Pacific Community
Communauté du Pacifique

Rapid Coastal Assessment of Mataniko River Catchment Report, Honiara, Guadalcanal Island, Solomon Islands

gef
UNDP Empowered lives. Resilient nations
FAO FIAT PANIS
UN environment programme
Pacific R2R Ridge to Reef

Rapid Coastal Assessment of Mataniko River Catchment Report, Honiara, Guadalcanal Island, Solomon Islands

Produced and reviewed by GEF Pacific International Waters Ridge to Reef Regional Project,
Pacific Community (SPC), Suva, Fiji

Pacific Community
Communauté du Pacifique

Suva, Fiji, 2020

Original text: English

Citation: Sobey, M. (2020) Rapid Coastal Assessment of Mataniko River Catchment Report, Honiara, Guadalcanal Island, Solomon Islands. Suva, Fiji SPC, 38 pp

Reviewed by George Naboutuiloma, Samasoni Sauni, Fononga Mangisi-Mafileo, Jose Antonio, Jade Delevaux, John A. Carreon, and Hilda Waqa-Sakiti.

Layout and Design by Navneet Lal / Pacific Community (SPC)

Jointly produced and funded by the SPC Regional IW R2R Project and the Ministry of Environment, Climate change, Disaster Management and Meteorology.

Prepared for publication at SPC's Suva Regional Office, Private Mail Bag, Suva, Fiji, 2020

www.spc.int | spc@spc.int

Printed by Quality Print, Suva, Fiji, 2020

CONTENTS

ABBREVIATIONS

BMU	The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Cefas	Centre for Environment Fisheries and Aquaculture Science
CME	Commonwealth Marine Economies
DBH	Diameter at Breast Height
GEF	Global Environment Facility
HURCAP	Honiara Urban Resilience and Climate Action Plan
IW	International Waters
MECDM	Government Ministry of Environment, Climate Change, Disaster Management and Meteorology.
MEP	Marine Economies Programme
NOC	National Oceanography Centre
PEBACC	Pacific Ecosystem-based Adaptation to Climate Change
R2R	Ridge to Reef
RapCA	Rapid Assessment of Coastal Areas
SPC	The Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
UKHO	United Kingdom Hydrographic Office

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

There are a number of people whose assistance in the collection of primary data must be gratefully acknowledged:

- Myknee Sirikolo and his team who did the botanical survey – Robert Olisae, Ruvie Pitavoqa, Keith Moveni, John Dovi.
- Andy Smith and his team from Cefas – Scott David and Andy Powell.
- David Boseto and Ikuo Tigulu who did the freshwater and terrestrial faunal surveys.
- Patrick Kekefe and his team who did the creel survey – Mande Poha, Sunita Pikacha and Shelly Tutua.
- Sammy Airahui, the R2R national project manager who organised all logistics and MECDM staff for logistical support.
- Fred Pattison, PEBACC project Country Manager who assisted in the selection of sites for the surveys.

EXECUTIVE SUMMARY

This exercise was the second trial of the methodology devised for the Rapid Assessment of Coastal Areas (RapCA) after the initial trial in Tagabe catchment, Vanuatu. Primary data was collected for four specific indicators to characterise Mataniko catchment, the pilot site for the Global Environment Facility (GEF) International Waters (IW) Ridge to Reef (R2R) project in the Solomon Islands. The fieldwork was conducted over a week in October 2018 by teams from the National Herbarium, a consultant freshwater biologist and his field assistant, and a team of enumerators for the creel survey, working simultaneously in the collection of primary data on the indicators E1 Diversity, E3 Habitat Quality and SE4 Exploitation of Living Resources. The data collection for indicator E6 Water Quality was conducted over three days in September 2018.

For the measurement of indicator E1, a forestry survey was conducted at the ridge in the upper Mataniko/Barana catchments. Relative dominance of endemic, native and introduced species was determined. A checklist of plant species was compiled, which revealed relatively low endemism. There are many trees that provide a number of different ecosystem services to the local communities and are worthy of conservation.

