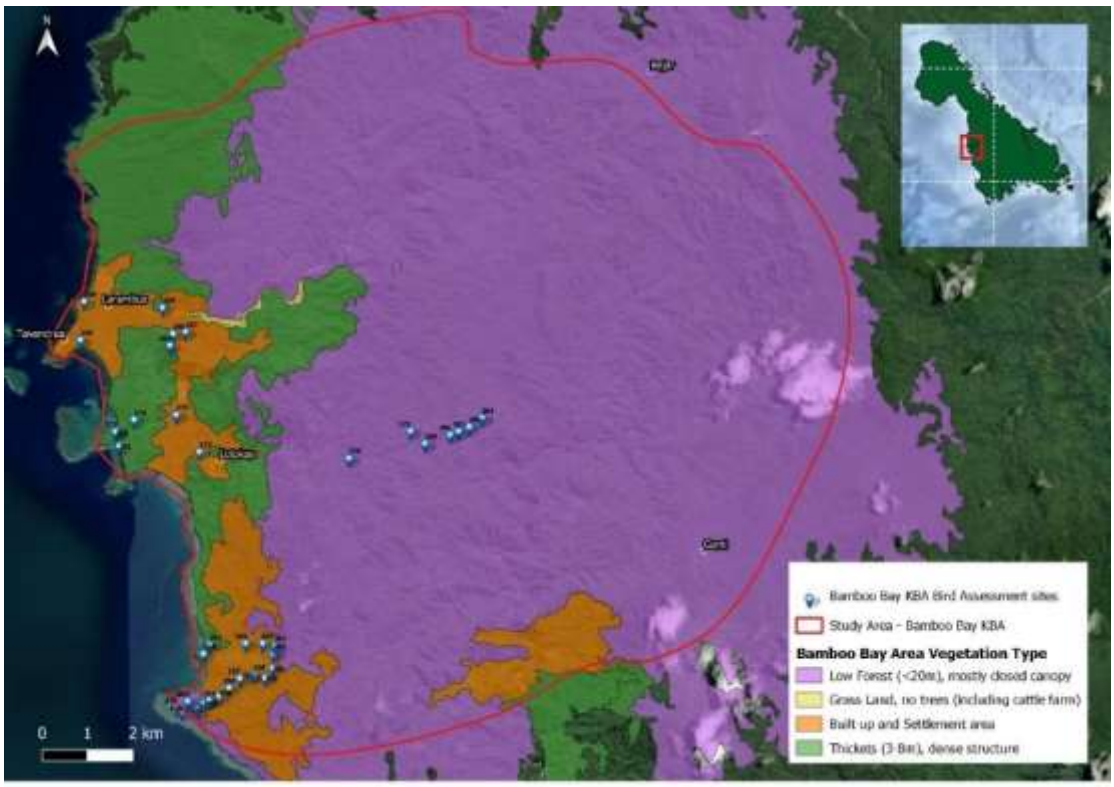


Figure 25: Map of Wiawi KBA, showing location of Point Count Stations.

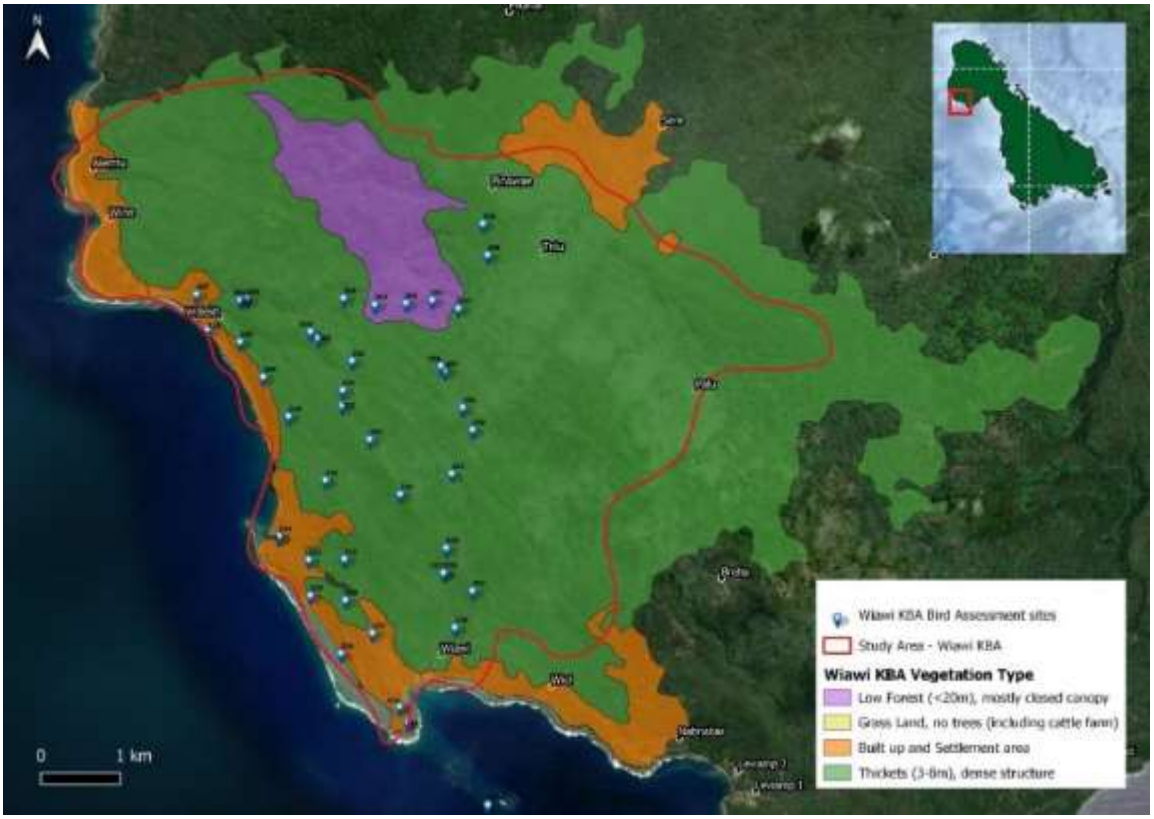
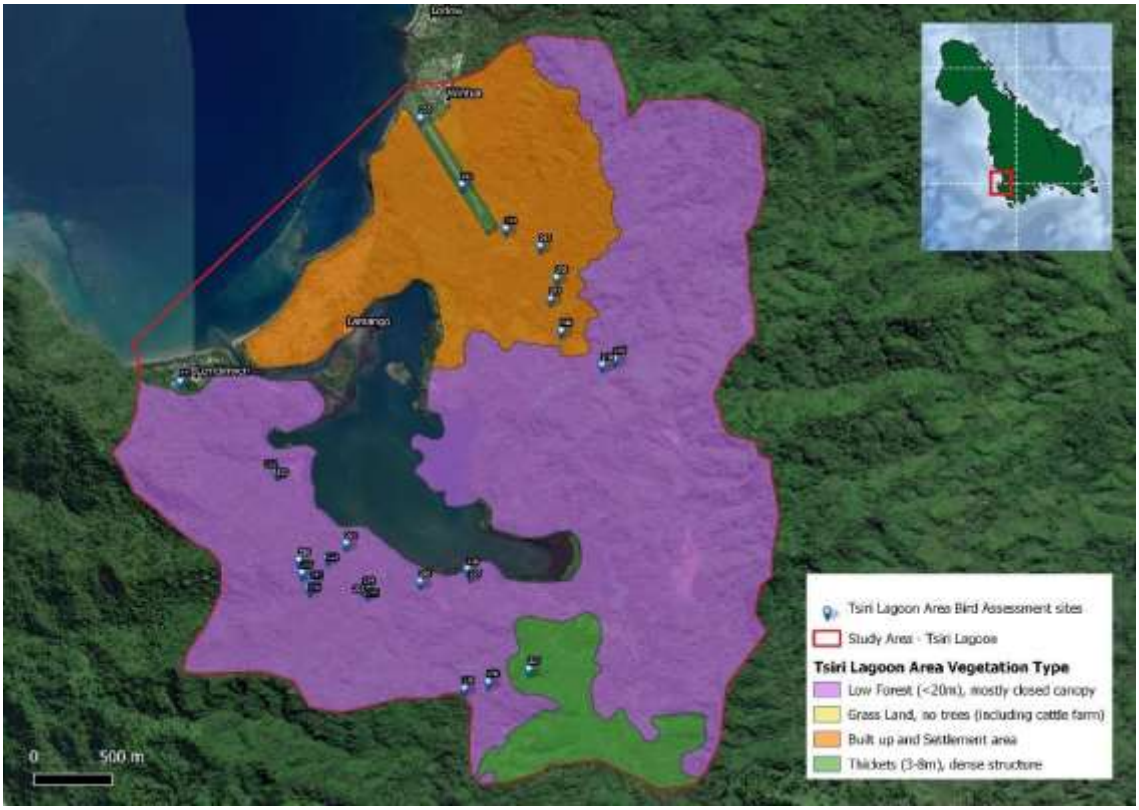


Figure 26: map of tsiri lagoon, showing location of point count stations.



3.4 RESULTS

The survey team recorded 2625 birds during field work on Malekula and confirmed the presence of 42 land bird species (Table 1). Five of Vanuatu's ten endemic species were recorded, Vanuatu Scrubfowl (*Megapodius layardi*), Yellow-bellied White-eye (*Zosterops flavifrons)*, Tanna Fruit-dove, (*Ptilinopus tannensis),* Buff-bellied Monarch *(Neolalage banksiana) and* Vanuatu Streaked Fantail *(Rhipidura spilodera).* Only one of these species is globally threatened – the Vanuatu Scrubfowl.

Table 9: The number of individuals of each species recorded during the survey (both the number of individuals seen during point count surveys and the total numbers recorded).

Species Name	Scientific Name	IUCN Red List	No. of individuals
Vanuatu White-eye[E]	*Zosterops flavifrons*	LC	232(328)
Cardinal Myzomela[N]	*Myzomela cardinalis*	LC	161(206)
Golden Whistler[N]	*Pachycephala pectoralis*	LC	143(202)
Red-bellied Fruit-dove[N]	*Ptilinopus greyi*	LC	182(200)
Grey-eared Honeyeater[N]	*Lichmera incana*	LC	135(180)
Pacific Imperial-pigeon[N]	*Ducula pacifica*	LC	129(170)
Coconut Lorikeet[N]	*Trichoglossus haematodus*	LC	79(161)
Glossy Swiftlet[N]	*Collocalia esculenta*	LC	49(142)
Collared Kingfisher[N]	*Todiramphus chloris*	LC	75(105)
Melanesian Flycatcher[N]	*Myiagra caledonica*	LC	57(90)
Silvereye[N]	*Zosterops lateralis*	LC	58(70)
Pacific Black Duck[N]	*Anas superciliosa*	LC	6(69)
Tanna Fruit-dove[N]	*Ptilinopus tannensis*	LC	47(68)
Red Junglefowl[INT]	*Gallus gallus*	LC	49(68)
Brown-capped Emerald Dove[N]	*Chalcophaps longirostris*	LC	42(58)
South Melanesian Cuckooshrike[N]	*Coracina caledonica*	LC	40(57)
Grey Fantail[N]	*Rhipidura albiscapa*	LC	29(56)
Vanuatu Streaked Fantail[E]	*Rhipidura spilodera*	LC	30(52)
Vanuatu Kingfisher[E]	*Todiramphus farquhari*	NT	34(51)
Chestnut Munia[INT]	*Lonchura atricapilla*	**LC**	17(42)
Buff-bellied Monarch[E]	*Neolalage banksiana*	**LC**	36(40)
Fan-tailed Gerygone[N]	*Gerygone flavolateralis*	**LC**	15(31)
Australasian Grebe[N]	*Tachybaptus novaehollandiae*	**LC**	4(27)
Vanuatu Scrubfowl[E]	*Megapodius layardi*	VU	12(25)
Long-tailed Triller[N]	*Lalage leucopyga*	LC	14(25)
Uniform Swiftlet[N]	*Aerodramus vanikorensis*	LC	12(24)

Buff-banded Rail[N]	*Hypotaenidia philippensis*	LC	10(22
Mackinlay's Cuckoo-dove[N]	*Macropygia mackinlayi*	LC	9(15)
White-breasted Woodswallow[N]	*Artamus leucoryn*	LC	4(12)
Metallic Pigeon[N]	*Columba vitiensis*	LC	9(11)
Island Thrush[N]	*Turdus poliocephalus*	LC	7(10)
Chestnut-breasted Mannikin[INT]	*Lonchura castaneothorax*	LC	7(7)
White-rumped Swiftlet[N]	*Aerodramus spodiopygius*	LC	0(6)
Swamp Harrier[N]	*Circus approximans*	LC	3(6)
Pacific Reef-egret[N]	*Egretta sacra*	LC	0(6)
House Swallow[N]	*Hirundo javanica*	LC	0(4)
Southern Shrikebill[N]	*Clytorhynchus pachycephaloides*	LC	4(4)
Brown Goshawk[N]	*Accipiter fasciatus*	LC	3(3)
Purple Swamphen[N]	*Porphyrio porphyrio*	LC	1(3)
White-browed Crake[N]	*Amaurornis cinerea*	LC	2(2)
Vanuatu Imperial-pigeon[E]	*Ducula bakeri*	LC	1(1)
Peregrine Falcon[N]	*Falco peregrinus*	LC	1(1)

Table 10: The number of individuals, the number of occupied stations and the estimated number of individuals present for each of the three sites (population estimates only presented when species is recorded at more than one station within the site).

Species Name	Bamboo Bay		Tsiri		Wiawi	
Vanuatu White-eye	143(30)	6,000	34(10)	175	55(13)	950
Cardinal Myzomela	89(23)	3,800	39(15)	200	33(14)	550
Golden Whistler	69(22)	2,950	40(15)	200	34(13)	600
Red-bellied Fruit-dove	90(34)	3,850	34(19)	175	58(21)	1,000
Grey-eared Honeyeater	67(18)	2,850	63(11)	325	5(3)	75
Pacific Imperial-pigeon	70(26)	3,000	39(20)	200	20(10)	350
Coconut Lorikeet	21(6)	900	49(5)	250	12(6)	200
Glossy Swiftlet	6(2)	250	29(3)	150	14(7)	250
Collared Kingfisher	35(21)	1,500	27(14)	150	13(9)	225
Melanesian Flycatcher	28(15)	1,200	18(11)	100	11(6)	200
Silvereye	20(5)	850	0	0	38(11)	650
Pacific Black Duck	5(1)		1(1)		0	
Tanna Fruit-dove	12(5)	500	11(7)	50	24(10)	400
Red Junglefowl	25(13)	1,050	14(9)	75	10(7)	175
Brown-capped Emerald Dove	12(8)	500	22(14)	125	8(7)	125
South Melanesian Cuckooshrike	18(15)	775	8(5)	40	14(11)	250

Grey Fantail	14(9)	600	8(6)	40	7(6)	125
Vanuatu Streaked Fantail	22(13)	950	8(5)	40	0	
Vanuatu Kingfisher	14(9)	600	17(10)	100	3(3)	50
Chestnut Munia	7(1)		5(3)	25	5(1)	
Buff-bellied Monarch	16(6)	700	0		20(9)	350
Fan-tailed Gerygone	14(8)	600	0		1(1)	
Australasian Grebe	4(1)		0		0	
Vanuatu Scrubfowl	4(3)	175	7(5)	35	1(1)	
Long-tailed Triller	14(7)	600	0		0	
Uniform Swiftlet	0		1(1)		11(2)	125
Buff-banded Rail	1(1)		8(4)	40	1(1)	
Mackinlay's Cuckoo-dove	5(4)	225	1(1)		3(3)	50
White-breasted Woodswallow	4(2)	175	0		0	
Metallic Pigeon	3(3)	125	6(4)	30	0	
Island Thrush	5(4)	225	1(1)		1(1)	
Chestnut-breasted Mannikin	7(1)		0		0	
Swamp Harrier	1(1)		2(2)	10	0	
Southern Shrikebill	4(3)	175	0		0	
Brown Goshawk	1(1)		1(1)		1(1)	
Purple Swamphen	0		1(1)		0	
White-browed Crake	0		2(1)		0	
Vanuatu Imperial-pigeon	0		1(1)		0	
Peregrine Falcon	0		0		1(1)	

Table 11: The number of point count stations in each of across the 3 sites in Malekula.

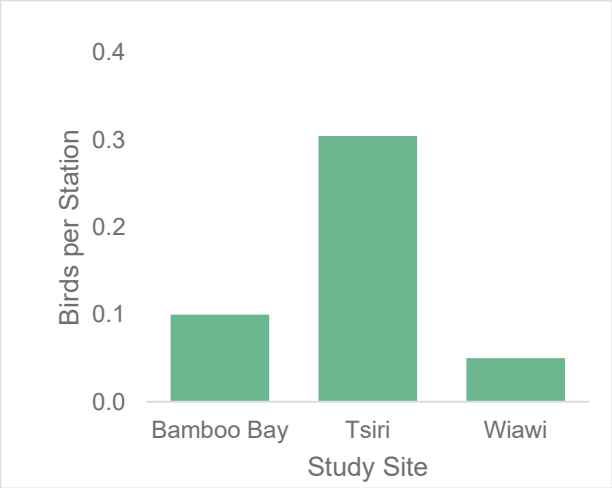
Habitat Types	Bamboo Bay	Tsiri	Wiawi	Total
Cultivated land and pastures	8	13	10	31
Littoral zones, wetlands and lagoons	5	2		7
Rocky areas			1	1
Sub/tropical forests	21	8	8	37
Sub/tropical grasslands and savannas	6		1	7
Grand Total	**40**	**23**	**20**	**83**

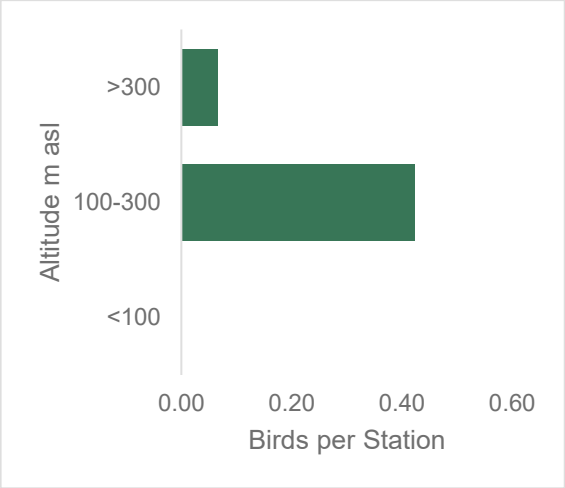
It can be seen from Table 3 that over half of the Bamboo Bay stations were located in forested areas, while at least half of the Tsiri and Wiawi stations were located in Cultivated Land and asture.

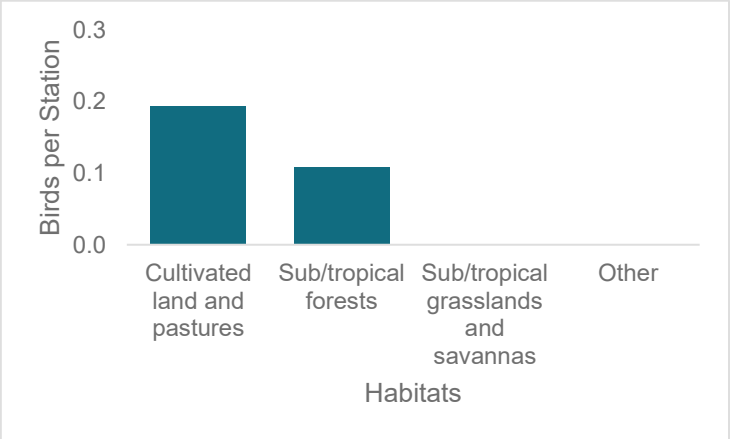
3.5 SPECIES ACCOUNTS

Vanuatu Scrubfowl (Megapodius layardi) IUCN Red List (2022) Vulnerable

This species is endemic to Vanuatu. The total population is estimated as 2,500 to 9,999 individuals. Therefore, 1% of this population would be represented by 62 mature individuals. In addition, the species has an estimated global range of just 6,445 km^2. Vanuatu Scrubfowl is therefore considered to be a Restricted Range species.







1. Four birds were recorded on the 5-minute point count at Bamboo Bay (n=40 sites), 7 at Tsiri (n=23) and 1 at Wiawi (n=20). Overall, 15, 9 and 1 birds were recorded at the sites.
2. All Vanuatu Scrubfowl records were of calling birds. Birds were estimated to be up to 150 m from the station.
3. Vanuatu Scrubfowl were not recorded, on 5-minute point counts, at stations below 100 m asl.
4. Perhaps surprisingly, more scrubfowl were recorded on cultivated land than in Tropical Forests.

5. 75% of habitat at Bamboo Bay was occupied by Vanuatu Scrubfowl (with more birds present than was indicated by the point counts). The area of Lower Nambas KBA is 214 km^2 – 75% of this would equate to c160 km^2 – or 2.5% of the global range of the species. We recorded 15 individuals overall at the site. On the assumption that the call can be recorded up to 150 m from the observer, we can estimate that we surveyed 1.32% of the total area of the KBA. If we assumed that the 4 individuals was an accurate estimate of the density of the species that would suggest that there were c300 mature individuals that can be considered to be at least 150 reproductive units. Vanuatu Scrubfowl, therefore, qualifies as a trigger species at Small Nambas KBA under criteria A1b(i,iv) and as a contributory species to B2 (Avian).
6. 90% of habitat at Wiawi is occupied by Vanuatu Scrubfowl (although only one of the 20 stations reported the bird at any stage). Wiawi KBA is 43 km^2 – 90% of 43 is c39 km^2. This is just 0.6% of the global range of the species. Vanuatu Scrubfowl, therefore, does not qualify as a trigger species at Wiawi.

Red Junglefowl (Gallus gallus) IUCN Red List (2022) Least Concern

The Red Junglefowl was historically introduced to Vanuatu from S.E. Asia. The species is established throughout the Pacific islands, although differentiation between farmyard birds, feral and truly wild individuals is difficult to assess. The global population size has not been assessed, while the species range clearly exceeds 50,000 km^2. The species does not qualify as a KBA trigger species in Vanuatu under any criteria.

25 birds were recorded on the 5-minute point count at Bamboo Bay (n=40 sites), 14 at Tsiri (n=23) and 10 at Wiawi (n=20). Overall, 37, 17 and 11 birds were recorded at the sites. 95% of all Red Junglefowl records were of calling birds. Birds were estimated to be up to 300 m from the station.

Pacific Black Duck (Anas superciliosa) IUCN Red List (2022) Least Concern

Indigenous to Vanuatu, the Pacific Black Duck ranges from Indonesia, Timor Leste and Australia in the west to French Polynesia and the Cook Islands in the east. The global population is estimated as between 180,000 and 1,200,000 individuals. 1% of this population can be considered to be 6,900 mature individuals. The species range clearly exceeds 50,000 km^2. The species may qualify, under category D1, Demographic Aggregations, if the site population exceeds 1% of the global population.

Five individuals were recorded at one site on Bamboo Bay during the 5-minute point counts. In addition, a single bird was recorded at Tsiri but no birds at Wiawi. Overall, at least 45 birds were recorded at three sites in Bamboo Bay with two birds at adjacent sites at Tsiri. The majority of birds were recorded in the 'Water areas and Wetlands' habitat at Bamboo Bay, although birds were also seen in the 'littoral zones and lagoons' and, at Tsiri, in the 'cultivated land and pastures' habitat category.

The numbers reported are well short of the minimum required for the species to be considered as a KBA trigger species.

Australasian Grebe (Tachybaptus novaehollandiae) IUCN Red List (2022) Least Concern

Indigenous to Vanuatu, this species is distributed from Indonesia and Timor-Leste in the west through Australia, Papua New Guinea, Solomon Islands and New Caledonia to Vanuatu and

New Zealand in the East. The global population has not been estimated, the Extent of Occurrence (in the breeding season) is 27,200,000 km^2. Clearly the range exceeds 50,000 km^2. This species does not qualify as a trigger species for KBAs in Vanuatu under any criteria.

Four individuals were recorded at one site at Bamboo Bay during the 5-minute point counts. Overall, a minimum of 5 birds were seen at one station, and 4 at a second station at Bamboo Bay. All birds were seen. Both stations are in 'Water areas and wetlands' habitat, and both are in the 'less than 100m asl' altitudinal zone.

Metallic Pigeon (Columba vitiensis) IUCN Red List (2022) Least Concern

Indigenous to Vanuatu, this species occurs from S.E. Asia east through to Samoa. The global population has not been quantified, although its Extent of Occurrence has been estimated at 18.2million km^2. The species does not qualify as a Range Restricted Species and, accordingly, does not qualify as a trigger species for KBAs in Vanuatu under any criteria.

Six birds were recorded, at four point count stations, at Tsiri and 3 birds were recorded at three point count stations on Bamboo Bay (with another pair recorded while walking between stations). All but one bird were recorded on sight, this species is often quiet and unobtrusive and so is likely to be under-recorded using this method.

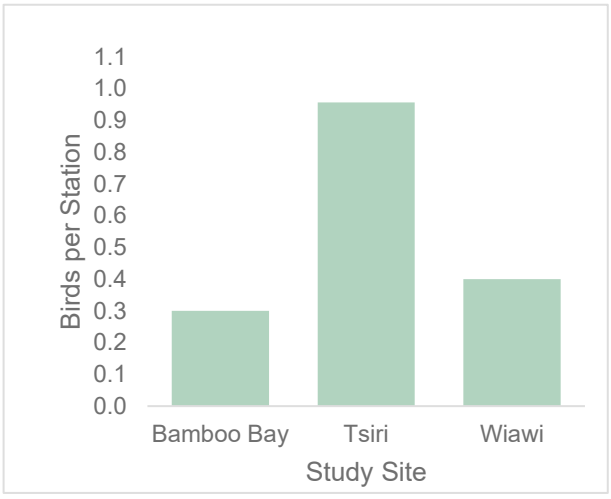
Mackinlay's Cuckoo-dove (Macropygia mackinlayi) IUCN Red List (2022) Least Concern

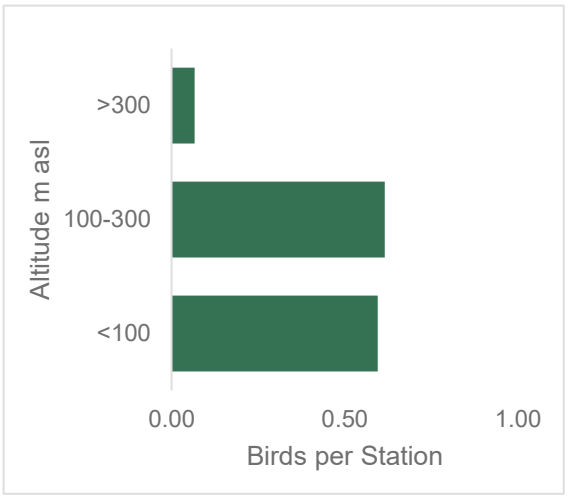
Indigenous to Vanuatu, this species can also be found in Papua New Guinea and the Solomon Islands. The global population has not been quantified, although the global range has been estimated at 54,490 km^2 – so the species does not qualify as a Restricted Range species. Accordingly, the species does not qualify as a trigger species for KBAs in Vanuatu under any criteria.

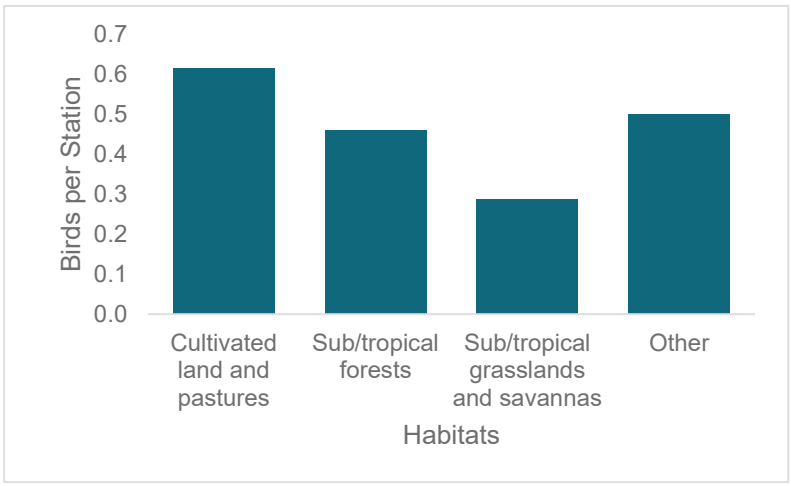
Five birds were recorded, at four point count stations, at Bamboo Bay, with a further four birds at three locations outside of the point count surveys. 3 birds were recorded, one at each of three point count locations at Wiawi.

Brown-capped Emerald Dove (Chalcophaps longirostris) IUCN Red List (2022) Least Concern

Indigenous to Vanuatu, this species also occurs from Timor Leste in the west, through northern Australia and New Guinea, to Solomons, New Caledonia and Vanuatu to the east. The estimated Extent of Occurrence is in excess of 12 million km^2 – the species does not qualify as restricted in range. Accordingly, it does not qualify as a KBA trigger species under any criteria.



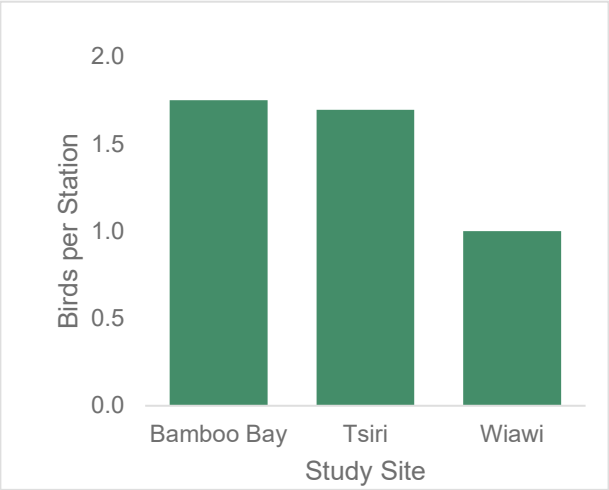


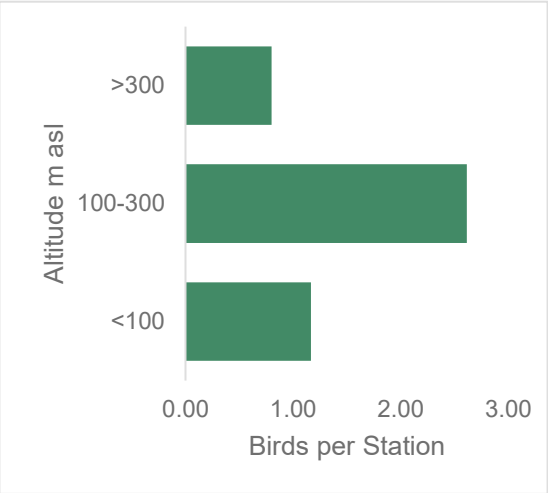


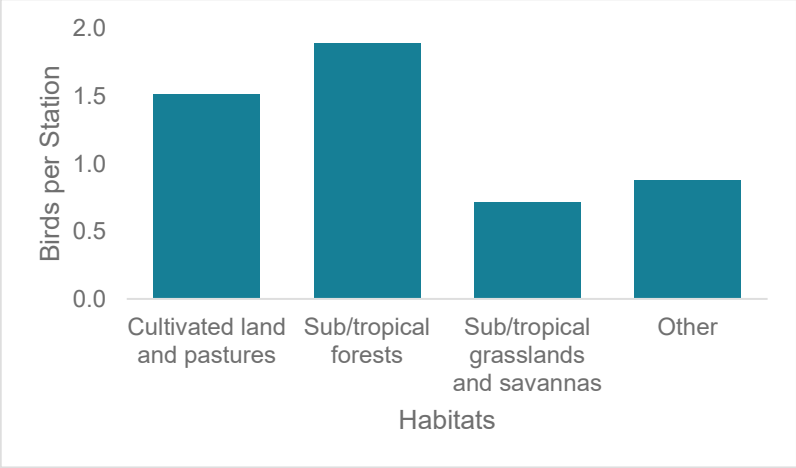
1. 12 birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), 22 at Tsiri (n=23) and 8 at Wiawi (n=20). Overall, 25, 28 and 8 birds were recorded at the sites.
2. 56% of Brown-capped Emerald Dove records were of birds seen. Birds seen were estimated to be up to 40 m from the station, while birds heard were estimated as up to 140 m from the site.
3. Brown-capped Emerald Dove records were primarily below 300 m asl. The density above that site was just over 10% of the density below 300 m asl.
4. Brown-capped Emerald Dove records were evenly spread across all 4 main habitat types.
5. Brown-capped Emerald Dove is a Least Concern species with a large global range. Accordingly it does not qualify as a trigger species for either KBA.

Pacific Imperial-pigeon (Ducula pacifica) IUCN Red List (2022) Least Concern

Indigenous to Vanuatu. Distribution from the small islands off the PNG coast eastwards as far as American Samoa, Niue and the Cook Islands. Global range, based on extent of land, is estimated at 29,566 km^2 – indicating that the Pacific Imperial-pigeon can be classed as a Range restricted species.







1. Seventy birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), 39 at Tsiri (n=23) and 20 at Wiawi (n=20). Overall, 104, 44 and 22 birds were recorded at the sites.
2. Two thirds of Pacific Imperial-Pigeon records were of calling birds. Birds were estimated to be up to 150 m from the station. Even birds seen were first recorded at this distance from the station.
3. Pacific Imperial-pigeon were recorded, on five-minute point counts, at all stations, with maybe twice the density on mid-range, 100-300 m asl compared with higher or lower sites.
4. Pacific Imperial Pigeons were recorded on all habitats – with a preference for cultivated and tropical forested habitats.
5. 100% of habitat at Bamboo Bay was occupied by Pacific Imperial-pigeon. The area of Lower Nambas KBA is 214 km^2. This represents just 0.54% of the global range of the species. Accordingly, the species does not qualify as a trigger species at Small Nambas KBA.

6. 100% of habitat at Wiawi is occupied by Pacific Imperial-pigeon. Wiawi KBA is 43 km^2. This is just 0.15% of the global range of the species. Pacific Imperial-pigeon, therefore, does not qualify as a trigger species at Wiawi.

Vanuatu Imperial-pigeon (Ducula bakeri) IUCN Red List (2022) Least Concern

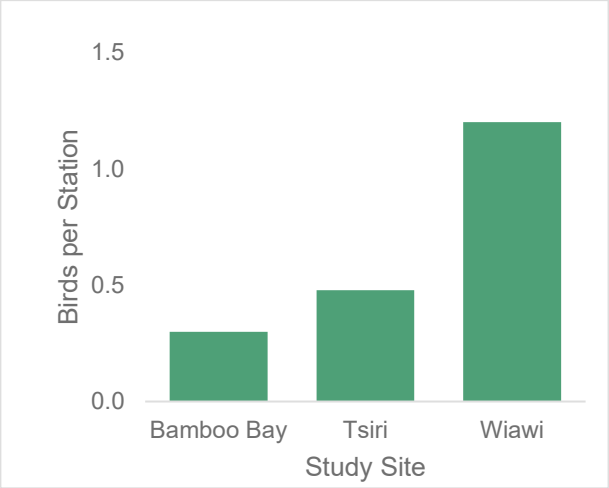
Endemic to Vanuatu, the distribution within Vanuatu is from the Banks Islands in the north to Ambrym in the south. Not previously reported for Malekula. The global population is estimated as 2,500 to 23,000 mature individual birds, while the global range is 4,128 km^2. The species can qualify as a contributory species to the B2, range restricted Avian species list.

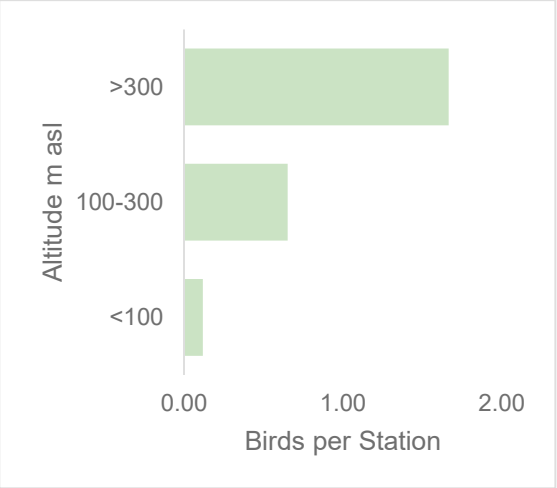
A single, distant bird was heard at one of the point count stations at Tsiri. The site is a lowland, wetland site, while the species is generally considered to be a high-altitude species on the large islands. This record would appear to be rather dubious and would need confirmation before being accepted as potentially the first record for Malekula.

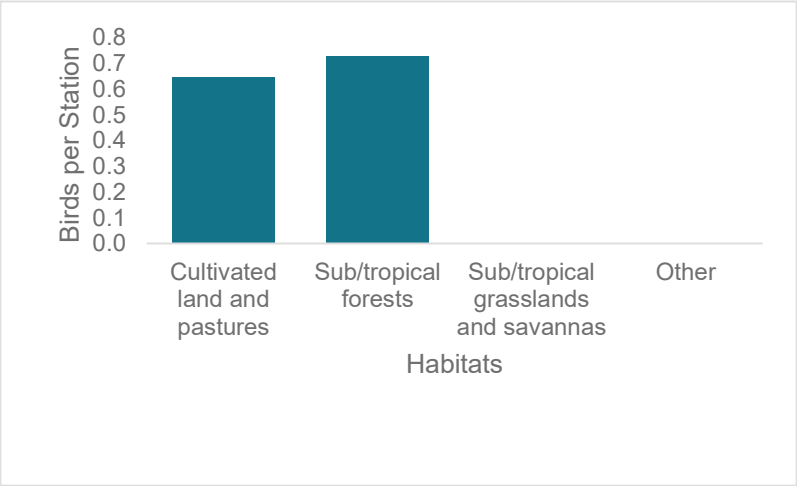
Tanna Fruit-dove (Ptilinopus tannensis) IUCN Red List (2022) Least Concern

Endemic to Vanuatu, from Aneityum in the south to the Banks Islands group in the north. There is no global population estimate for this species. The global range is estimated at c12,000 km^2 – accordingly the species is classed as 'range-restricted'.

The Tanna Fruit-dove inhabits old-growth rainforest, but also degraded habitats with large fruiting trees, including open woodland, parkland, plantations and gardens. It is most common in the lowlands and low hills, but is also present in mountains to at least 1500 m asl (BirdLife International, 2023).



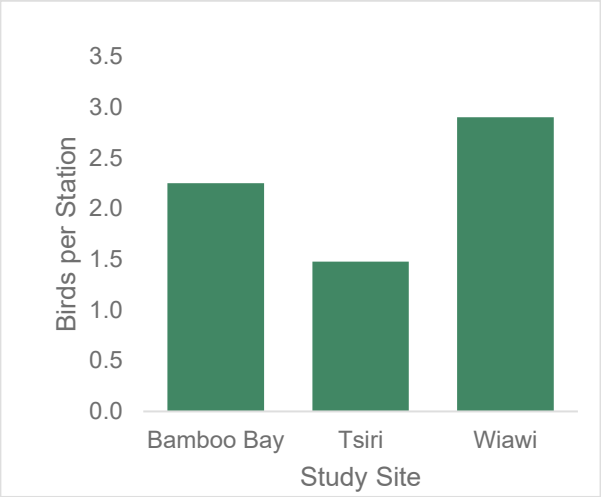


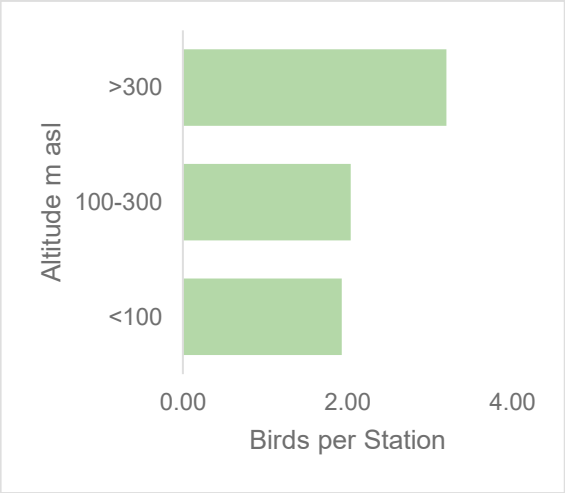


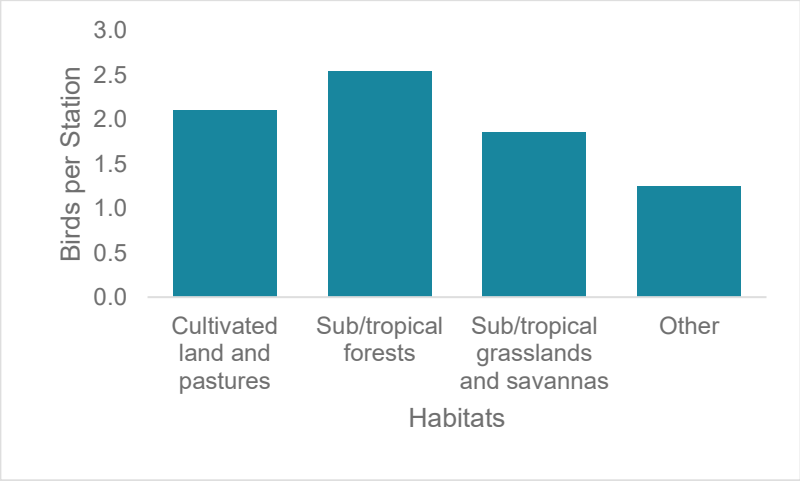
1. Twelve birds were recorded on the 5-minute point count at Bamboo Bay (n=40 sites), 11 at Tsiri (n=23) and 24 at Wiawi (n=20). Overall, 24, 14 and 30 birds were recorded at the sites.
2. Eighty percent of Tanna Fruit-dove records were of calling birds. There were no estimates of distance of birds from the station.
3. Tanna Fruit-dove were recorded, on five-minute point counts, at 15 times the density at stations above 300 m asl compared with stations below 100m asl.
4. Tanna Fruit-dove were recorded in equal densities on cultivated land and Tropical Forests with no records from other habitats.
5. 75% of habitat at Bamboo Bay was occupied by Tanna Fruit-dove. The area of Lower Nambas KBA is 214 km^2 – 75% of this would equate to c160 km^2 – or 1.3% of the global range of the species. We recorded 24 individuals overall at the site. Tanna Fruit-dove, therefore, qualifies as a contributory trigger species at Small Nambas KBA under B2 (Avian).
6. 90% of habitat at Wiawi is occupied by Tanna Fruit-dove (13 of the 20 stations reported the bird). Wiawi KBA is 43km^2 – 90% of 43 is c39 km^2. This is just 0.3% of the global range of the species. Tanna Fruit-dove, therefore, does not qualify as a trigger species at Wiawi KBA.