The measurement of Indicator E3 was conducted by the assessment of the Ngoti stream system that feeds into the Mataniko river upstream. The freshwater fauna of the stream and terrestrial fauna of the surrounding environs were surveyed. The stream system supports a large number of freshwater taxa, which would indicate a healthy system and the species present indicate connectivity between the stream and ocean via the Mataniko river. An important subsistence fishery exists that is endangered by the use of chemicals in the harvest of freshwater prawns.

Monthly water qualiy monitoring at the Mataniko River Catchment

Three endemic birds inhabit the catchment, one of which is a totemic bird to the local villagers and listed in the IUCN Red List as vulnerable i.e. the Solomon sea eagle Haliaeetus sanfordi locally known as “manuchacha”.

The measurement of indicator SE4 was done by means of a creel survey. Interviews were conducted with 93 individuals from Renlau, Lord Howe and Fishing Village communities. Fishing is a major revenue earner for the Fishing Village community who fish furthest offshore, whereas Renlau members fish for subsistence at the Mataniko river mouth and shallow coastal waters. Lord Howe community members appear to fish the least.

The measurement of indicator E6 revealed sewage pollution in the river from the informal settlements that line the river. The results confirmed findings from previous studies that have highlighted the poor water quality in the river due to poor sewage and solid waste disposal.

The upper Mataniko/Barana catchments are of high conservation value due to the high species diversity of both aquatic and terrestrial ecosystems. The survey recorded 76 tree species within vegetation plots of which five are endemic: Canarium salomonense, Ptychosperma solomonensis, Melastoma novae-georgiae, Physokentia insolita, Heterospathe solomonensis and the endemic palm Rhopaloblaste elegans.

The freshwater fauna is diverse and is a source of protein for villagers living upstream and the floral diversity provides a number of critical ecosystem services for the local communities.

1. INTRODUCTION

Component 1 of the GEF Pacific International Waters-funded Ridge to Reef Program seeks to implement national pilot projects in 14 countries. The national projects have been designed to integrate land, forest, water, biodiversity and coastal resource management to enable poverty reduction, sustainable livelihoods and climate resilience. Output 1.1.1 states “14 national pilot project area diagnostics based on R2R approach including baseline environmental state and social data incorporating CC vulnerabilities; and local governance of water, land, forests and coasts reviewed”. One of the activities supporting this output is the characterisation of the pilot site in terms of the physical, biological and social variables that will lend to the holistic management of the ecosystems and the rapid assessment of the coastal areas identified by the countries requiring ridge to reef interventions.

The data gaps to be filled by the fieldwork in the Solomon Islands were determined by an extensive literature review and discussions with project managers of the Pacific Ecosystem-based Adaptation to Climate Change (PEBACC) project implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP) and the Solomon Islands Government and funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) ; and the Commonwealth Marine Economies (CME) Programme for the Pacific, funded by the United Kingdom Government and implemented by the Centre for Environment Fisheries and Aquaculture Science (Cefas), the UK Hydrographic Office (UKHO) and National Oceanography Centre (NOC). Both projects are being implemented in Fiji, Vanuatu and Solomon Islands. After reviewing the 22 indicators that were selected for measuring in RapCA (Annex 1), the only ones where primary data collection was deemed necessary were for Water Quality, Exploitation of living resources, Diversity, and Habitat Quality. The data for the other indicators can be accessed from different Government agencies and project reports.

The focus of this report will be on those indicators for which primary data was collected.

1.1 Description of Project site

The Mataniko catchment is roughly 20 km^2 in area and has a population density of 5112 people per km^2 which is twice that of the rest of Honiara (Trundle & McEvoy 2016). The lower catchment has light industry in Chinatown, NGO offices and small businesses with some large informal settlements where at least 20% of the population resides. The lower catchment is exposed to severe flooding risk as evidenced by the catastrophic April 2014 flood. At the mouth of the Mataniko River is one of the most densely populated settlements, Ontong Java, otherwise known as the Lord Howe settlement. The settlement has major problems with riverine flooding, coastal erosion, high population density and excessive levels of sewage pollution. Settlements further inland like Tuvaruhu and the Fijian Quarter are exposed to sewage effluent from settlements in neighbouring Kola'a. There are several tributaries that flow into Mataniko River and there is largely secondary forest and grassland in the upper catchment. The rationale for doing the botanical survey in the upper Mataniko and Barana catchments, which share a common border, was because a key component of the national R2R project is to monitor pollution and nutrients entering Honiara coastal waters. This will require ridge to reef interventions starting from the forests at the "ridge". The PEBACC project implemented by SPREP and the Solomon Islands Government is also working in the Mataniko/Barana area, thus affording an opportunity for partnership and complementarity.