Red-bellied Fruit-dove (Ptilinopus greyi) IUCN Red List (2022) Least Concern

Indigenous to Vanuatu, this species can also be found in New Caledonia and the Temotu province of the Solomon Islands. There is no global population estimate for this species. The global range is estimated at over 32,000 km^2. Accordingly, it qualifies as a Restricted-range species.



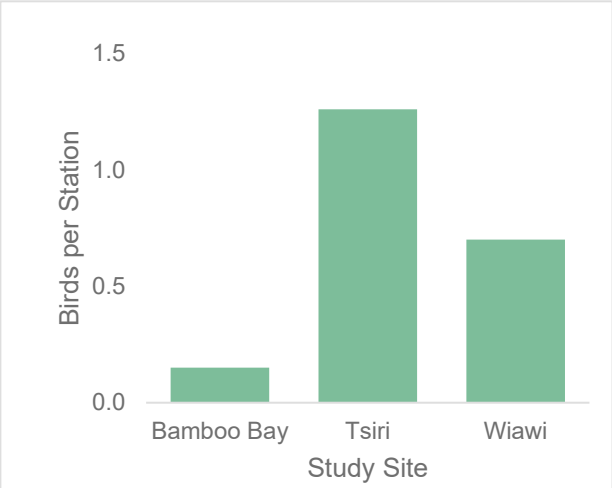


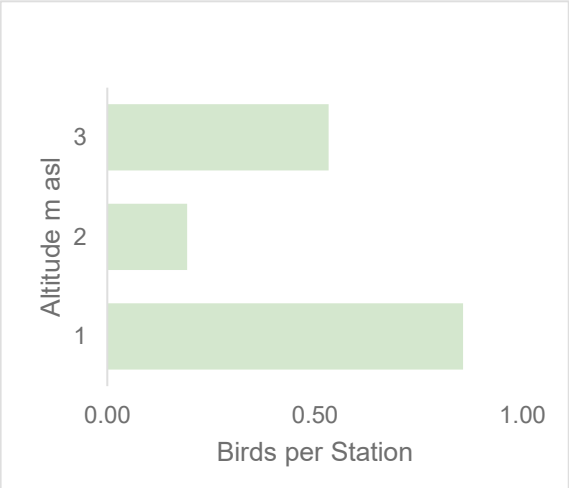


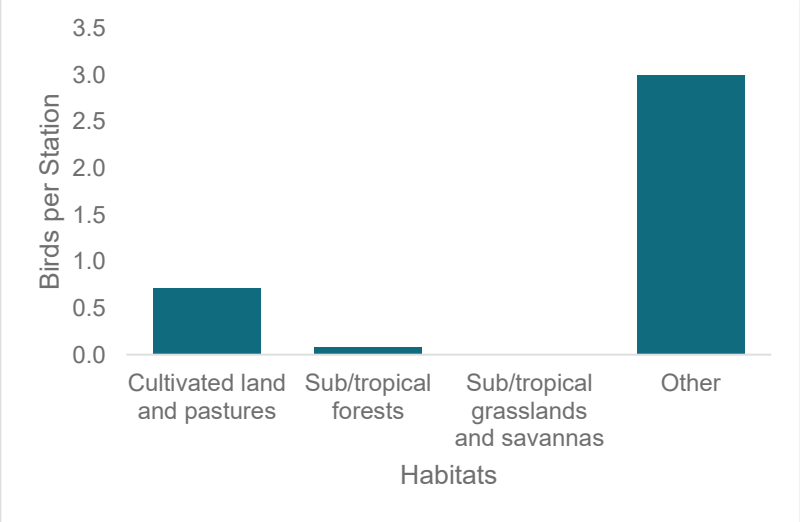
1. Ninety birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), 34 at Tsiri (n=23) and 58 at Wiawi (n=20). Overall, 101, 39 and 60 birds were recorded at the sites.
2. Eighty seven percent of Red-bellied Fruit-dove records were of calling birds. Birds were recorded up to 150m from the station.
3. Red-bellied Fruit-doves were recorded, on five-minute point counts, at similar densities across the altitudinal range.
4. Red-bellied Fruit-dove were recorded in equal densities across all habitats.
5. 100% of habitat at Bamboo Bay was occupied by Red-bellied Fruit-dove. The area of Lower Nambas KBA is 214 km^2, or 0.7% of the global range of the species. We recorded over 100 individuals overall at the site. Red-bellied Fruit-dove does not qualify as a trigger species at Small Nambas KBA.
6. 100% of habitat at Wiawi is occupied by Red-bellied Fruit-dove (the bird was reported at 18 of the 20 stations). Wiawi KBA is 43 km^2. This is just 0.13% of the global range of the species. Red-bellied Fruit-dove, therefore, does not qualify as a trigger species at Wiawi KBA.

Glossy Swiftlet (Collocalia esculenta) IUCN Red List (2022) Least Concern

Indigenous to Vanuatu. Occurs from S.E. Asia through New Guinea, Solomon Islands and New Caledonia as far east as Vanuatu. There is no global population estimate for the species – while the global range is considered to be in excess of 2.75 million km^2. The species does not qualify as a KBA trigger species under any criteria.







1. Six birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), 29 at Tsiri (n=23) and 14 at Wiawi (n=20). Overall, 58, 66 and 14 birds were recorded at the sites. A high proportion of the birds were seen outside the five-minute observation period.
2. 80% of Glossy Swiftlet records were of birds seen. Birds were recorded up to 150m from the station.
3. Glossy Swiftlets were recorded, on 5-minute point counts, at higher densities at low altitudinal range (<100 m asl) than elsewhere in the altitudinal range.
4. Glossy Swiftlets were recorded in much higher densities across 'Other' habitats.
5. Glossy Swiftlet is a Least Concern species with a large global range. Accordingly, it does not qualify as a trigger species for either KBA.

Uniform Swiftlet (Aerodramus vanikorensis) IUCN Red List – Least Concern

Indigenous to Vanuatu. Range includes S.E. Asia, New Guinea and the Solomon Islands. There is no global population estimate. The global range of this species is just over 1.2million km^2. The species does not qualify as a KBA trigger species under any criteria.

Uniform Swiftlet is considered to be abundant throughout its range. Zero birds were recorded, during the five-minute point counts, at Bamboo Bay, 1 at Tsiri and 11 at Wiawi. Overall, 12, 1 and 11 birds were recorded at the three sites. All birds were seen – with all 12 birds at Bamboo Bay at the one station while the 11 birds at Wiawi were recorded at 2, adjacent, stations. All birds were recorded close to the station – within 25 m.

Buff-banded Rail (Hypotaenidia philippensis) IUCN Red List – Least Concern

Indigenous to Vanuatu. Occurs from S.E. Asia, through Australia and New Guinea, Solomon Islands, New Caledonia and Vanuatu, extending east to Samoa and New Zealand. Global range is in excess of 2.5million km^2. The species does not qualify as a KBA trigger species under any criteria.

The Buff-banded Rail is common throughout much of its range. One bird was recorded, during the five-minute point counts, at Bamboo Bay, 8 birds at Tsiri and 1 at Wiawi. Overall, 10, 10 and 1 bird were recorded on the respective sites. All but one bird was recorded based on call. Birds were estimated as being up to 100 m from the recording station.

White-browed Crake (Amaurornis cinerea) IUCN Red List – Least Concern

Indigenous to Vanuatu. Occurs from Samoa in the east to S.E. Asia, as far as Thailand, in the west. There is no global population estimate, while the Extent of Occurrence is estimated at 22.5 million km^2. The species does not qualify as a KBA trigger species under any criteria.

Two birds were heard, from one point count station, at one site in Tsiri. The birds were estimated to be c100 m from the station.

Purple Swamphen (Porphyrio porphyrio) IUCN Red List – Least Concern

Indigenous to Vanuatu. The most wide-ranging species, globally, on the list. This species occurs in Europe, Africa, South Asia, Australia, New Guinea, Solomon Islands, New Caledonia and Vanuatu – and east to Samoa and New Zealand – a global range in excess of 18.5 million km^2. The species does not qualify as a trigger species under any of the KBA criteria.

A single bird was recorded, during five-minute stationary counts, at Tsiri in cultivated land. Two birds were also recorded at Bamboo Bay, but outside the stationary counts. Birds were heard up to a distance of 100 m from the recording station.

Pacific Reef-egret (Egretta sacra) IUCN Red List – Least Concern

Indigenous to Vanuatu. A wide-ranging species from Burma and Japan in the west to the Marquesas in French Polynesia, in the east. The species Extent of Occurrence is estimated at 88million km^2. This species, therefore, does not qualify as a trigger species for KBAs in Vanuatu.

Two birds recorded at Bamboo Bay with both sighted outside the 5 minute point counts. The birds were on, or adjacent to, the Lake shoreline.

Swamp Harrier (Circus approximans) IUCN Red List – Least Concern

Indigenous to Vanuatu. Occurs from Tonga, in the east to Indonesia and Australia in the west. No global population estimate, the Extent of Occurrence is estimated at 17.5 million km^2. The species does not qualify as a trigger species under any of the KBA criteria.

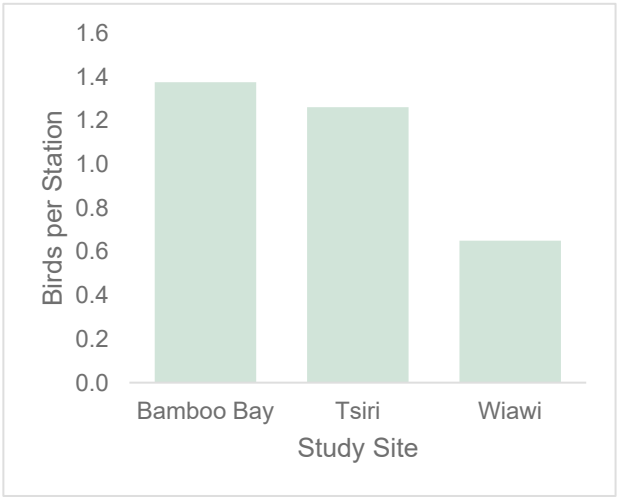
A single bird recorded at each of Point Count Stations at Tsiri and Bamboo Bay. Both birds were recorded on sight. The species is likely to cover the entire area of all KBAs searching for food.

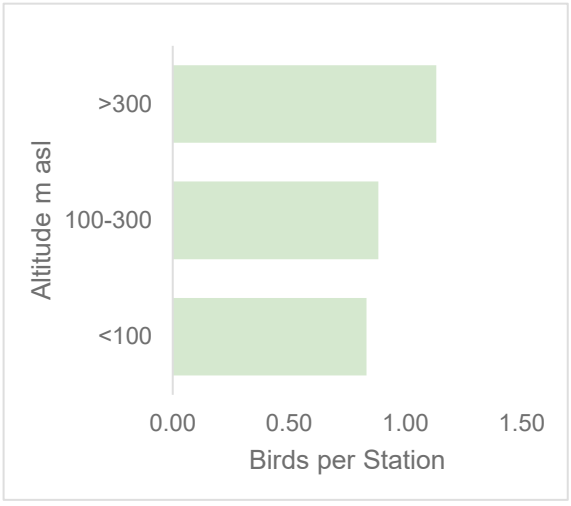
Brown Goshawk (Accipiter fasciatus) IUCN Red List – Least Concern

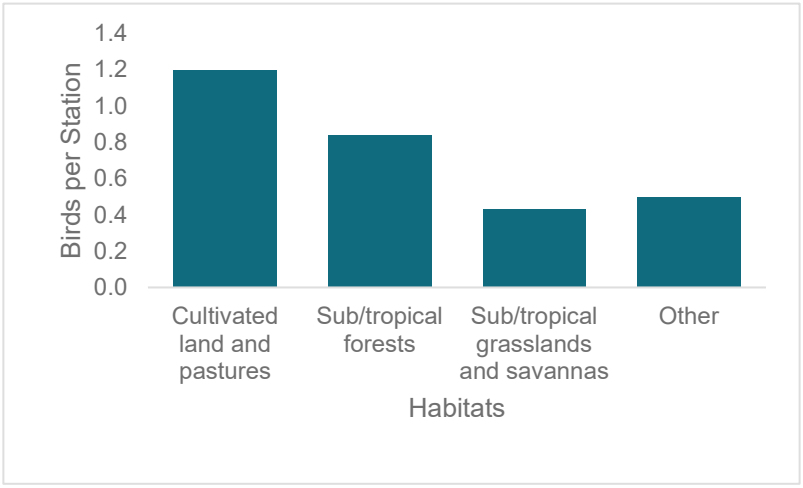
Indigenous to Vanuatu. Occurs from Indonesia and Timor Leste in the west with Vanuatu being the easternmost location for the species. The Extent of Occurrence is estimated at 22.2million km^2. The species does not qualify as a trigger species under any of the KBA criteria in Vanuatu.

Collared Kingfisher (Todiramphus chloris) IUCN Red List – Least Concern

Indigenous to Vanuatu. Ranges in the west from SE Asia through Northern Australia, New Guinea, Solomon Islands and east to Fiji, Tonga and American Samoa. There is no global population estimate. Global range is nearly 4 million km^2. The species does not qualify as a trigger species under any of the KBA criteria.



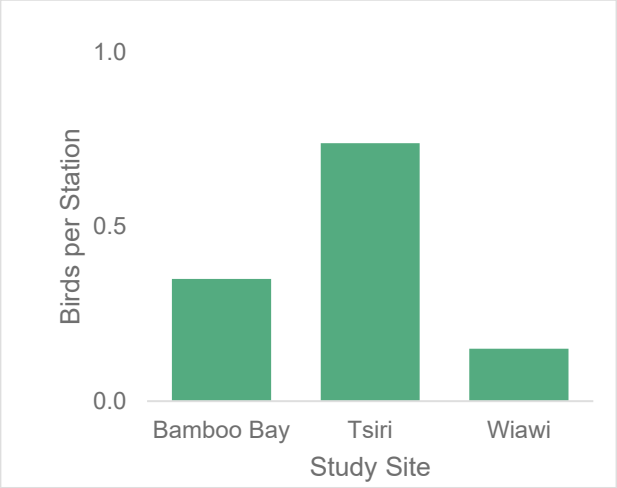


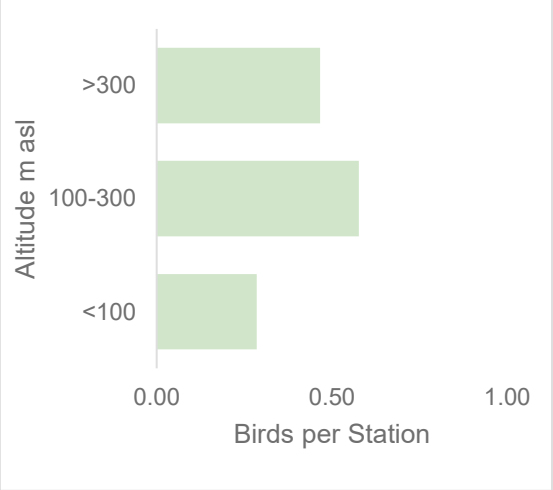


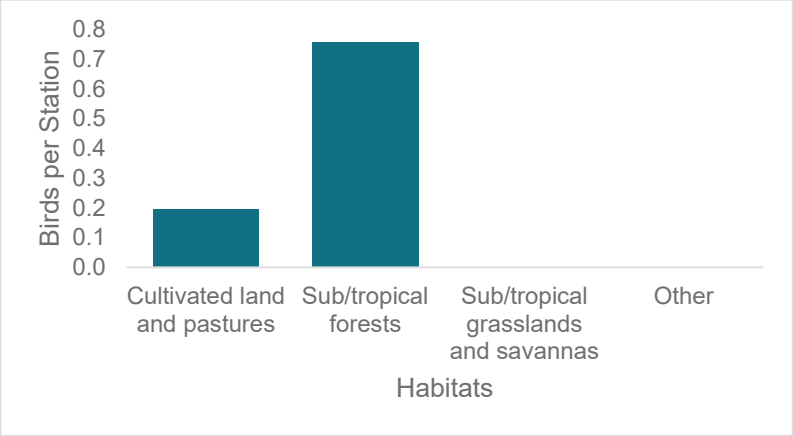
1. 35 birds were recorded on the 5-minute point count at Bamboo Bay (n=40 sites), 27 at Tsiri (n=23) and 13 at Wiawi (n=20). Overall, 55, 29 and 13 birds were recorded at the sites.
2. 88% of Collared Kingfisher records were of birds heard. Birds were recorded up to 150 m from the station.
3. There is little variation in the density of Collared Kingfishers by altitudinal range.
4. Collared Kingfisher densities in cultivated habitats were double those in tropical forests or other habitats. They were recorded in all habitats and so can be considered to be spread across the sites.
5. Collared Kingfisher is a Least Concern species with a large global range. Accordingly, it does not qualify as a trigger species for either KBA.

Vanuatu Kingfisher (Todiramphus farquhari) IUCN Red List (2022) Near-Threatened

Vanuatu Kingfisher is endemic to the northern islands of Vanuatu – being restricted to Santo, Malekula and islands in between. This species is listed as Near-threatened because it has a small range in which the habitat is declining due to forest loss and degradation. The population size has been estimated at between 14,000 to 94,000 mature individuals (median 54,000 individuals). The Extent of occurrence of the species is just 12,500 km^2 while its range has been estimated at just 5,635 km^2. This species qualifies as a range-restricted species.







1. Fourteen birds were recorded on the 5-minute point count at Bamboo Bay (n=40 sites), 17 at Tsiri (n=23) and 3 at Wiawi (n=20). Overall, 26, 20 and 5 birds were recorded at the sites.
2. All Vanuatu Kingfisher records were of birds heard. Birds were recorded up to 150m from the station.
3. Vanuatu Kingfisher densities above 100 m asl were twice those below 100 m asl.
4. Vanuatu Kingfisher were predominantly recorded in or around tropical forests with lower densities in the cultivated land, and were not recorded, at all, in other habitats.
5. If we assume that Vanuatu Kingfisher occurs in both cultivated land and tropical forests then 75% of habitat at Bamboo Bay is occupied by Vanuatu Kingfisher (with more birds present than was indicated by the point counts). The area of Lower Nambas KBA is 214 km^2 – 75% of this would equate to c160 km^2 – or 2.8% of the global range of the species.
6. We recorded 26 individuals overall at the site – with 14 during the five-minute point counts. Even if we assume that both males and females call, then we came across at least 7 pairs of bird. On the assumption that the call can be recorded up to 150 m from the observer we can estimate that we surveyed 2.83 km^2 of the KBA. If we assumed that the 14 individuals was an accurate estimate of the of the species within the 2.83 km^2 then that would suggest that the density was 4.9 birds per km^2, which would suggest a population c800 mature individuals which can be considered to be at least 400 reproductive units. Vanuatu Kingfisher, therefore, qualifies as a trigger species at Small Nambas KBA as a contributory species to B2 (Avian).
7. 90% of habitat at Wiawi is occupied by Vanuatu Kingfisher (although only five of the 20 stations reported the bird at any stage). Wiawi KBA is 43 km^2 – 90% of 43 is c39 km^2. This is just 0.7% of the global range of the species. Vanuatu Kingfisher, therefore, does not qualify as a trigger species at Wiawi.