1.2 Policies and Legislation

There are three Acts that have a direct bearing on the management of Mataniko catchment. The first is the Environment Act (1998), which is the umbrella legislation for environmental governance in the Solomon Islands. Part IV of the Act addresses Control of Pollution. It stipulates that no person shall allow waste to be placed in any location where it will likely result in pollution. There are fines prescribed for those that breach the Act, but given the huge volume of sewage and solid waste being disposed in the Mataniko waterways, the Act is clearly not rigorously enforced. The Environment Regulations (2008) also cover waste disposal but are specifically intended for the preparation of Public Environmental Reports or Environmental Impact Assessments for any development application.

The River Waters Act (1964) was revised in 1996. The Act prohibits any structure that might impede the flow of a river. It covers developments that will impact rivers specifically mentioned under the Act, which include the Mataniko River and its tributaries. The mounds of solid waste on the riverbanks would suggest that this Act is also not being enforced.

The Protected Areas Act (2010) provides guidelines for the selection, establishment and management of protected areas. The Act stipulates the need to furnish scientific evidence to support the application for an area to be declared a protected area and proof of local support for the application. It also regulates the research that can be done in such areas. The results of this RapCA exercise would support an application for the upper catchment to be declared a Protected Area if local communities deemed it appropriate.

The Forests Bill (2004) provides for the conservation and protection of forests and the improved management of forest resources, control harvesting of timber and to facilitate sustainable forestry practices.

1.3 National Plans

The national plan most relevant to the Mataniko catchment is the Honiara Urban Resilience and Climate Action Plan (HURCAP) developed in 2014/2015 after the extreme flooding event of April 2014 that claimed 22 lives, destroyed 675 homes, displaced thousands of residents and caused an estimated USD 108 million in damages. The plan is designed to increase Honiara's resilience to impacts of climate change, the urban drift from rural areas leading to expanding informal settlements, increasing pressure on the environment and existing infrastructure of the municipality and the associated socio-economic issues that arise. The HURCAP was developed through a participatory approach involving representatives from national and local government, NGOs, community representatives, private sector and other stakeholders. Specific actions in the plan for Mataniko include conducting a study of sewerage outfalls and exploring options for treating or piping sewage downstream. Another proposed action is to develop a protection plan for the local water source from the urban growth and to engage local informal communities. The Tagabe Catchment Management Committee of Port Vila, Vanuatu is specifically mentioned in HURCAP as a model that could be replicated for Mataniko River.

2. AIM

To characterise the Mataniko/Barana catchment by collecting baseline data for the following indicators:

E1 Diversity

E3 Habitat Quality

E6 Water Quality

SE4 Exploitation of living resources

3. METHODOLOGY

3.1 Indicator E1 Diversity

The flora survey site plots were randomly selected in the upper water catchment areas based on vegetation spot sighting and guided by an area map produced by the SPREP–PEBACC Project for the area. A total of nine 500 m2 plots were assessed over five days (Figure 1). Five plots were assessed in the upper reaches and four plots in the lower reaches of the Mataniko/Barana catchments that share a common boundary.

Different tasks were delegated and shared between the four Herbarium Officers who conducted the botanical survey (Figure 2).

i. Record and GPS reader

ii. Measure the tree diameter at breast height (DBH)

iii. Tree height measurement estimation

iv. Team Leader was responsible for tree species identification, general observation, assessment of the status of different plant species and compilation of the plant checklist

In each plot a tape 50 m long was extended and all trees within 5 m on either side of the transect were identified. Diameter at Breast Height (DBH) measurements were taken for all trees ranging from 10cm DBH and above using a diameter tape. Tree heights were collectively estimated through consensus of the four officers. The four corners of each plot were marked and pegged with four sticks and clearly tagged with red and yellow plastics for visibility.

The plot locations were marked and recorded with a Garmin GPS MAP 78 model. Each tree was identified taxonomically and recorded on the field form together with their diameter and height. A combined Plant Checklist was compiled that included all other plants observed within the watershed area. Important commercial trees, those used for special purposes, endemic and invasive plants within the area were noted.

The relative dominance of the ten species that occurred in at least four of the nine plots was calculated by calculating their basal area and dividing it by the total basal area for all 76 trees and multiplying by 100.

*Relative Dominance= basal area/total basal area (76 trees) * 100*

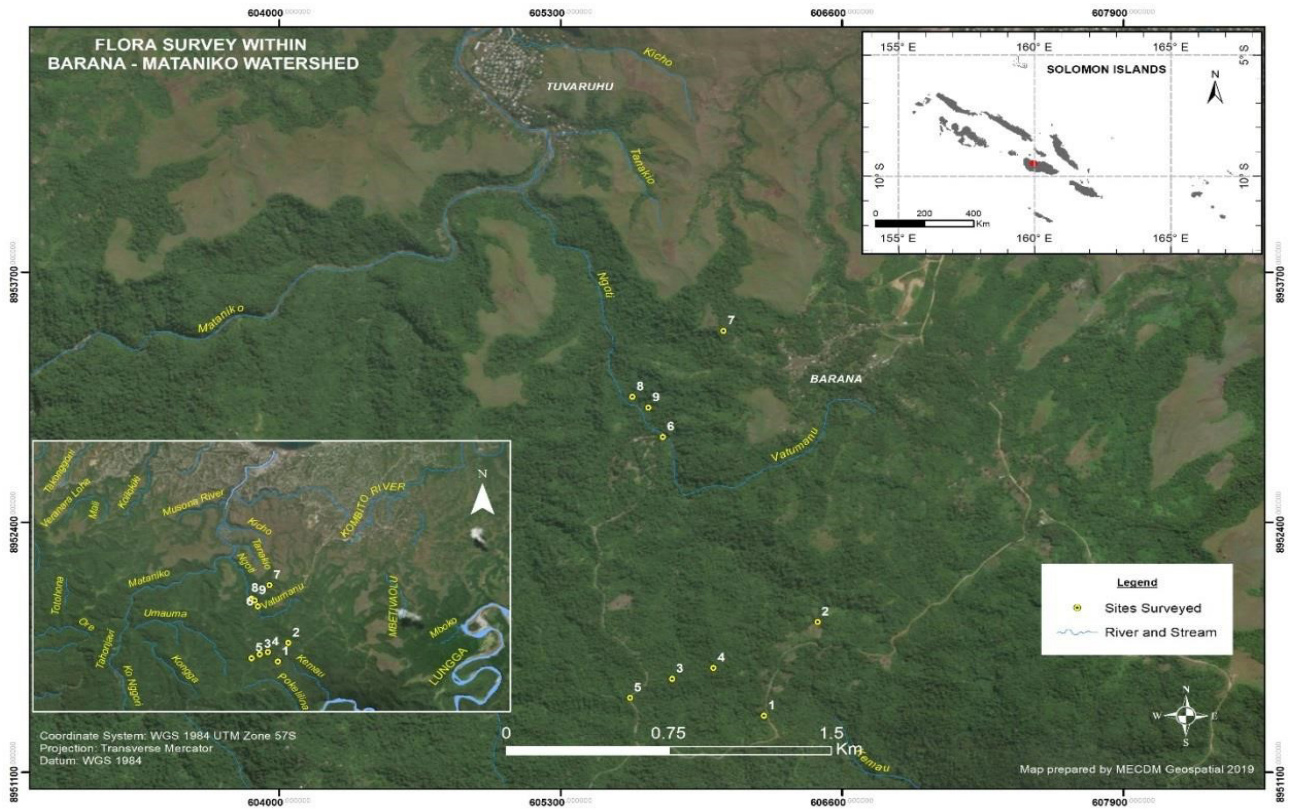

Figure 1: Botanical assessment sites in upper Mataniko/Barana catchments

Figure 2. Forestry survey team from left to right: Robert Olisae, Ruvie Pitavoqa, Keith Moveni, John Dovi and Myknee Sirikolo (team leader).