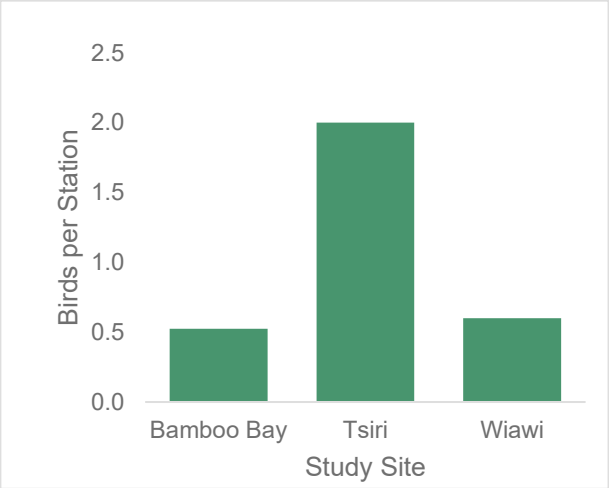
Peregrine Falcon (Falco peregrinus) IUCN Red List – Least Concern

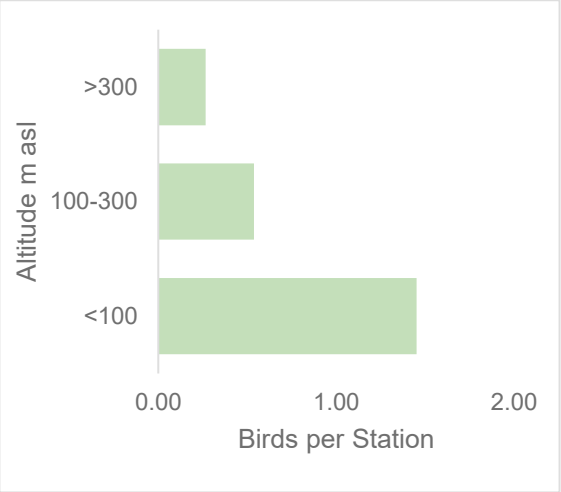
Indigenous to Vanuatu – the subspecies F. p. *nesiotus* is restricted to Vanuatu and Fiji and has, unlike most other populations of Peregrine, not shown evidence of recent increases. Peregrine falcon is, like the Purple Gallinule, one of the most widespread species globally. The Extent of Occurrence has been estimated as 413 million km^2, while a global population size of the order of 100,000 to 499,999 individuals has been estimated. The species is unlikely to qualify as a trigger species under any criteria in Vanuatu.

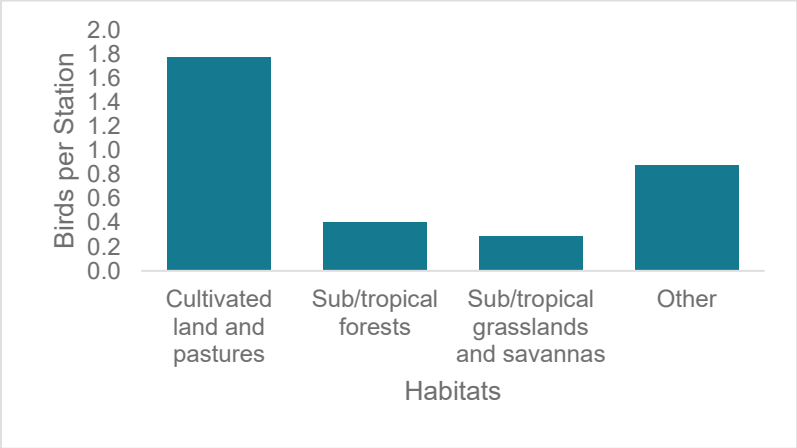
A single Peregrine was seen at Wiawi, during a five-minute point count. It is likely that the bird breeds in the area – although we did not obtain evidence to confirm this.

Coconut Lorikeet (Trichoglossus haematodus) IUCN Red List – Least Concern

Indigenous to Vanuatu. Global distribution includes New Guinea, Solomon Islands and New Caledonia. There is no global population estimate. The species range is estimated at 875,000 km^2. This species does not qualify as a KBA trigger species under any of the criteria.



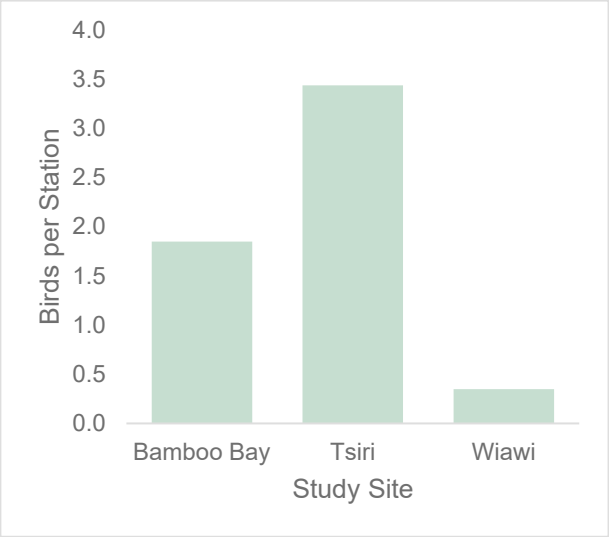


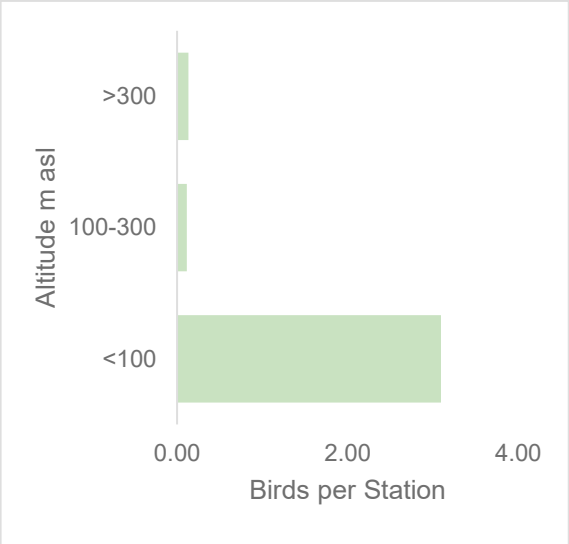


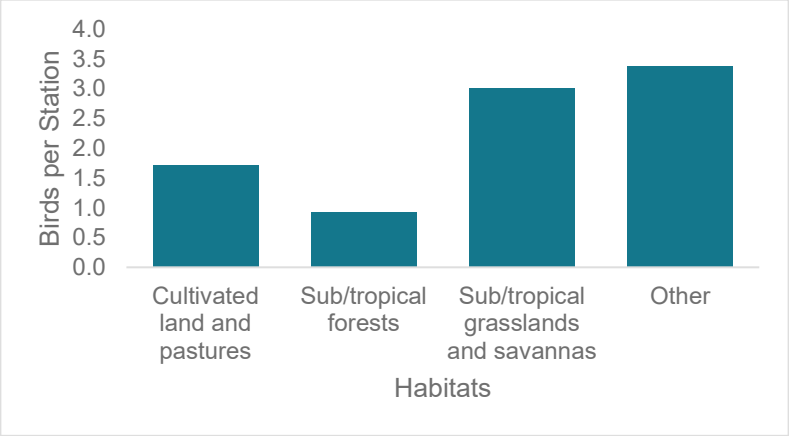
1. 21 birds were recorded on the 5-minute point count at Bamboo Bay (n=40 sites), 46 at Tsiri (n=23) and 12 at Wiawi (n=20). Overall, 85, 60 and 16 birds were recorded at the sites.
2. 83% of Coconut Lorikeet records were of birds heard. Birds were recorded up to 100 m from the station.
3. Coconut Lorikeet were much more frequently encountered (three times the density) at low altitudinal range (<100 m asl).
4. Coconut Lorikeet densities in cultivated habitats were double those in other habitats and higher still than densities in tropical forests or grasslands. They were however recorded in all habitats and so can be considered to be spread across the sites.
5. Coconut Lorikeet is a Least Concern species with a large global range. Accordingly it does not qualify as a trigger species for either KBA.

Grey-eared (Dark Brown) Honeyeater (Lichmera incana) IUCN Red List (2022) Least Concern

Indigenous to Vanuatu, also occurs in New Caledonia. There is no global population estimate. The estimated extent of occurrence is 315,000 km^2 while the range is estimated at 24,109 km^2. This species, thus, qualifies as a Range-restricted species.



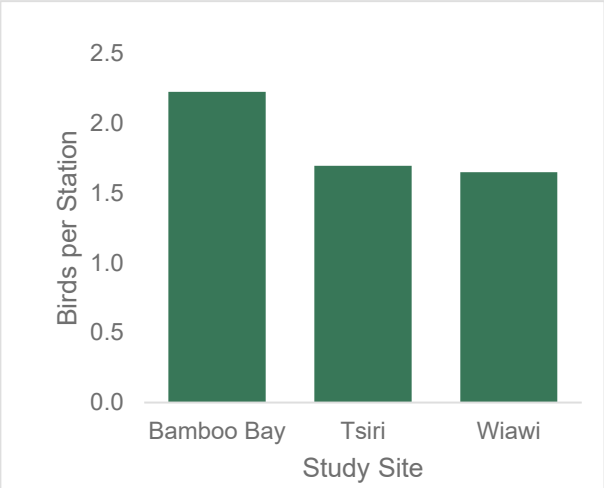


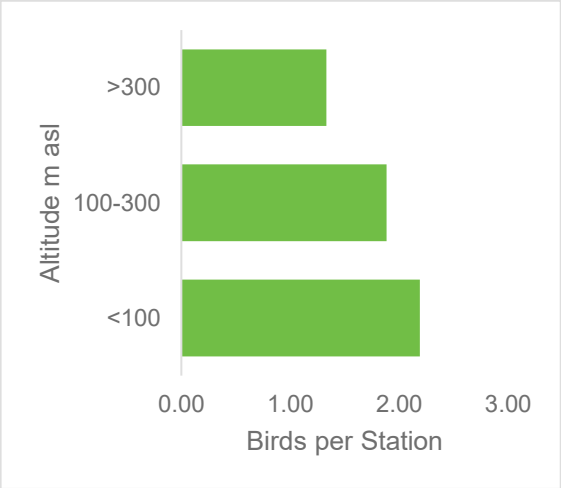


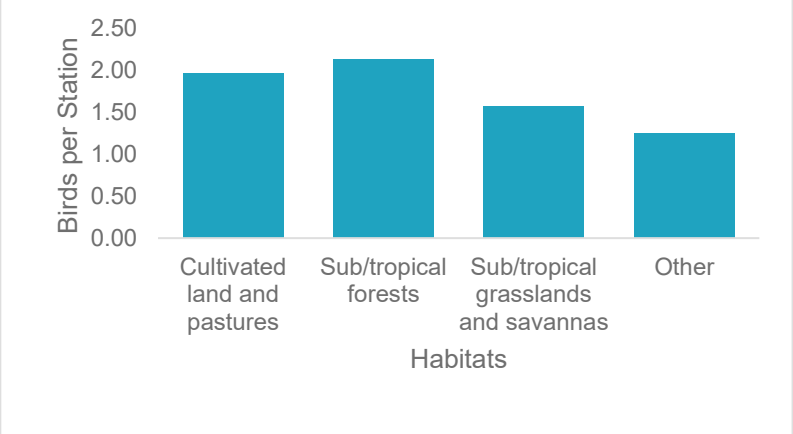
1. Sixty-seven birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), 63 at Tsiri (n=23) and 5 at Wiawi (n=20). Overall, 74, 79 and 7 birds were recorded at the sites.
2. 82%of all Grey-eared Honeyeater records were of birds heard. Birds were recorded up to 100 m from the station.
3. Grey-eared Honeyeater records were predominantly in the below 100 m asl altitude band.
4. Grey-eared Honeyeaters were predominantly recorded in or around tropical grasslands and other habitats with lower densities in the cultivated land and tropical forests.
5. If we assume that Grey-eared Honeyeater occurs in all habitats at Bamboo Bay, then the site range is 214 km^2 or 0.9% of the global range of the species. Grey-eared Honeyeater, therefore, does not qualify as a trigger species at Small Nambas.
6. Grey-eared Honeyeater density at Wiawi is low compared with other sites. In addition, the area of Wiawi, 43 km^2 is just 0.2% of the global range of the species. Grey-eared Honeyeater, therefore, does not qualify as a trigger species at Wiawi.

Cardinal Myzomela (Myzomela cardinalis) IUCN Red List, Least Concern

Indigenous to Vanuatu, this species also occurs in the south of the Solomon Islands and the Loyalty islands of New Caledonia. The species global population has not been estimated. The global range is estimated at 22,200 km^2 – making this a Restricted range species.







1. 89 birds were recorded on the 5-minute point count at Bamboo Bay (n=40 sites), 39 at Tsiri (n=23) and 33 at Wiawi (n=20). Overall, 110, 57 and 36 birds were recorded at the sites. This was the second most frequently reported species in the survey.
2. Over 90% of all Cardinal Myzomela records were of birds heard. Birds were recorded up to 100 m from the station.
3. Cardinal Myzomela records were across all altitudinal ranges – from 0 to 500 m asl.
4. Cardinal Myzomela were recorded in all habitats with relatively little variation between habitats.
5. If we assume that Cardinal Myzomela occurs in all habitats at Bamboo Bay, then the site range is 214 km^2 or 0.96% of the global range of the species. Cardinal Myzomela, therefore, does not qualify as a trigger species at Small Nambas – although it is very close.

6. Cardinal Myzomela occurs in all habitats at Wiawi. However, the area of Wiawi, 43 km^2 is just 0.2% of the global range of the species. Cardinal Myzomela, therefore, does not qualify as a trigger species at Wiawi.

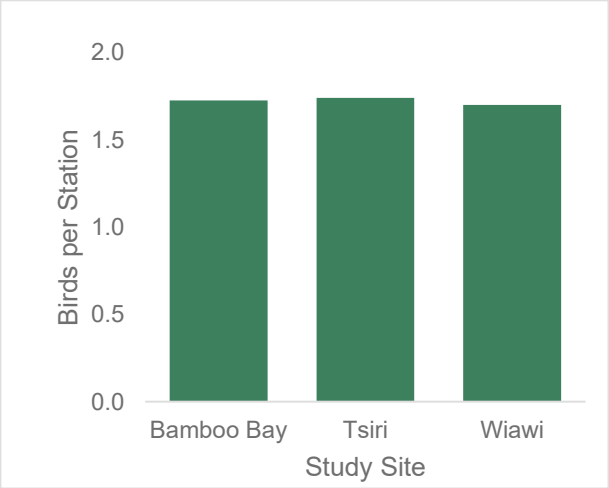
Fan-tailed Gerygone (Gerygone flavolateralis) IUCN Red List (2022) Least Concern

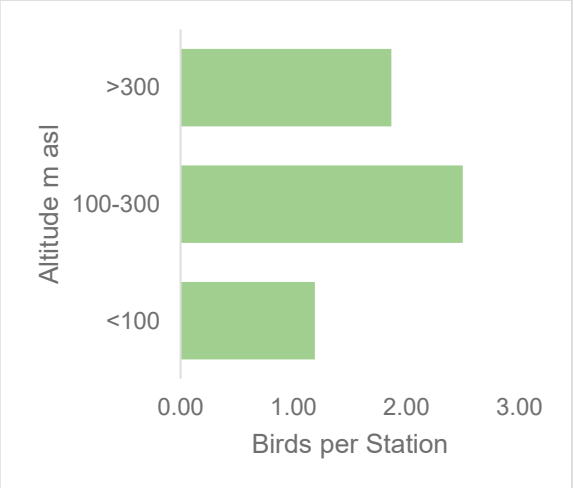
Indigenous to Vanuatu, his species is also found in New Caledonia. The global population size has not been quantified, the global range is estimated at 28,357 km^2 making this a Restricted Range species.

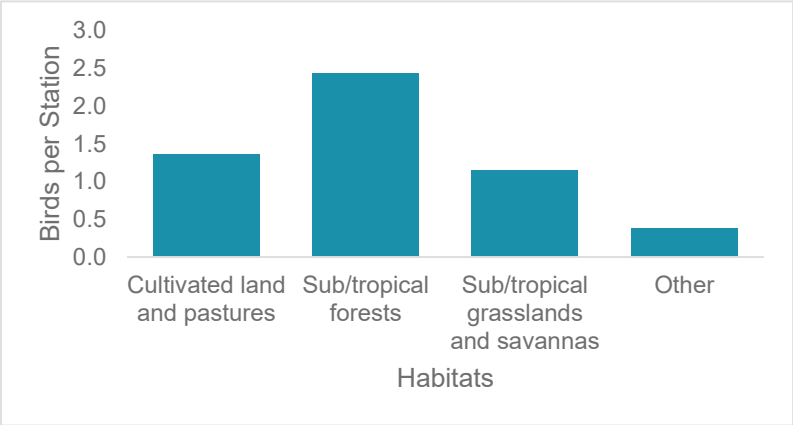
1. Fourteen birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), zero at Tsiri (n=23) and 1 at Wiawi (n=20). Overall, 28, zero and 3 birds were recorded at the sites.
2. Over 60% of all Fan-tailed Gerygone records were of birds heard. Birds were recorded up to 70m from the recording station.
3. 80% of the Fan-tailed Gerygone records were in the 0 to 100 m asl altitudinal range.
4. Fan-tailed Gerygone were recorded in all habitats with relatively little variation between habitats.
5. If we assume that Fan-tailed Gerygone occurs in all habitats at Bamboo Bay, then the site range is 214 km^2 or 0.75% of the global range of the species. Fan-tailed Gerygone, therefore, does not qualify as a trigger species at Small Nambas.
6. Fan-tailed Gerygone occurs in all habitats at Wiawi. However, the area of Wiawi, 43 km^2 is just 0.15% of the global range of the species. Fan-tailed Gerygone, therefore, does not qualify as a trigger species at Wiawi.

Golden Whistler (Pachycephala pectoralis) IUCN Red List (2022) Least Concern

Indigenous to Vanuatu. This species has a disjunct distribution with populations on islands in Indonesia, Bismarck Archipelago, Vanuatu and the Temotu province in Solomon Islands – as well as Australia and the Loyalty Islands, New Caledonia. There is no global population estimate for the species, while the global range is estimated at almost 2 million km^2. The species does not qualify under any of the KBA criteria.



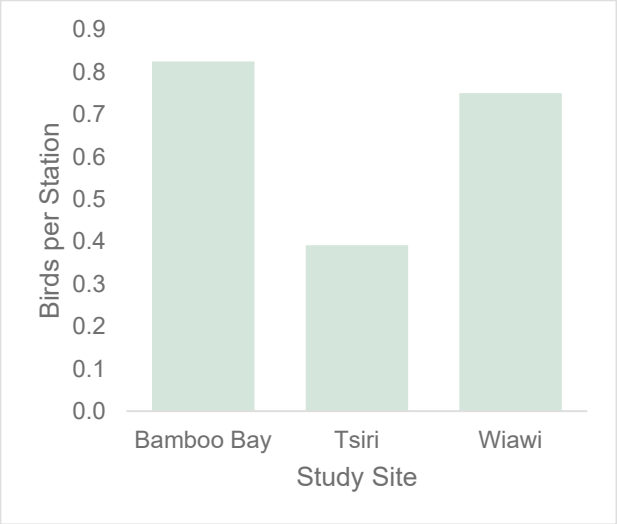


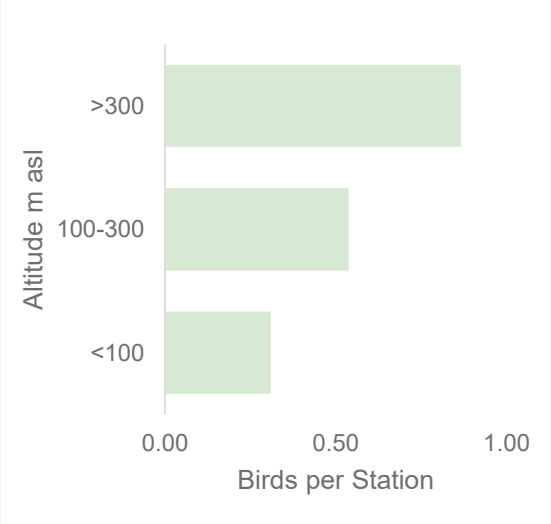


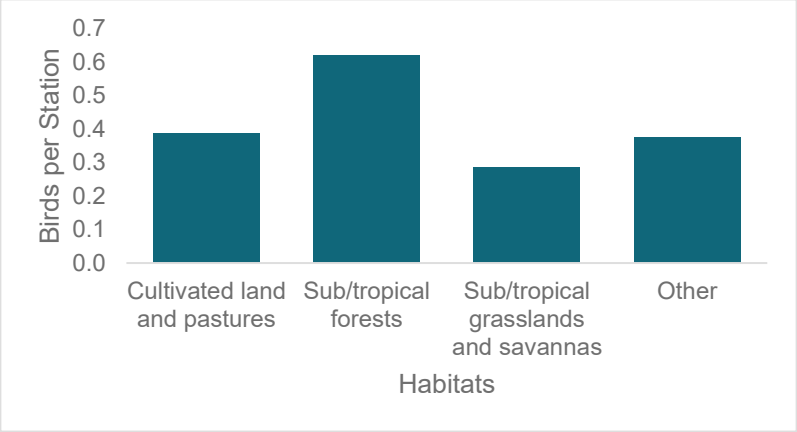
1. 69 birds were recorded on the 5-minute point count at Bamboo Bay (n=40 sites), 40 at Tsiri (n=23) and 34 at Wiawi (n=20). Overall, 90, 72 and 40 birds were recorded at the sites. This was the third most commonly recorded species across the survey.
2. 80 percent of Golden Whistler records were of birds heard. Birds were recorded up to 150 m from the station.
3. Golden Whistlers were recorded at all altitudes, but were twice as frequent above 100 m asl compared with lower altitudes.
4. Golden Whistler densities in tropical forests were almost double those in other habitats. They were however recorded in all habitats, and so can be considered to be spread across each of the sites.
5. Golden Whistler is a Least Concern species with a large global range. Accordingly, it does not qualify as a trigger species for either KBA.

South Melanesian Cuckooshrike (Coracina caledonica) IUCN Red List (2022) Least Concern

Indigenous to Vanuatu. This species also occurs in New Caledonia. There is no global population estimate. The Estimated Extent of occurrence of the species is 565,000 km^2 while the Global Range is estimated at 25,234 km^2. This qualifies it as a Restricted Range species.







1. 18 birds were recorded on the 5-minute point count at Bamboo Bay (n=40 sites), 8 at Tsiri (n=23) and 14 at Wiawi (n=20). Overall, 33, 9 and 15 birds were recorded at the sites.
2. Over 90% of all South Melanesian CuckooShrike records were of birds heard. Birds were recorded up to 150 m from the station.
3. South Melanesian Cuckooshrike records were across all altitudinal ranges – from 0 to 500 m asl, but were highest in the >300 m asl range.
4. South Melanesian Cuckooshrikes were recorded in all habitats, but with highest densities in tropical forest areas.
5. If we assume that South Melanesian Cuckooshrike occurs in all habitats at Bamboo Bay, then the site range is 214 km^2 or 0.85% of the global range of the species. South Melanesian Cuckooshrike, therefore, does not qualify as a trigger species at Small Nambas.
6. South Melanesian Cuckooshrike occurs in all habitats at Wiawi. However, the area of Wiawi, 43 km^2 is just 0.17% of the global range of the species. South Melanesian Cuckooshrike, therefore, does not qualify as a trigger species at Wiawi.

Long-tailed Triller (Lalage leucopyga) IUCN Red List – Least Concern

Indigenous to Vanuatu, the Long-tailed Triller also occurs in New Caledonia, Solomon Islands and Norfolk Island. There is no global population estimate. The global range is estimated at 34,357 km^2, making this a Restricted Range species.

14 birds were recorded, during the five-minute stationary counts, at six of the stations at Bamboo Bay (n=40 sites). No birds were recorded at Tsiri or Wiawi during the five-minute point counts. In total 22 birds were seen at Bamboo Bay as well as three birds at Wiawi. 65% of birds were heard during the surveys. Birds were recorded up to 50m from the station. Birds were recorded in all habitats, but only in the <100 m asl altitude zone.

Even if the Triller occurs throughout the Bamboo Bay/Small Nambas KBA, this only represents 0.62% of the global range of the species. Therefore Long-tailed Triller does not qualify as a trigger species at Small Nambas. Similarly, the area of the Wiawi KBA is too small to represent 1% of the global range of the species, so Long-tailed Triller does not qualify as a trigger species at Wiawi.

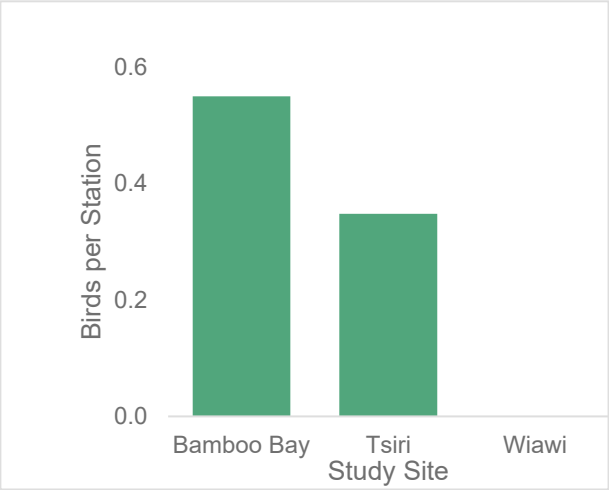
White-breasted Woodswallow (Artamus leucoryn) IUCN Red List – Least Concern

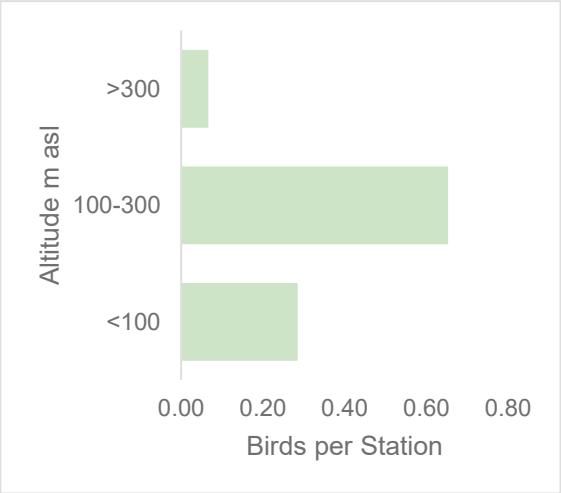
Indigenous to Vanuatu. Also present from S.E. Asia, New Guinea, Australia and New Caledonia. There is no global population estimate. The global range is estimated at just over 7.5million km^2. The species does not qualify under any of the KBA criteria.

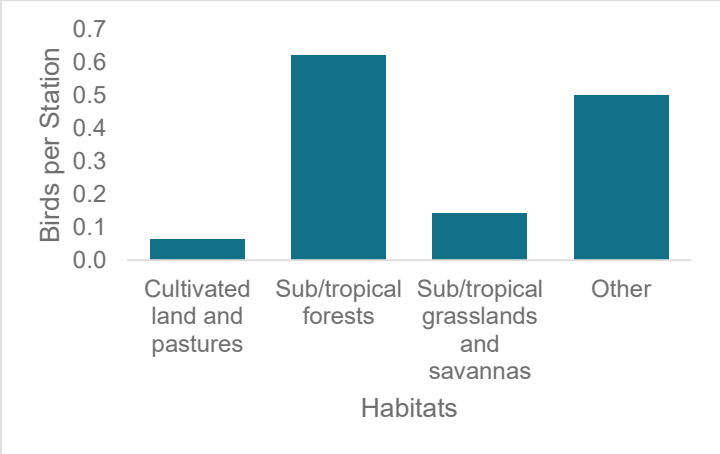
Three birds were recorded, during the five-minute stationary counts, at one station at Bamboo Bay in Tropical Grassland. Four birds, and two birds were also recorded at Bamboo Bay, but outside the stationary counts. The four birds were around the wetland habitat, while the two birds were in tropical forest. All birds were recorded by sight and all being recorded within 25 m of the station.

Vanuatu Streaked Fantail (Rhipidura spilodera) IUCN Red List – Least Concern

Endemic to Vanuatu from Efate to the Banks Islands. The global population size is unknown. The global range is estimated at 9,509 km^2, so this can be assessed a Restricted Range species.



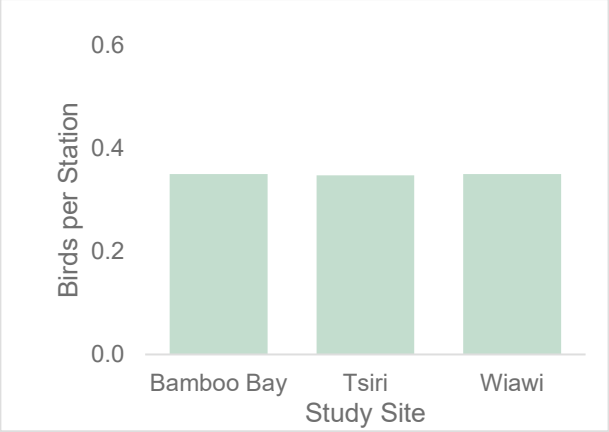


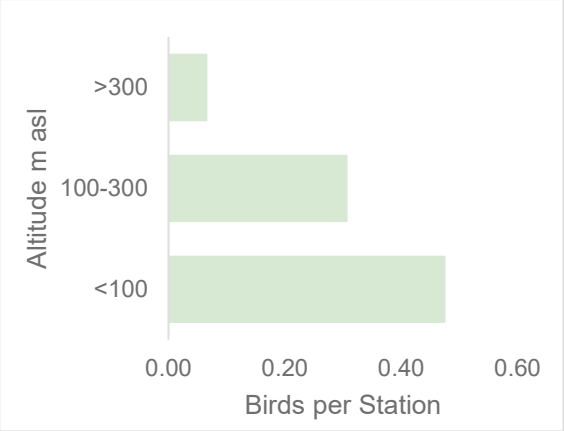


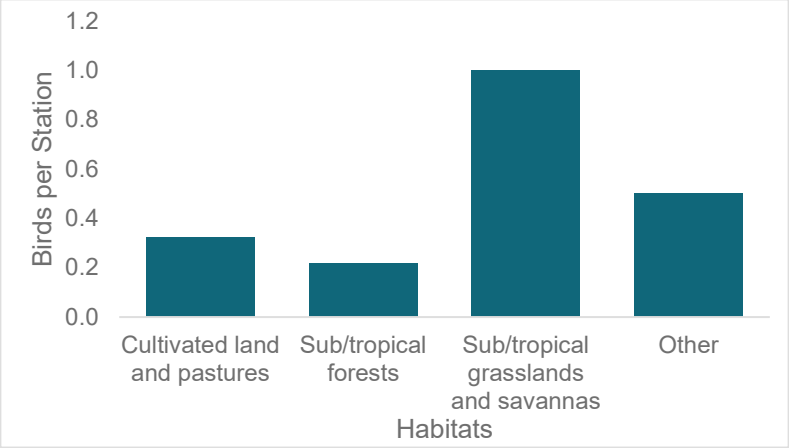
1. 22 birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), eight at Tsiri (n=23) and zero at Wiawi (n=20). Overall, 43, 9 and zero birds were recorded at the sites.
2. 60% of all Vanuatu Streaked Fantail records were of birds heard. Birds were recorded up to 100 m from the station.
3. Vanuatu Streaked Fantail records were across all altitudinal ranges but were highest in the 100-300 m asl range (Twice the density of birds in the <100 m asl, and 10 times the density of birds above 300 m asl).
4. Vanuatu Streaked Fantails were recorded in all habitats, but with highest densities in tropical forest areas and relatively few in the cultivated land and tropical grassland areas.
5. If we assume that Vanuatu Streaked Fantail occurs in all habitats at Bamboo Bay, then the site range is 214 km^2 or 2.25% of the global range of the species. Even if we exclude the area of cultivated habitat then the local range will still represent 1.82% of the species global range. Accordingly, Vanuatu Streaked Fantail qualifies as a candidate trigger species under criterion B2 at Small Nambas KBA.
6. Vanuatu Streaked Fantail was not recorded at Wiawi. Therefore, it does not qualify as a trigger species at Wiawi.

Grey Fantail (Rhipidura albiscapa) IUCN Red List (2022) Least concern

Indigenous to Vanuatu. This species also occurs in Australia, New Caledonia and the Solomon Islands. It has an estimated Extent of Occurrence of 11,700,000 km^2 and a Range in excess of 50,000 km^2. Therefore, it does not qualify under any of the KBA criteria.



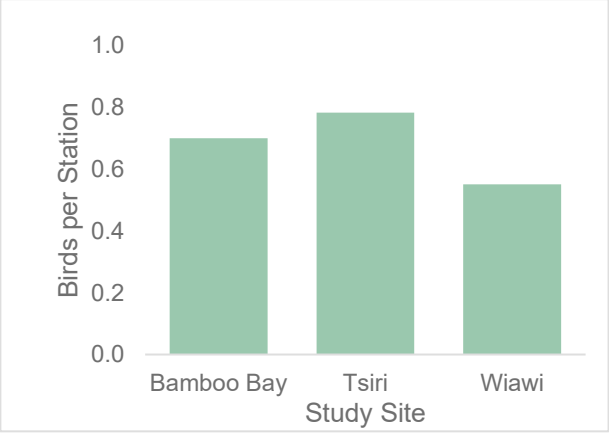


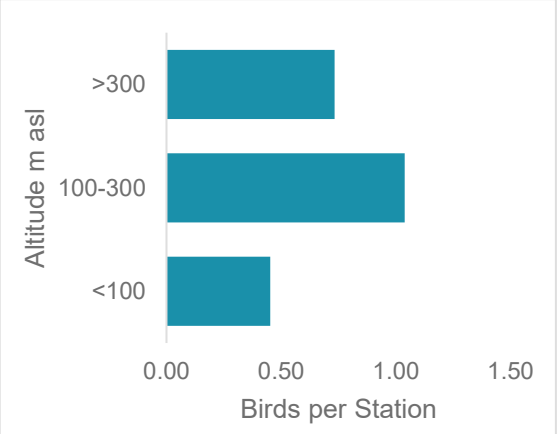


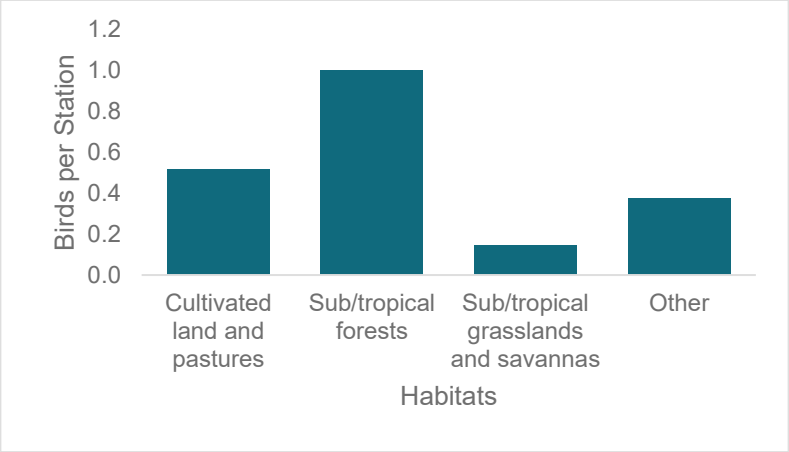
1. 14 birds were recorded on the 5-minute point count at Bamboo Bay (n=40 sites), 8 at Tsiri (n=23) and 7 at Wiawi (n=20). Overall, 26, 22 and 8 birds were recorded at the sites.
2. 90%of Grey Fantails records were of birds heard. Birds were recorded up to 100 m from the station.
3. Grey Fantails were recorded at all altitudes but were five times more frequent below 100 m asl compared with above 300 m asl.
4. Grey Fantail densities in tropical grasslands were more than twice those in other habitats, with lowest densities in tropical forests. They were recorded in all habitats and so can be considered to be spread across each of the sites.
5. Grey Fantail is a Least Concern species with a large global range. Accordingly, it does not qualify as a trigger species for either KBA.

Melanesian Flycatcher (Myiagra caledonica) IUCN Red List – Least Concern

Indigenous to Vanuatu. This species is also widespread across New Caledonia and can be found on the island of Rennell in the Solomon Islands. There is no global population estimate. The global range is just under 31,500 km^2, so this can be assessed as a Restricted Range species.



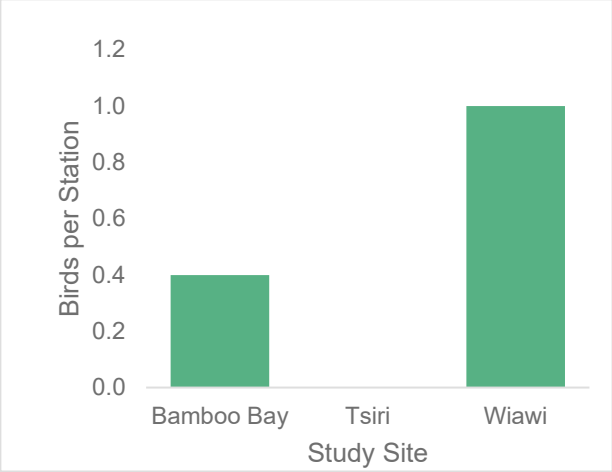


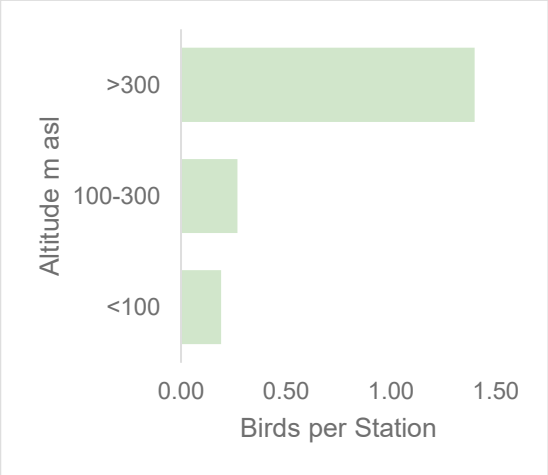


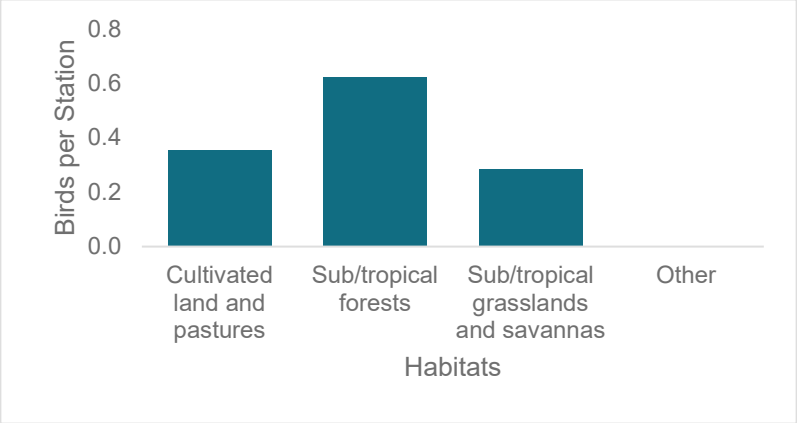
1. 28 birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), 18 at Tsiri (n=23) and 11 at Wiawi (n=20). Overall, 42, 34 and 13 birds were recorded at the sites.
2. Just under 89% of all Melanesian Flycatcher records were of birds heard. Birds were recorded up to 80 m from the station.
3. Melanesian Flycatcher records were across all altitudinal ranges – from 0 to 500 m asl – but were highest in the mid 100-300 m asl range (twice the density recorded in the low altitude range).
4. Melanesian Flycatchers were recorded in all habitats, but with highest densities in tropical forest area, and with twice the density here compared with cultivated land and other habitats.
5. If we assume that Melanesian Flycatcher occurs in all habitats at Bamboo Bay, then the site range is 214 km^2 or 0.68% of the global range of the species. Melanesian Flycatcher, therefore, does not qualify as a trigger species at Small Nambas.
6. Melanesian Flycatcher occurs in all habitats at Wiawi. However, the area of Wiawi, 43 km^2 is just 0.14% of the global range of the species. Melanesian Flycatcher, therefore, does not qualify as a trigger species at Wiawi.