3.2 Indicator E3 Habitat Quality

The field survey was conducted over five days at the four sites in the Ngoti Stream system, which is located between Barana and the Mataniko Catchment (Figure 3). The Ngoti stream is located within a secondary forest that forms a confluence into Mataniko River and continues to flow downstream as Mataniko River (see Figure 4). Three days were spent conducting freshwater and terrestrial faunal surveys during the day targeting avifana, herpetofauna, freshwater invertebrates and vertebrates, insects and other terrestrial invertebrates; and two days were spent on nocturnal surveys targeting bats and herpetofauna.

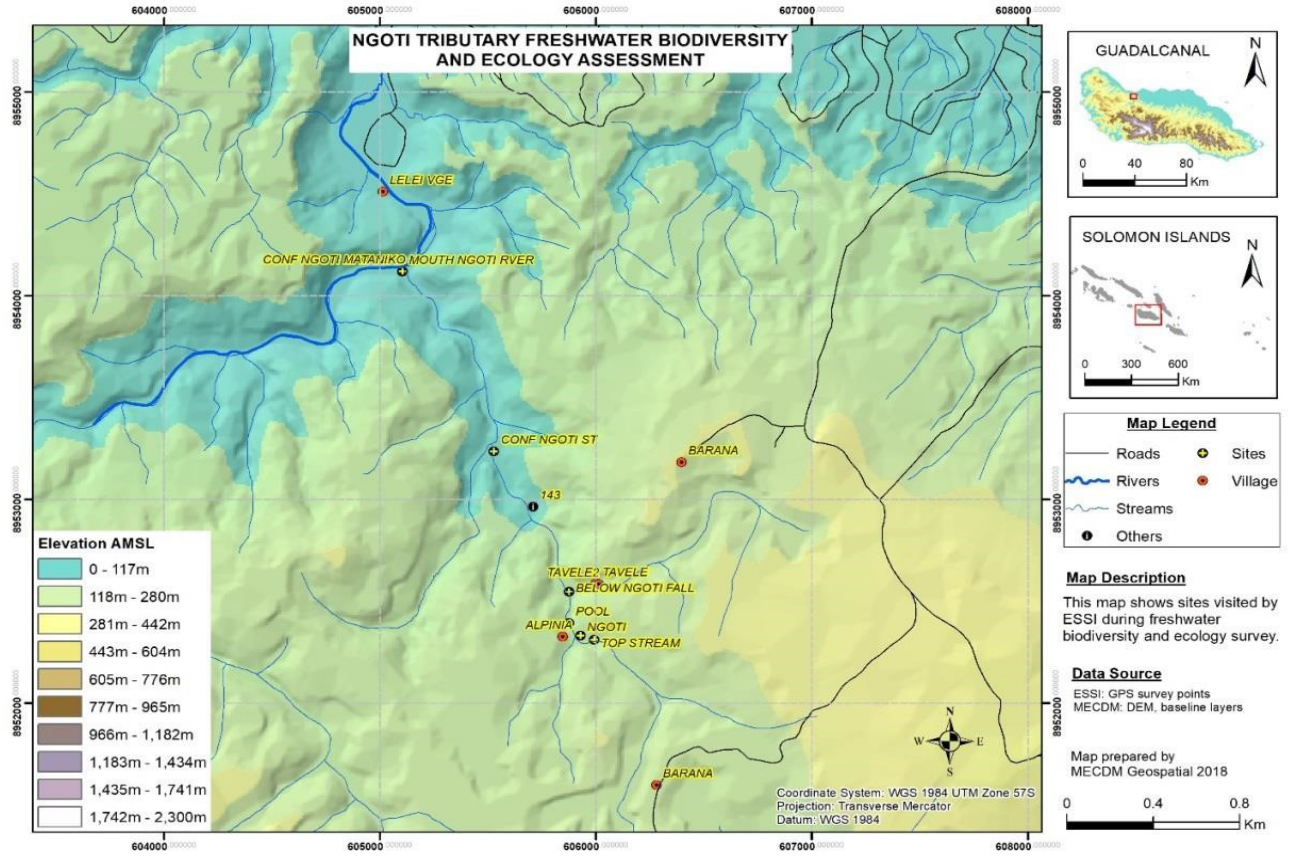

Figure 3. Four sampling sites for the freshwater and terrestrial faunal surveys

Figure 4. Ngoti stream system flows into the Mataniko River

3.2.1 Macro-invertebrates Sample Collection

A single sample was collected from each site using a hand-net (mesh 0.5 mm). A hand net was used in two ways to collect the macro-invertebrates (Figure 5). Five stones were randomly collected in the pool and washed inside the hand net detaching loosely attached organisms. The second way in which it was used was by placing it in the ripples downstream of the water flow after disturbing the habitat to dislodge the invertebrates. Active sampling of macro-invertebrates was also conducted on aquatic plants on the edges of the stream.

Active sampling was also was conducted on the edge of a slow flowing stream targeting the following taxa: snails and Odonata (damselflies) that prefer such habitats.

Figure 5. Aquatic fauna survey team member in Ngoti stream carrying hand net

3.2.2 Other Aquatic Fauna Survey

A 200 m transect line was used as a guide to document other aquatic life such as algae, aquatic plants, snails, crustaceans, macro-invertebrates and fishes.

Snorkel and underwater visual observations one metre on either side of the transect were used to document the aquatic fauna and flora (Figure 6). Some of the aquatic fauna were photographed *in situ* and also collected for identification.

Figure 6. Freshwater fauna survey team member snorkelling in stream

3.2.3 Terrestrial Fauna Survey

A visual survey method was conducted to record frogs, skinks, snakes, butterflies, birds and dragonflies by extending a 200 m transect and recording taxa 1 m on either side of the transect.