Buff-bellied Monarch (Neolalage banksiana)
IUCN Red List – Least Concern.

Endemic to Vanuatu. There is no global population estimate. The Global range of this species is just short of 10 thousand km^2 (9,980) so this can be considered as a Restricted Range species.







1. 16 birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), zero at Tsiri (n=23) and 20 at Wiawi (n=20). Overall, 18, zero and 22 birds were recorded at the sites.
2. 56% of all Buff-bellied Monarchs records were of birds heard. Birds were recorded up to 150 m from the station.
3. Buff-bellied Monarch records were primarily from the higher altitudinal range in the higher than 300 m asl range (Birds in this range were at five times the density of birds in the 100-300 m asl, and eight times the density of birds below 100 m asl).
4. Buff-bellied Monarchs were recorded in all habitats, but with highest densities in tropical forest areas and relatively few in the cultivated land and tropical grassland areas.
5. If we assume that Buff-bellied Monarch occurs in all habitats at Bamboo Bay, then the site range is 214 km^2 or 2.14% of the global range of the species. Even if we exclude the area of other habitat at the site then the local range will still represent 1.88% of the species global range. Accordingly, Buff-bellied Monarch qualifies as a candidate trigger species under criterion B2 at Small Nambas KBA.
6. Buff-bellied Monarch was recorded in high densities at Wiawi. However, even if its range is considered to be the entire area of the KBA then this only represents 0.43% of its global range.

Southern Shrikebill (Clytorhynchus pachycephaloides) IUCN Red List (2022) - Least Concern

Indigenous to Vanuatu. This species can also be found in New Caledonia. There is no global population estimate, the Extent of Occurrence is 365,000 km^2 while its global range is estimated as 27,352 km^2, it thus qualifies as a Range-restricted species.

Three birds were recorded at Point Count Stations on Bamboo Bay (n=40 sites). One bird was heard and two were seen. All birds were within 40 m of the Stations. Small Nambas KBA, at 214 km^2, represents 0.78% of the total range of the species and so the species does not qualify as a potential trigger under criterion B2. Assessing the density of the species at the site and comparing that with other sites may overturn that decision, but we currently do not have information on mean densities of the species across its range.

Chestnut Munia (Lonchura atricapilla) IUCN Red List (2022) – Least Concern

A recent introduction, the Chestnut Munia has recently spread from Santo to Malekula and can now be commonly found in grassland areas. The species originally comes from S.E. Asia, but is now established in Palau and Guam, and Hawaii, as well as Vanuatu in the Pacific Region. There is no global population estimate, the Extent of Occurrence is of the order of 13,200,000 km^2 and the Range far exceeds 50,000 km^2. Accordingly, this species does not qualify as a KBA trigger species in Vanuatu under any criteria.

Seven birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), 5 at Tsiri (n=23) and 5 at Wiawi (n=20). Overall, 18, 9 and 15 birds were recorded at the sites. All birds were recorded in the low altitude (<100 m asl) zone. All Chestnut Munia records were of birds seen. Birds were recorded up to 50 m from the station.

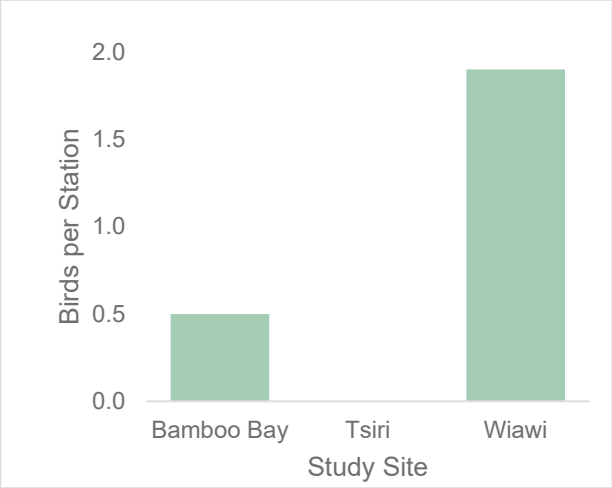
Chestnut-breasted Munia (Lonchura castaneothorax) IUCN Red List (2022) – Least Concern

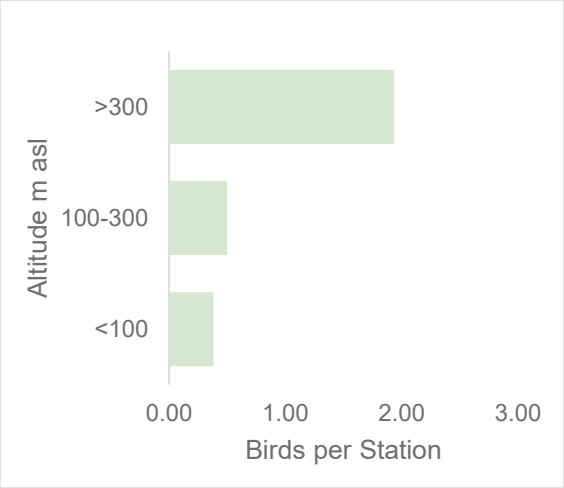
Recent Introduction. The species has recently spread from Santo to Malekula and can now be found, in grassland areas (although usually not as common as the Chestnut Munia). The species is native to Australia, Indonesia and Papua, New Guinea and has become established in New Caledonia, Wallis and French Polynesia as well as Vanuatu. The population size for this species has not been quantified, while the Extent of Occurrence is estimated at 7,980,000 km^2 and the Range clearly exceeds 50,000 km^2. Accordingly, this species does not qualify as a KBA trigger species in Vanuatu under any criteria.

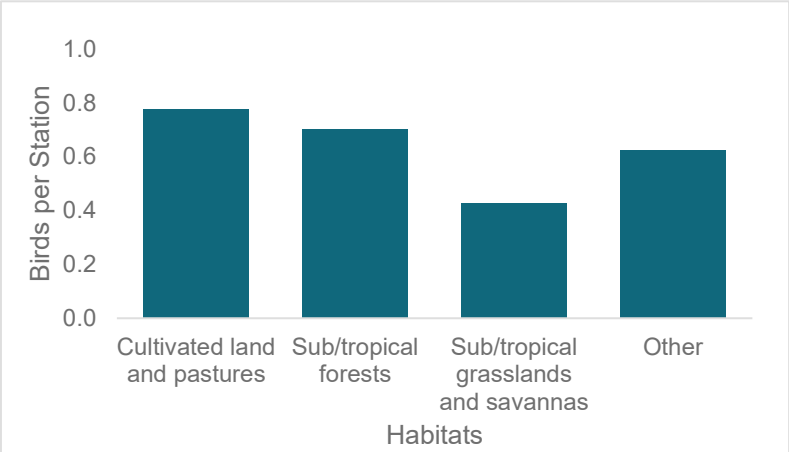
Seven birds were recorded on the five-minute point count at one site in Bamboo Bay. This site is in 'cultivated land and pastures' and is in the low-altitude <100 m asl zone. This would be the first record for Malekula, if confirmed as records of this species do appear to be increasing in Vanuatu.

Silvereye (Zosterops lateralis) IUCN Red List (2022) – Least Concern

Indigenous to Vanuatu. This species can also be found in Australia, New Zealand, New Caledonia and Fiji. There is no global population estimate. The global range of the species is estimated at c2.7 million km^2. This species does not qualify as a trigger species under any of the KBA criteria.



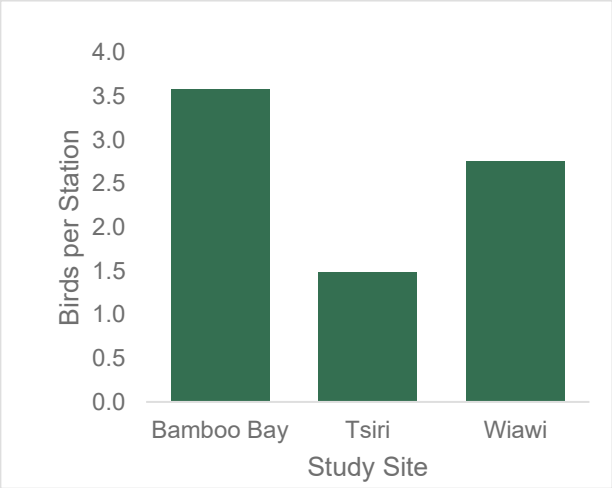


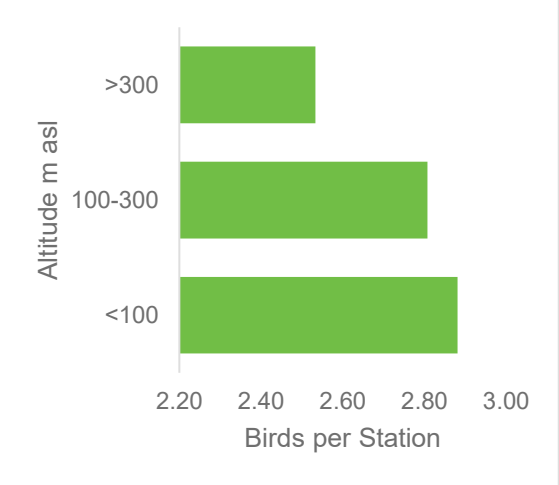


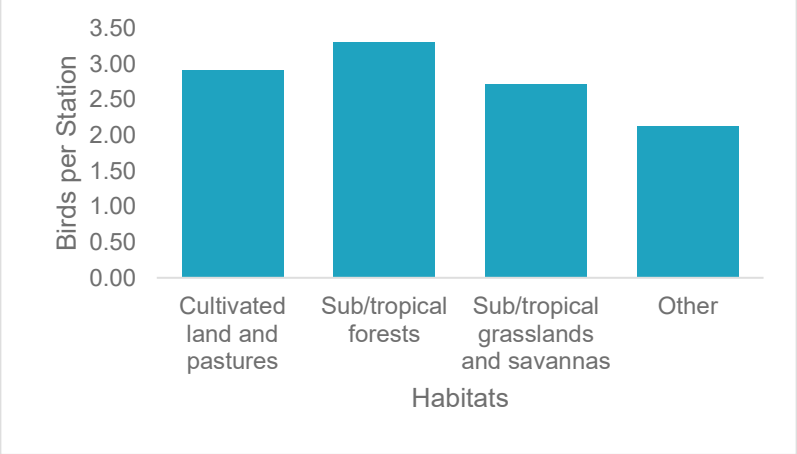
1. 20 birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), zero at Tsiri (n=23) and 38 at Wiawi (n=20). Overall, 29, zero and41 birds were recorded at the sites.
2. 52% of Silvereye records were of birds heard. Birds were recorded up to 50 m from the station.
3. Silvereyes were recorded at all altitudes, but were four times more frequent above 300 m asl compared with lower altitude sites.
4. Silvereye densities were similar across all habitats.
5. Silvereye is a Least Concern species with a large global range. Accordingly, it does not qualify as a trigger species for either KBA.

Vanuatu White-eye (Zosterops flavifrons) IUCN Red List – Least Concern Endemic to Vanuatu

There is no global population estimate for the species – the Global Range is estimated at just over 12 thousand km^2. This is one of the two trigger species identified for the legacy North Pentecost KBA.







1. 143 birds were recorded on the five-minute point count at Bamboo Bay (n=40 sites), 34 at Tsiri (n=23) and 55 at Wiawi (n=20). Overall, 212, 53 and 57 birds were recorded at the sites. This was the most frequently reported species during this survey.
2. 75% of all Vanuatu White-eye records were of birds heard. Birds were recorded up to 100 m from the station.
3. Vanuatu White-eye records were from all altitudinal range, with slightly higher densities reported for the lower altitudes.
4. Vanuatu White-eye were evenly recorded across all habitats, with highest densities in tropical forest areas.
5. If we assume that Vanuatu White-eye occurs in all habitats at Bamboo Bay, then the site range is 214 km^2 or 1.78% of the global range of the species. Accordingly, Vanuatu White-eye qualifies as a candidate trigger species under criterion B2 at Small Nambas KBA.

6. Vanuatu White-eye was recorded in high densities at Wiawi. However, even if its range is considered to be the entire area of the KBA (43km^2) then this only represents 0.36% of its global range.

Island Thrush (Turdus poliocephalus) IUCN Red List – Least Concern

Indigenous to Vanuatu. This species can also be found, as many subspecies, from Samoa westwards through to S.E. Asia. There is no global population estimate. The Extent of Occurrence of the species is estimated at c21.9 million km^2. This species does not qualify as a trigger species under any of the KBA criteria.

A single bird at a single Point Count Station at both Tsiri and Wiawi (the latter bird heard only). Five birds at four Point Count Stations at Bamboo Bay with another two single individuals heard on the site while moving between Stations.

3.6 DISCUSSION

The bird survey on Malekula was undertaken in July 2023. The survey included visits to two Key Biodiversity Areas (Bamboo Bay aka Small Nambas KBA and Wiawi KBA), and a third area (Tsiri Lagoon) identified as important by the surveyors. Point count surveys were used to estimate the populations of bird species at each of the sites. These recorded 850 birds of 34 species at Bamboo Bay (40 stations), 494 birds of 30 species at Tsiri Lagoon (23 stations) and 494 birds of 27 species at Wiawi's 20 stations). Only one of these species, Vanuatu Scrubfowl, is considered to be globally-threatened, while a further four species, the Tanna Fruit-dove, Vanuatu Streaked Fantail, Buff-bellied Monarch and Yellow-bellied (Vanuatu) White-eye are endemic to Vanuatu.

The survey data indicates that all five of the endemic species qualify as trigger species at the Small Nambas KBA under the B2, co-occurring geographically restricted species, criterion. In addition, the globally-threatened Vanuatu Scrubfowl qualifies under A1b(i,iv). Note that the Grey-eared (Dark Brown) Honeyeater was considered a legacy trigger species, but does not now qualify. Conversely, the newly-recognised Vanuatu Streaked Fantail does qualify as a trigger while the Vanuatu Scrubfowl is a newly recognised trigger species under two criteria.

The avifauna data for the Wiawi indicates that the site is not of sufficient size nor has sufficient bird densities to justify any of the four legacy trigger species at the site. We will need to consider other taxonomic groups to justify the continued inclusion of this site in the KBA database. The Tsiri Lagoon site is too small to hold any bird species as KBA triggers. However, it is adjacent to the Small Nambas KBA – and, if added to that site, would enable one more species, Cardinal Myzomela, to be listed as a trigger species under B2 for the extended site.

Previous ornithological studies have identified a further 24 species as occurring on, or around Malekula; however, these 14 marine or coastal species were not a focus for the current study: Short-tailed Shearwater, Wedge-tailed Shearwater, Tropical Shearwater, Brown Booby, Lesser Frigatebird, Great Crested Tern, Black-naped Tern, Sooty Tern, Pomarine Skua, Arctic Skua, Striated Heron, Pacific Golden Plover, Wandering Tattler, Common Sandpiper. Of the other ten species, the Palm Lorikeet, Vanuatu Honeyeater, Royal Parrotfinch, Pacific Robin, Rufous-winged Starling and, maybe, Polynesian Triller are likely to be more abundant in the higher altitude sites on the island but were not surveyed during the current study.

The Palm Lorikeet was considered to be common even up to the end of the 20th Century and may also be more frequently recorded in the higher altitude areas on the island. The Fan-tailed

and Shining-bronze Cuckoos are two species that have significantly declined in numbers in the last few decades in Vanuatu. The Sacred Kingfisher record is of a single individual collected in the 19th Century. It is likely a migrant rather than a resident species. The Barn Owl is a nocturnal species which is considered common on the island; and being nocturnal, does not lend itself well to this type of survey.

Andersen *et al* (2017) established a camp along a dirt road some 5.2 km southwest of Lingarak Village from 25 to 30 November 2014. This site was equidistant between the Bamboo Bay and Wiawi sites surveyed in the current study and is located in the southwest corner of the Neck of Malakula – Crab Bay KBA, shown in Figure 1. They surveyed mature primary forest along two trails: a ridge trail above the camp to approximately 330 m asl, and west along an overgrown jeep road for 1.5 km. Understorey vegetation was relatively open and easy to walk through. They used mistnets to capture birds and obtained recordings of singing birds. They documented 35 native and one introduced species of bird for Malakula.The species that were recorded were not seen on the current survey were Shining Bronze-cuckoo, Barn Owl, Vanuatu Honeyeater and Polynesian Triller. Conversely, they did not record Australasian Grebe, Pacific Black Duck, Pacific Reef-heron, Brown Goshawk, Grey Fantail, Peregrine Falcon, Purple Swamphen, Vanuatu Imperial Pigeon or White-browed Crake.

eBird data for Malekula includes the following species in addition to those listed in this survey: Whimbrel, Far Eastern Curlew, Bar-tailed Godwit, Grey-tailed Tattler, Ruddy Turnstone (all on intertidal area between Norsup and Uri island), Black Noddy, Red-footed Booby (offshore to the east of Malekula), White-faced Heron, Striated Heron (along the eastern shoreline) and Palm Lorikeet (two locations, Norsup Airport and the Maskelyne Islands).

Chapter IV

Freshwater Fish and Crustaceans

4.1 INTRODUCTION

Malekula Island is home to four of the Key Biodiversity Areas (KBA) in the Vanuatu Islands identified by the Critical Ecosystem Partnership Fund (CEPF) programme as part of the East Melanesia Islands biodiversity hotspots. Two of these KBAs are on Malekula Island:

1. Small Nambas (Bamboo Bay) KBA is situated on the southwest of the island (Figure 1).
2. Wiawi KBA is in the north-western part of Malekula Island (Figure 2).

This survey was undertaken on five freshwater sites, three in Wiawi KBA and two in Bamboo Bay KBA.

These freshwater faunal surveys were included as an extra activity despite there being no trigger species present in this area.

Figure 27: Freshwater assessment map of Bamboo Bay KBA. Dixon Reef is adjacent to Tavendrua.

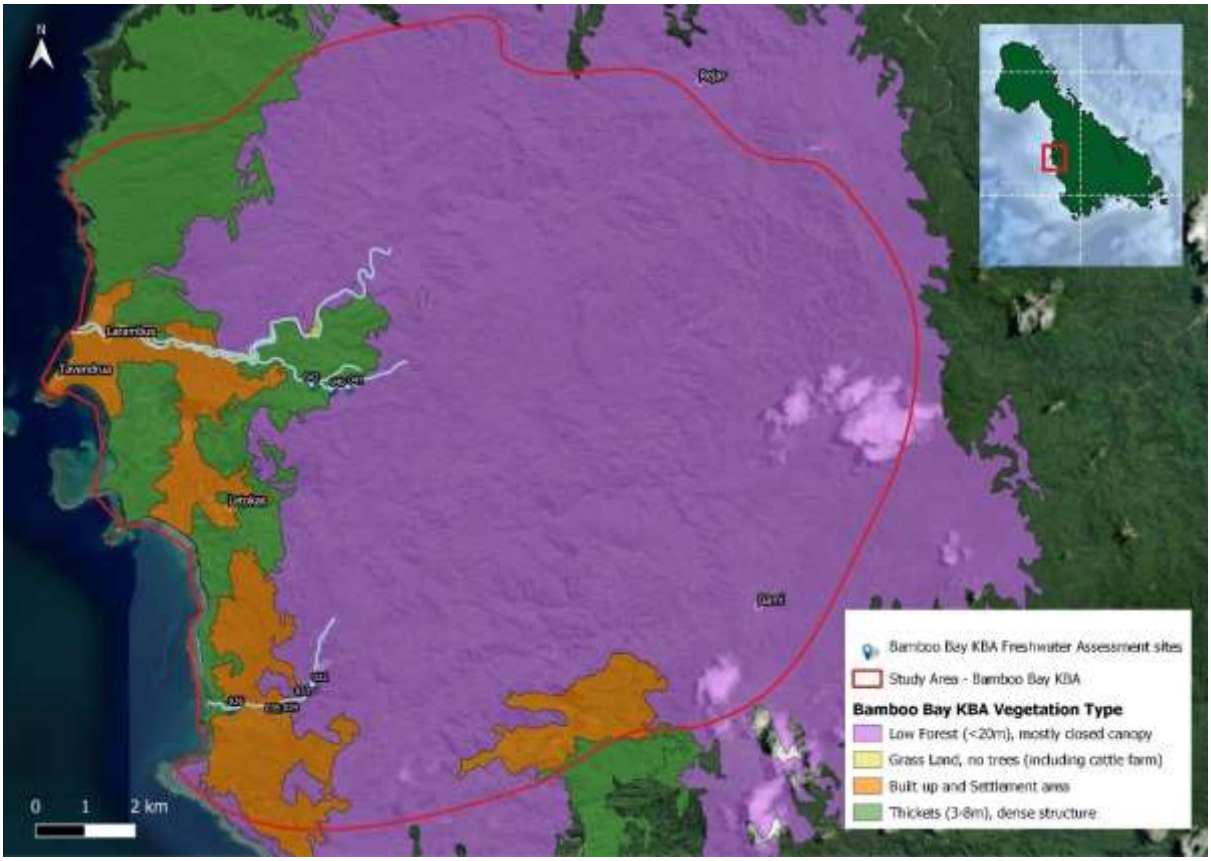
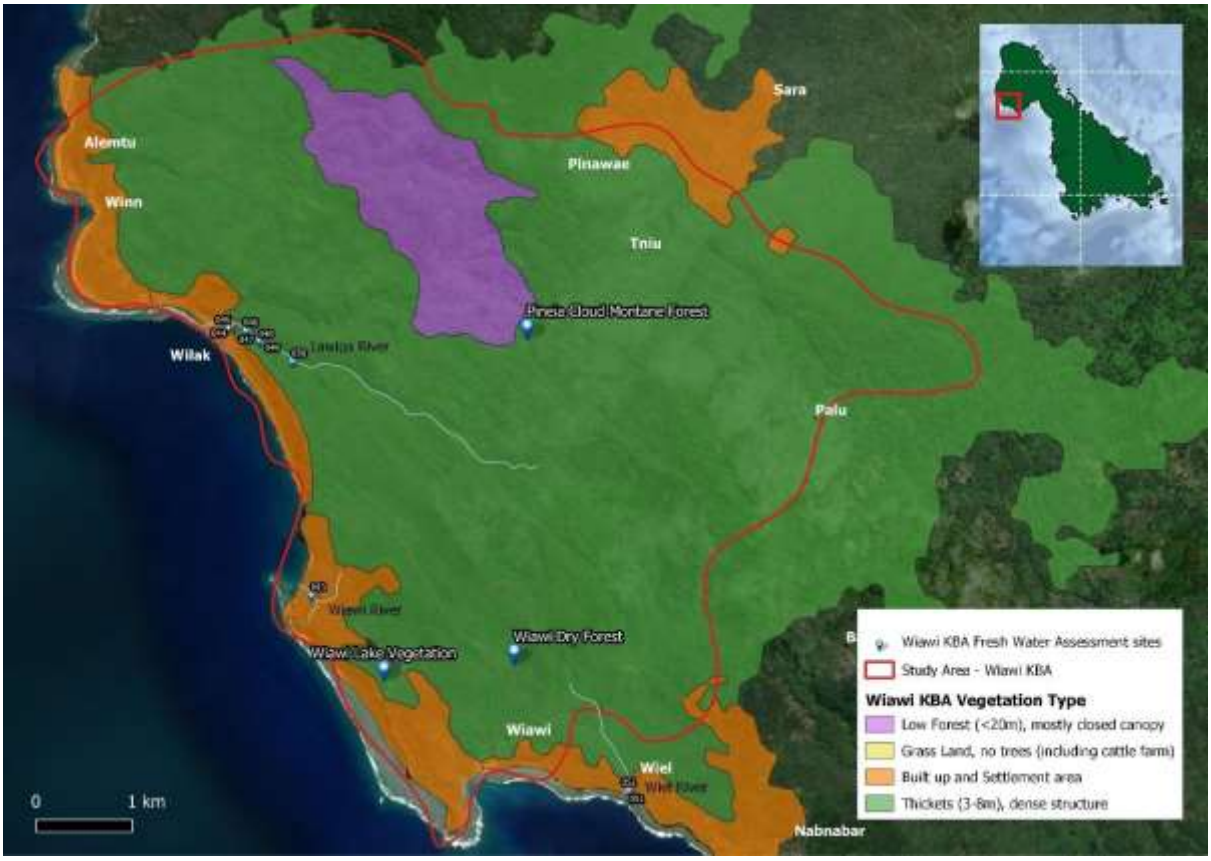


Figure 28: Freshwater assessment map of Wiawi KBA.



4.2 APPROACH AND METHODOLOGY

STUDY SITE

The assessment was carried out on two rivers in the Bamboo Bay KBA situated on the southwest of Malekula, and three rivers inside Wiawi KBA located at the north-western part of the island. There were two sites evaluated within the Bamboo Bay area: Nowoiwoldip river in Lawa area, and Dixon reef river in Dixon reef village (Figure 1). Surveys in the Nowoiwoldip lower-section, and mid-section assessments were carried out. Nowoiwoldip River track extends from thickets, through human settlement and up to low forest vegetation. The river riparian ecosystem has declined in health due to heavy rain and flooding. The Dixon reef river middle course assessment lies within thicket vegetation (refer to map Figure 1). The riparian zone is lush with trees and smaller plants that have good anchorage and there were fewer numbers of species recorded, compared to Lawa area.

For the Wiawi KBA, 3 freshwater sites were assessed: Nalep river, Wilak river in Wiawi area, and Lawipa river in Wilak village (refer to Figure 2). Only the Nalep estuary was assessed for this site, as this was the only accessible part of the river. The estuary consists of little intact vegetation on its banks, especially as it runs through a cattle farm area (refer to Figure 2). On Wilak river, all three sites were accessible where the river extends from the village settlement up to dense forests (refer to Figure 2). As for the Wiel river site, the lower reach was rapidly assessed due to limited time, where it runs through a coconut plantation near the coast. Less vegetation was observed along the riverbank. Due to the limited amount of time, the Wiel River

Assessment was not carried out thoroughly. It is believed that the river ecosystem contains a variety of species and further assessments are recommended.

ASSESSMENT PROTOCOLS

The assessment was conducted by observing freshwater vertebrate species along a 100 m transect in each lower course and middle course of the rivers. Due to limited time, the assessments were restricted to lower parts of rivers and few mid-parts. Assessments were carried out using the following methods and species found were identified using the 'Vanuatu Freshwater Crustaceans and Fish booklet.

RANDOM OBSERVATION

Random freshwater faunal observation was made from a viewpoint above the water surface or during dives by experts or field assistants in the lower and middle river courses (Figure 3). Photos captured on an underwater camera sometimes assisted with identifying the species. Porters also functioned as field assistants during the surveys.

Figure 29: A field assistant diving to observe specimens.

HAND SCOOP NETS

Hand scoop nets of varying sizes are used to catch species of small prawns, gobies and slippery animals like eels in still or slow-moving waters (figure 41).

Figure 30: Anguilla obscura caught using a hand net.

TRADITIONAL FISHING METHOD- BOW AND ARROW

This method was used in Lawa river where water was murky and visibly poor. The specimens had to be killed with a bow and arrow or rocks in order to catch them for identification purposes.

SPEARING METHOD

This method was used as the last option when all others failed to collect the sample specimen. Field assistants had to spear fast-moving specimen before they could be identified, especially eels, flagtails and prawns (figure 42).

Figure 31: A field assistant using the spearing method- Dixon River.

CAPTURING PHOTOS FOR IDENTIFICATION USING THE VANUATU FRESHWATER CRUSTACEANS AND FISH BOOKLET

Specimens were identified with the Vanuatu fish and crustacean research booklet (Figure 6). The identification keys in the book specifying shape or body structure, size, variety, spots, rings, and other highlights were used to confirm species. Other identifying aspects included the species distribution in different parts of the river and islands.

Figure 32: Freshwater and Crustaceans of Vanuatu book is used to identify Macrobrachium species.

COLLECTION OF LOCAL NAMES

Where needed, the field assistants were asked to give local dialect names of the different freshwater species caught and names recorded.

4.3 RESULTS

A total of 12 freshwater species were observed and identified in the Small Nambas (Bamboo Bay) KBA, including eight fish species (the *Kuhlia* spp being the most common genus) and three crustacean species, listed in Table 1 and photos (Figures 7 – 10). *Macrobrachium lar* was most common crustacean. The species recorded are common in other areas of Vanuatu.

Table 12: The number of fish and crustacea assessed by tally count of 2 river sites in Bamboo Bay KBA.

Scientific Name	Nowoiwoldip River (Lawa Village)		Dixon reef stream
	Mid-Course	Lower Course	Mid-Course
Fish			
Kuhlia marginata	30+	20+	2
Kuhlia munda	30+	10+	
Kuhlia rupestris	10+	20+	
Eleotris fusca			1
Ophieleotris aporos	1	2	
Ophieleotris sp.			1
Stiphodon rutilareus	20+	7	
Anguilla reinhardtii			2 (juveniles)
Crustacea			
Macrobrachium lar	20+	20+	17
Macrobrachium latimanus	1		3
Macrobrachium grandimanus	1		1
Cardinia weberi			1

Figure 2: Mountain river prawn (M. latimanus) comparing size to 5vt and 10vt coins, Dixon River

Figure 1: Speckled longfin-eel (A. reinhardtii), Dixon River

Figure 4: Dark-margined flagtail (Kuhlia marginata), Dixon River

Figure 3: Ophieleotris spp., Dixon River

WIAWI KBA

A total of 11 freshwater species and were observed and identified within Wiawi Key Biodiversity Areas (listed in Table 2 and photos in Figures 11-14), including eight fish species with *Stiphodon rutilarius* being the most common species, followed by *Kuhlia sp* and two species of eels and three crustacean species and one unknown crab specimen (Figure 14). These species recorded are common in other areas assessed in Vanuatu.

Table 13: The numbers of fish and crustacea assessed by tally count in 3 river sites of Wiawi KBA.

Scientific Name	Nalep River Estuary	Lawipa river			Wiel River Estuary
	Lower-Course	Lower-Course	Mid-Course	Upper-Course	Lower-course
Fish					
Kuhlia marginata	5+	5+	10+		8
Kuhlia munda					
Kuhlia rupestris					4
Ophiocara porocephala	2				
Stiphodon rutilareus		20+	10+		6+
Awaous ocellaris			4		5
Anguilla obscura	5				
Anguilla megastoma		2 (1 ad+1 juv)			
Crustacea					
Macrobrachium lar	10+	5+	5+	8	5
Varuna litterata		9+	3		5+
Crab unknown		1			

Figure 6: Pacific short-finned eel (A.obscura)- Nalep river, Wiawi area.

Figure 5: Awaous ocellaris- Lawipa river in Wilak area.

Figure 8: Crab unknown- Lawipa river, Wilak area.

Figure 7: Varuna litterata - Lawipa river, Wilak area.

4.4 DISCUSSION

Vanuatu freshwater rivers are characterised by the absence of indigenous primary and secondary fish. Diadromous fish and crustaceans inhabit rivers and are those that migrate between freshwater and marine waters in the course of their life cycles. The southwest part and northwest of Malekula island has various number of rivers, streams and other freshwater ecosystems. Due to the limited time, only two rivers in Bamboo Bay and three rivers in Wiawi KBA were surveyed.

For the **Bamboo Bay KPA**, the fish species that were observed by snorkelling and captured by the spearing method was the Dark margined flag-tail *(Kuhlia marginata*) (Figure 8), Silver flagtail *(Kuhlia munda),* Rock flagtail *(Kuhlia rupestris).* The flagtail species can easily be identified by their different coloured caudal fins. The Broadhead Sleeper (*Eleotris fusca)* is the species that can be mistaken with Snakehead gudgeon (*Ophieleotris aporos*), and its most outstanding feature is the absence of a gap between the first and second dorsal fins and its dark brownish colour.

The Eleotris snake (*Ophieleotris sp.)* was found in the mid-course of Dixon River. The Vanuatu freshwater species identification book (Keith et al. 2010) mentions that it is restricted to low courses; however, this survey recorded its range to middle courses (Figure 7). The species can also be found on Espiritu Santo and Gaua Island. Golden Red Stiphodon *(Stiphodon rutilaureus)* were common in lower courses of rivers, feeding on algae and small invertebrates by scraping them off rocks.

Two Speckled longfin-eel *(Anguilla reinhardtii)* were speared by field assistants in Dixon River (Figure 10). This species has a long dorsal fin similar to *Anguilla megastoma*, but the rare identifying feature is its color, which ranges from green-olive to yellow-brown skin and black dots. It is also known to be present on Vanua Lava and Maewo Island.

For crustacean species**,** the Giant jungle prawn *(Macrobrachium lar)* is common in both rivers, and it is believed to be the main crustacean that is consumed by people that live in Bamboo Bay areas. Both, the Hawaiian river prawn *(Macrobrachium grandimanus)* and Mountain river prawn *(Macrobrachium latimanus)* were recorded in mid courses and higher courses where the water is well oxygenated. This prawn was sampled from a water cascade in Dixon River, it is smaller

than *M. lar* and has a short and globular carpus, or front claws (see Figure 9). The Webers shrimp (*Cardina weberi)* is smaller than the Macrobrachium species.

Logging is one threat that has a small-scale impact in Bamboo Bay KBA. The outcome of flooding has been seen in Nowoiwoldip river track, where the river's width has increased as a result of the displacement of rocks that served as anchors for riparian areas and water level is shallow (ankle-level depth). Deforestation activities were visible near the rivers. If it is not managed properly, this could lead to greater impacts during heavy flooding and rain events. The Dixon reef estuarine area is highly populated and this is thought to be the source of much exploitation of the freshwater resources. Awareness on watershed management is recommended to be targeted toward these communities.

In Vanuatu, two species of introduced fish (*Tilapia mosambicus* and *T. niloticus*) are listed as invasive and are already present in Maleluka. Although these species have been observed in a lake in the central part of Malekula, the surveyed river sites in the two Key Biodiversity areas did not contain any evidence of their presence. Additional freshwater studies should be conducted at the sites and in surrounding freshwater areas to monitor for any incursion of these invasive species.

The invasive aquatic water lettuce (*Pistia stratiotes*) was observed in a stream in the Letokas area (Figure 20). Again, monitoring of this invasive plant(s) is recommended. Natural resource exploitation continuously pressures freshwater ecosystems and responsible management practices are encouraged to conserve fish, eels and prawns, which are important food resources for the local residents.

For Wiawi KBA, the three species of flagtails were observed throughout all three rivers, as well as the commonly occurring Golden red Stiphodon (*Stiphodon rutilaureus),* Northern mud gudgeon *(Ophiocara porocephala)* and Gobie ocelle (*Awaous ocellaris).* A number of the three species occur in slowing flowing zones of the lower course of Lawipa river (Figure 2).

Other observations included a juvenile Polynesian longfinned eel (*Anguilla megastoma)* was spotted swimming downstream as it scavenged for food in Lawipa river and five mature Pacific short-finned eels (*Anguilla obscura*) were seen sleeping along its closed estuary in the littoral zone.

Due to the small population of Seventh-day Adventists not catching them, (*Macrobrachium lar*) is prevalent in Wiawi freshwaters, specifically in the Nalep lake and Wiel river. In contrast, the crustacean is scarce in Wilak village, Lawipa River, and it is believed that the high human village population is responsible for its scarcity, due to its consumption and economic significance.

The *Varuna litterata* crab is common along the riverbanks of Lawipa and Wiel river estuary, with its square shell and hairy pair of legs. Another crab species was found within Lawipa waters but could not be identified with the Freshwater booklet.

The Nalep River runs through a cattle farming area. The river's upper and middle sections may have dried up as a result of cattle trampling and grazing on nearby vegetation. The riparian vegetation that grows along the river's lower reach is still present. Little vegetation remains on the riverbank, resulting in muddy soil and may accelerate soil erosion. The cattle farm or less intact forest surrounding its water catchment, may be responsible for the dryness of the upper and lower reaches.

Gardening activities that occur on the riverbanks have been observed in the lower reaches of both freshwater sites in both KBAs. These activities were identified to be a common threat to riparian biodiversity.

Replanting native trees along riverbanks is important for a number of reasons, including the fact that the leaves and organic matter of the trees provide nutrients, controls the quality of freshwater ecosystems, and set the temperature in which freshwater species can thrive.

It is important to protect estuary areas that are the entryway for the migration of transitory species to complete their lifecycles. Workshops and awareness programs should be held in communities and schools to educate adults and children of the significance of conserving and protecting freshwater ecosystems and species.

4.5 CONCLUSION

In conclusion, for the freshwater species evaluated in both KBA's, a majority of their distribution were confirmed on Malekula Island, in reference to the Vanuatu Freshwater Fish and Crustacean research booklet.

These freshwater survey findings indicate that Bamboo Bay KBA has a greater count of individual fish than Wiawi KBA, but both sites recorded eight species, with the three *Kuhlia spp* occurring in both areas. The outcome of the species count show that this might be a result of the archipelago and environment of the southwest part of Malekula Island. In the Bamboo Bay area, one species of eel fish was found in Dixon river mid-course, but there was no sign of a crab species in the areas that were surveyed.

In Lawipa river, there were fewer fish, but crabs were frequently observed. Nalep has a good number of eels in its area, compared to the other two rivers assessed in Wiawi KBA.

The high number of people living in Dixon area and their demand for food is likely the reason for reduced freshwater resources in terms of fish and crustaceans, as is similar to the Wilak area. The village settlement of Lawa is far from Noiwoiwoldip river, but human activities around the river was seen, such as deforestation.

It is thought that the communities adjacent to the KBAs are not sufficiently well informed of the significance of freshwater biodiversity, its ecosystem services and functions, nor of its benefits and values for people. Hence this recommendation for workshops on how to manage riparian ecosystems and spread awareness among communities. Knowledge on which species thrive in freshwater habitats and how to conserve them is also important. The conservation of ecosystems and the significant plants and animals that are found within a community's KBA, should go beyond the maintenance of resources for food.

Figure 41: Small cascade with intact trees on riverbank- Dixon River

4.6 RECOMMENDATIONS

- Hold local workshops to present findings from this study to each community in and around the KBAs.
- Hold awareness workshops for the villages in each KBA on freshwater conservation and the management of riparian areas.
- Produce awareness tools such as posters and pamphlets of important species (e.g. the life cycle of eels) for workshop to the communities and schools.
- Restore the riparian zone by establishing riparian trees and smaller plants along the rivers.
- Cameras made available for quality pictures for freshwater species.
- Broaden assessment surveys and monitoring of rivers and streams and lakes of the two KBA areas to collect more information on freshwater aquatic diversity of the area and surveillance of the already resident invasive fish species.

Chapter V

Invasive Ants

The occurrence of introduced species of ants (Hymenoptera, Formicidae) on three priority sites for biodiversity on Malekula Island, Vanuatu

5.1 INTRODUCTION

The main threat to Key Biodiversity Areas (KBAs) in the Pacific region is considered to be the spread and occurrence of invasive species (CEPF 2007, SPREP 2013). There is considerable data concerning the presence of invasive mammals (rats, cats, pigs and dogs) in Melanesian forested areas, while invasive weeds are known to cause significant damage to native forest whenever areas are disturbed. This study looks at another group of invasive species – the ants. There are five species of ants that are listed in the IUCN list of the World's Worst Invasive Species (Lowe *et al* 2000). Although four of these five species are known to occur in Vanuatu, there is little information on their distribution between the various islands.

A focus of this BIORAP assessment was to consider the potential impact of invasive ant species on the native biodiversity. This report focusses on the specimen data collections of invasive ant species that were collected through the 3 different surveys in the Malekula KBAs in the southwest and northwest parts of Malekula Island.

5.2 METHODS

Pitfall traps were set at Tsiri by baiting the traps with peanut butter and soap. After the Tsiri survey, it was decided that canned tuna was more attractive than the other two baits, and thus it was decided to use canned tuna baits at Bamboo Bay and Wiawi, alongside peanut butter.

Figure 42: Pitfall trap baited with soapy water

Figure 9: Canned tuna bait

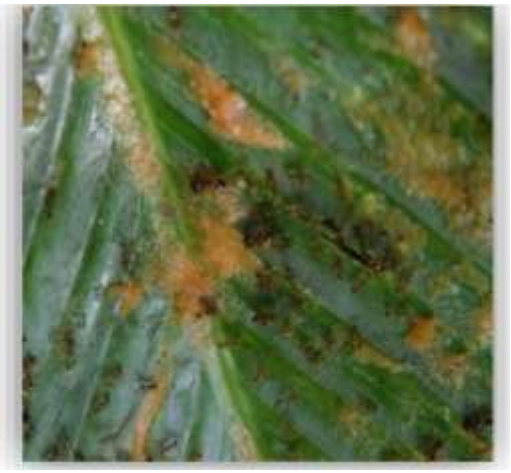


Figure 10: Peanut butter bait

The pitfall traps were placed at three points along a one kilometre transect. The first quadrat was at the starting point, second 500 m along the transect and the third quadrat was placed at 1000 m. Each trap was checked after half an hour (30 minutes).

The specimens were collected, rolled on a tissue and placed into a small specimen container. The specimens were brought back to the laboratory for identification after collection in the field. Identification was made using a compound microscope and the dichotomous method devised by the Pacific Invasive Ants Identification key booklet (Pacific Invasive Ants Taxonomy Workshop).

5.3 Results

These three sites were surveyed for invasive ant specimens: Tsiri Lagoon, Bamboo Bay and Wiawi.

TSIRI LAGOON IMPORTANT BIODIVERSITY SITE

Tsiri lagoon is primarily a wetland lagoon environment, and there was continual rain during the survey period. The area was mostly new settlements and associated cultivated land. Five different species of invasive ants were found throughout the Tsiri lagoon.

Table 14: The species and their habitat associations at Tsiri Lagoon. Traps were set in cultivated land (garden and cocoa and coconut plantation).

Species Name	Habitat Where Species Were Collected	Image of Species from Tsiri Lagoon
Solenopsis sp.	This species lives on small plants and short and tall trees between the branches and their leaves. It was present on the soils that are surrounded with dry green leaves, small bushes, dry and green branches, tall and short trees. Muddy soil, swamps, soil near the lagoon	
Pheidole megacephala	This species lives on small plants and short and tall trees between the branches and their leaves. It was present on the soils that are surrounded with dry green leaves, small bushes, dry and green branches, tall and short trees.	

Wasmannia auropunctata	This species lives on small plants and short and tall trees between the branches and their leaves. It was present on the soils that are surrounded with dry green leaves, small bushes, dry and green branches, tall and short trees. On the beach. Also recorded on houses in the bush.	
Monomorium sp.	This species lives on small plants and short and tall trees between the branches and their leaves. It was present on soils that are surrounded with dry green leaves, small pushes dry and green branches, tall and short trees. Muddy soil, swamps, soil near the lagoon	

Figure 45: The location of the invasive ant species recorded at Tsiri Lagoon.

Bamboo Bay KBA

Conditions at Bamboo Bay are much drier than Tsiri lagoon, although there are seasonal creeks and streams. The area was largely covered with bamboo with primary (moist) forest at higher elevation. There was also cultivated land.

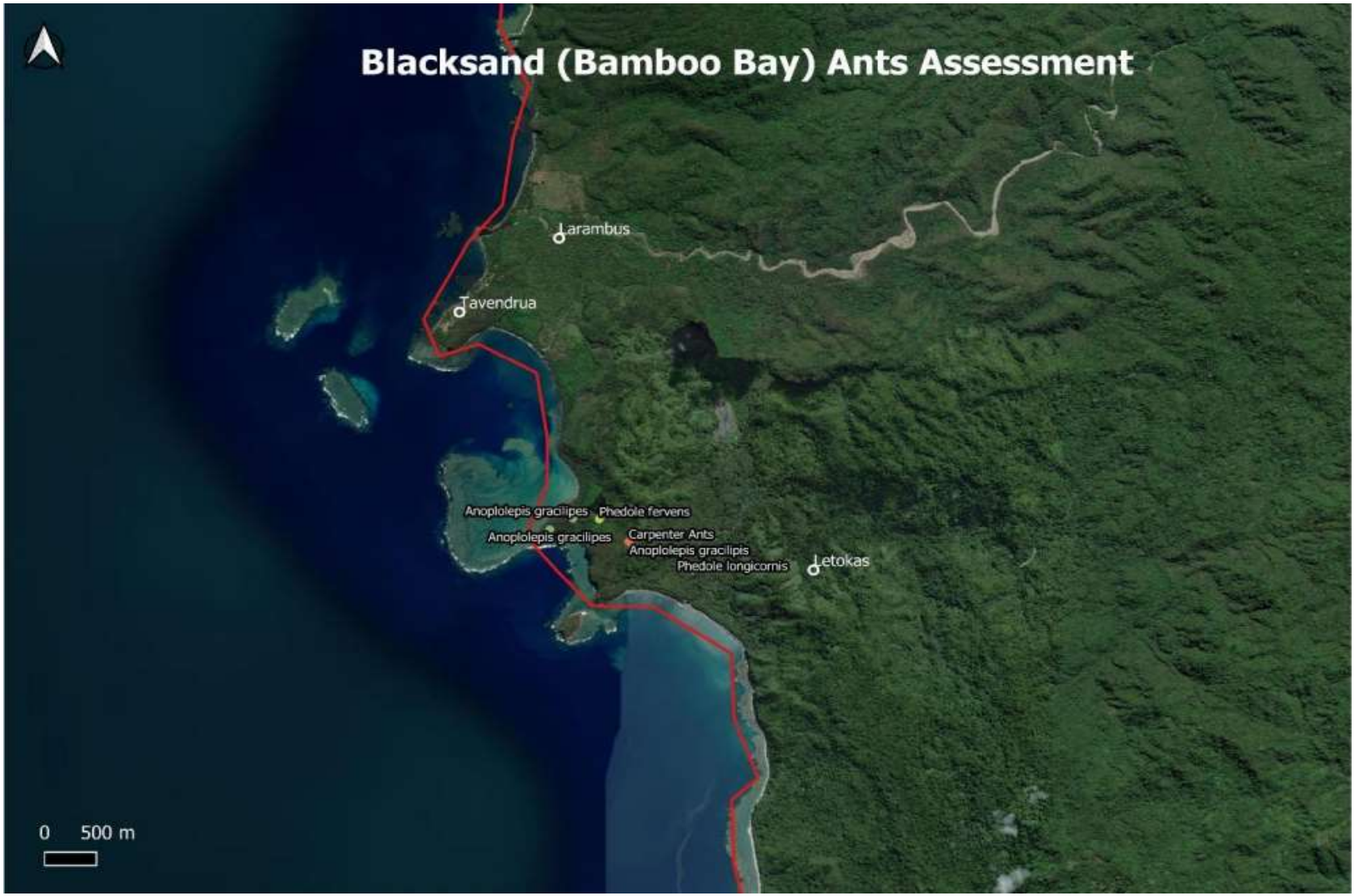
Table 15: The species and their habitat associations at Bamboo Bay.

Species Name	Habitat Where species was collected	Image of species from Bamboo Bay
Linepithema humile	On moist soil under dry bamboo leaves under tall trees and on cultivated land (gardens).	
Anoplolepis gracilipes	On moist soil under dry bamboo leaves under tall trees and on the cultivated lands (gardens). Near the creek, small streams and the bushes	
Pheidole fervens	On moist soil under dry bamboo leaves under tall trees and on the cultivated lands (gardens). Near the creek, small streams and the bushes	

Paratrechina longicornis	On moist soil under dry bamboo leaves under tall trees. Spotted in between the bamboo leaves and the tree's bark	

Figure 46: Map showing the Munvet area of Bamboo Bay and the location of species collected at this site.

Figure 47: Map showing the species distribution at the black sand area of Bamboo Bay.



WIAWI KBA

The Wiawi weather conditions was drier with swamps, cultivated lands and new settlements with bushes and dry forest. Five different species of invasive ants were found at Wiawi.

Table 16: Different species and their habitat at Wiawi. Samples were collected on dry soil, surrounded with dry leaves and branches.

Species Name	Habitat where species collected	Images of species from Wiawi.
Paratrechina sp. longicornis	Spotted on the dry wood bark	
Solenopsis sp.	In gardens and the coconut and cocoa plantations	

Wasmannia aurupunctata	In gardens, the coconut and cocoa plantations, near the swamps and in the houses.	
Pheidole fervens	In gardens, the coconut and cocoa plantations, near the swamps	
Anoplolepis gracilipes	In gardens, the coconut and cocoa plantations, near the swamps and on the beach.	

Figure 48: Map 4 showing the Invasive ant species distribution at Wiawi.

5.4 DISCUSSION

Table 17: Summary of the proportion of sites that each species group was recorded.

Species	Bamboo Bay	Tsiri	Wiawi	Grand Total
Anoplolepis gracilipes	50%	0%	27%	28%
Carpenter Ants	50%	33%	40%	42%
Linepithema humile	8%	0%	0%	3%
Monomorium sp.	0%	33%	0%	8%
Paratrechina sp.	17%	11%	20%	17%
Pheidole fervens	42%	0%	0%	14%
Pheidole megacephala	0%	22%	0%	6%
Solenopsis sp.	0%	11%	20%	11%
Wasmannia auropunctata	0%	44%	13%	17%

TRAMP ANTS

Many of the species on this list, *Anoplolepis gracilipes*, *Linepithema humile, Solenopsis* sp., *Pheidole megacephala and Wasmannia auropunctata* are known as tramp ants. These are species that easily become established and dominant in a new habitat due to traits such as aggression toward other ant species, little aggression toward members of its own species, efficient recruitment and large colony size (Kirschenbaum and Grace 2008). They are considered to be the five worst invasive ant species, and all are on the IUCNs 100 of the World's Worst Invasive Alien Species list due to the damage they cause, and their worldwide distributions.

Anoplolepis gracilipes, Yellow crazy ant. This species is thought to be native to West Africa or Asia but has been accidentally introduced to many countries around the world's tropics. Populations can be especially dense in the Pacific region. *A. gracilipes* can cause significant damage to native biological diversity. Records from Vanuatu go back at least to the 1960s, and the species is well-established across many of the island groups. The species was recorded at both Bamboo Bay and Wiawi but, surprisingly, not at Tsiri.

Linepithema humile, Argentine Ant. This species is native to South America, from northern Argentina, through Uruguay, Paraguay and Boliva to southern Brazil. There are no records for this species on GBIF from Vanuatu – all records in the region are restricted to Guam and Hawaii. Accordingly, confirmation of the identification of this species at Bamboo Bay on Malekula Island is a priority as this would represent the first record for the country.

Solenopsis sp, Fire Ant. Over 200 species of Solenopsis have been identified. One of these, the Red Imported Fire Ant, *Solenopsis invicta*, is an invasive pest in many parts of the world. It is thought to have been transferred around the globe in shipping crates, and the likely source of their introduction to Australia. Regular sightings in Efate and Tanna are all identified as *S. geminata, the* Tropical Fire Ant – a species distributed throughout the Pacific from Timor Leste to French Polynesia and Hawaii.

Pheidole megacephala, big-headed ant, coastal brown ant. This is a very successful invasive species and considered a danger to native ants in Australia and elsewhere. Originally from

Africa, the species is present throughout the Pacific region from PNG and Northern Marianas to Hawaii and Tahiti. There have been sightings in Efate and Tanna with first records from the 1970s. There were no previous records from Malekula.

Wasmannia auropunctata, Electric ant, Little Fire-ant. Another very successful invasive species that is known to occur from Vanuatu, Solomon Islands, New Caledonia, Yap and Northern Marianas. Records further east are not yet confirmed (although colonies have recently been established in Fiji). There are no records on iNaturalist from Vanuatu – the species is considered to be present in the Banks Island and maybe Santo. This would be the first confirmed record for as far south as Malekula Island.

OTHER ANT SPECIES

Camponotus sp. Carpenter Ants. Carpenter ants are large ants, indigenous to many forest parts of the world. There are 15 observations of *Camponotus* ants in Vanuatu on PBIF, and all those identified to species in PBIF are listed as *C. chloroticus. C. chloroticus* is native to Pacific Islands from New Caledonia, Solomon Islands and east to Cook Islands. There is a record on iNaturalist, from 2023, for Malekula. *Camponotus* ants are not considered to be invasive, although they can damage wood used during the construction of buildings.

Monomorium sp. is a genus of ants which has about 400 species that are distributed around the world, with many species native to the Old World Tropics (Aldawood and Sharaf 2011). It includes several pest species, two of which, *M. pharaonis* (Pharaoh Ant) and *M. floricola* (Flower Ant), have been recorded in Efate, Vanuatu. All records are recent (since 2022) and there is no previous record of either species away from Efate in Vanuatu – suggesting that this may be a very recent colonist. Accordingly, confirmation of the identification of the species involved, at Tsiri in Malekula– the only site where it was found during this study - is a priority as this would represent the first record for the island and province.

Paratrechina sp. There are only seven species of *Paratechina* and all but one are native to sub-Saharan Africa and Madagascar. The seventh species is only found in southern China. Only one species is found outside these regions – *P. longicornis*, the Black or Longhorn crazy ant. Listed as one of the 13 other problematic ant species, it occurs throughout the Pacific island countries and territories. Within Vanuatu there were seven observations from Tanna to Malekula.

Pheidole fervens. Recorded in a number of Pacific island countries, including Vanuatu. However, there are no records on PBIF or iNaturalist for this species. A number of other *Pheidole* species have been recorded in Vanuatu, *P. oceanica, P. umbonata, P. templaria* and all have been recorded on Santo, with the former two also present on Efate. Clearly, confirmation of the species identification is required.

5.5 SUMMARY

This survey has obtained samples from a series of locations through the three key sites in the survey. It was unfortunate that the samples could not be exported and identified by an ant expert. It was a shame that the images captured were not uploaded to a portal, such as iNaturalist, to determine whether the images are sufficient to confirm identification of the species. Many of the most recent observations of ants in Vanuatu, and elsewhere, are a consequence of identification by experts through iNaturalist.

There is an immediate need to confirm the species involved. Four of the five most damaging invasive ant species were recorded during this survey, and a number of the other species are included in a secondary list of the next 13 most damaging species.

There is general agreement that these invasive ants can impact on biodiversity, when they are at sufficiently high densities, but there is little/no information on whether/when these species are achieving these levels in many Pacific Island countries, and particularly in Vanuatu. These sites in Malekula may appear to be natural forested areas, but the presence of this number of invasive species of ants, and the presumed presence of rats, cats, pigs and dogs, etc as well as weeds, is likely to be reducing the ecological integrity of the sites. Assessing the extent to which this integrity has been reduced, and the extent to which it has compromised the resilience of the sites to other threats (such as Climate Change) should be a high priority for future conservationists.

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Appendices

APPENDIX 1. FURTHER NOTES FROM THE FLORA FIELDWORKERS REGARDING THE SITES SELECTED

Table 18: Numbers of Transect that were setup on different types of forest in every key biodiversity area.

Types of Forest	Dry Dense Forest	Mountain Cloud Forest	Secondary Forest	Primary Lowland Forest	Thickets
Tsiri Lagoon	1 transect ridge 40 meters		1 transect slope 40meters	1 transect 40 meters	1 transect 40 meters
Munvet, Bamboo Bay/Small Nambas		1 transect 40 meters		1 transect 40 meters	
Blacksand, Bamboo Bay/Small Nambas		1 transect 40 meters			1 transect 40 meters
Dickson reef, Nemake Lake Vegetation(?), Bamboo Bay/Small Nambas KBA	1 transect 40 meters				
Wiawi KBA		1 transect 40 meters	1 transect 40 meters		1 transect 40 meters

Figure 49: Setting up of transect in 13 different vegetation types in 3 Key Biodiversity Areas.

Figure 50: The picture shows the abundance of Merremia on Tsiri lagoon.

APPENDIX 2. THREATS TO FOREST ECOSYSTEM

The threats to ecosystem a Human Activities such as gardening, new settlement, logging, cattle farming, and bush fire especially on the tickets area. Cattle disturb growth of forest- Damage to Seedlings. The natural disaster such as cyclone, drought and heavy down fall of rain.

Figure 51: Some of the picture showing the disturbance on forest vegetation by cattle farming.

APPENDIX 3. TSIRI LAGOON

Figure 52: Surveying Tsiri lagoon

APPENDIX 4. MUNAVET

Figure 53: Surveying Munavet

APPENDIX 5. BLACK SAND

Figure 54: Surveying Black Sand area

APPENDIX 6: REPTILE TEAM

Figure 52: Some more images of various Herptiles recorded during the survey.

APPENDIX 7: PRIORITISING THE REPTILE SPECIES RECORDED ON MALEKULA

IUCN Red List species recorded on Malekula

Leodoro and Tavue (in prep) recorded 9 species of skinks/geckoes, 1 snake and 1 frog on the three sites surveyed on Malekula. Eight of these nine species are listed in the IUCN Red List for species – all classed as of Least Concern.

The ninth, *Cryptoblepharus pulcher*, is a species endemic to southern and eastern Australia. There are related species that occur in Vanuatu – most notably *C. novohebridicus* – which is endemic to Vanuatu and also classed as Least Concern. Clearly there is a need to confirm the identity of the Cryptoblepharus spp on site.

Three species are endemic to Vanuatu – *C. novohebridicus* (if we assume this to be the correct species), *Emoia sanfordi* and *E. nigromarginata*. Only the latter qualifies as a Restricted Range species, *C. novohebridicus* occurs throughout Vanuatu while *E. sanfordi* is excluded only from the Tafea province. The range of both species is, therefore, in excess of 10,000 km^2. Therefore, only *E. nigromarginata* can contribute to KBA criterion B2. A minimum of two species of reptile are required for this criterion, so it becomes unavailable for any of the sites assessed in Malekula.

Improved knowledge of the occurrence/distribution of *E. nigromarginata* should be the focus of any future work on Malekula, along with a detailed search to confirm the continued presence of the Vulnerable *Gehyra georgpotthasti*. These, combined with further information on the distribution, status and habitat requirements of the other endemic species present – *E. sanfordi* and confirming the identification of the *Crytoblepharus* species would provide a body of work on the island.

APPENDIX 8 FISH CHECKLIST

Scientific Name	Common Name	Bislama Name	Southwest Bay- Lawa vernacular Name	Wiawi Vernacular Name	Red List Category
Kuhlia marginata	Dark-margined (Silver) flag-tail	Fis blo wota	Nimigaehmis	Tilou nawei (Freshwota fish)	LC
Kuhlia munda	Silver flagtail	Fis blo wota		Tilou nawei	DD
Kuhlia rupestris	Rock flagtail (Jungle Perch)	Fis blo wota	Nombothogothabo	Tilou nawei	LC
Eleotris fusca	Broadhead sleeper		Bombolasowongeh	Tilou nawei	LC
Ophieleotris aporos (=Giuris margaritaceus)	Snakehead gudgeon			Tilou nawei	LC
Ophieleotris sp.	Eleotris serpent			Tilou nawei	
Ophiocara porocephala	Northern mud (Spangled) gudgeon			Tilou nawei	LC
Awaous ocellaris	Gobie ocelle		Kalbobotei	Tilou nawei	LC
Stiphodon rutilaureus	Golden red Stiphodon			Tilou nawei	
Macrobrachium lar	Giant jungle prawn	Naura blo wota	Nurhrai	Nuur nanao	LC
Macrobrachium latimanus	Mountain river prawn	Naura blo wota	Nurhrai		LC
Macrobrachium grandimanus	Hawaiian river prawn	Naura blo wota	Nurhrai		LC
Caridina weberi	Webers shrimp	Smol naura			LC
Anguilla reinhardtii	Speckled (Australian) longfin-eel	Namarae	Nesleven dam	Mnari	LC
Anguilla obscura	Pacific shortfinned-eel	Namarae	Nesleve niaveh	Mnari	DD
Anguilla megastoma	Polynesian (Pacific) longfinned eel	Namarae	Nesleve sohra	Mnari	DD
Varuna litterata		Krab	Norkhum	Rharehum	NR
Crab unknown		Krab	Nokhum	Rharehum	

APPENDIX 9 FRESHWATER NOTES

Note that only one of the species (*Varuna litterata*) is not listed on the IUCN Red List for species. All other species are either Least Concern and wide-ranging (the fish *Awaous ocellaris* is listed as Restricted Range – but that is based on an inaccurate distribution map on the Red List page which does not accord with the geographic description onthe same site).

The IUCN Red List Geographic Range does not include Vanuatu for the following species: *Macrobrachium lar*, *M. latimanus*, *M. grandimanus* or *Caridina weberi*. It would be logical to bring this information, and the information on GBIF, to the attention of the Red List Assessment team as soon as possible.

Note that there are no records, on GBIF, of *Macrobrachium grandimanus* or *Varuna litterata* from Vanuatu. A priority should be to ensure that these records are reported in such a way that these will be added to the formal list of species that occur in country. Including the photographs of the species on iNaturalist would be a simple, and easy, way to achieve this.

Figure 53: Trees around Nalep estuary in Wiawi area.

Figure 54: A glass eel of an Anguilla sp. cut by a young field assistant found in Nalep estuary- Wiawi area

Figure 55: Identification of Macrobrachium lar and Macrobrachium latimanus in Dixon River.

Figure 56: Invasive Pistia stratiotes in a river at Letokas area in Bamboo Bay area.

Figure 57: Riparian zone of Nalep river. A young field assistant holding a scoop net in Wiawi area.


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