Another opportunistic survey method was employed whilst walking from the village to the study site and back. Any fauna observed one metre on either side of the track was recorded. Forest birds were documented based on actual sighting and on recognised bird calls.

Spotlighting was undertaken during the nocturnal surveys using LED flashlights from 6:00pm to 8:00pm to look for frogs, skinks, geckos and snakes along a 200 m transect beside the Ngoti stream. Frog calls and bird calls were also used to document those that were not sighted. The bats were documented at dusk when they became active.

Those specimens that could not be identified in the field were collected, sorted and identified at the accommodation using the following guides: Alison 2001 (snails), Gooderham & Tsyrlin 2002 (macro-invertebrates), Polhemus et al. 2008 (freshwater biota), Boseto 2011 (freshwater biota), Dutson 2011 (birds), and Marinow & Pikacha 2013 (dragonfly).

3.3 Indicator E6 Water Quality

The Cefas team worked with the R2R national Project Manager for a day and visited all seven sites along the Mataniko River (Figure 7). Using a modern CTD – conductivity, temperature and depth probe – at sea, the team lowered it through the water column to take depth profiles at over 30 marine sites, focused around Honiara. The instrument also measures oxygen levels, pH and PAR – the light wavelengths that are used by algae for photosynthesis. This provides data that helps interpret how the river inputs, ocean currents and geological structures affect the movement of seawater around

the area. Further data was collected for surface waters using a hand-held multiparameter probe. Water samples were also collected and measured for total coliform count and toxicity assay. Using a mobile microbiology lab, the team assessed water samples to measure Total Coliform counts. To conduct the toxicity assay, the Cefas team used the Deltatox II system that employs a dried bacterium Vibrio fischeri that is reconstituted by adding to test samples and a diluent control at time t0. The samples are incubated for 15 minutes and the luminescence measured at time t1. The difference in luminescence emitted by the reconstituted bacterium in the test and control samples is expressed as a percentage change with the control at 100%. If the samples are toxic, the percentage change will be a negative value (Devlin et al. 2018).

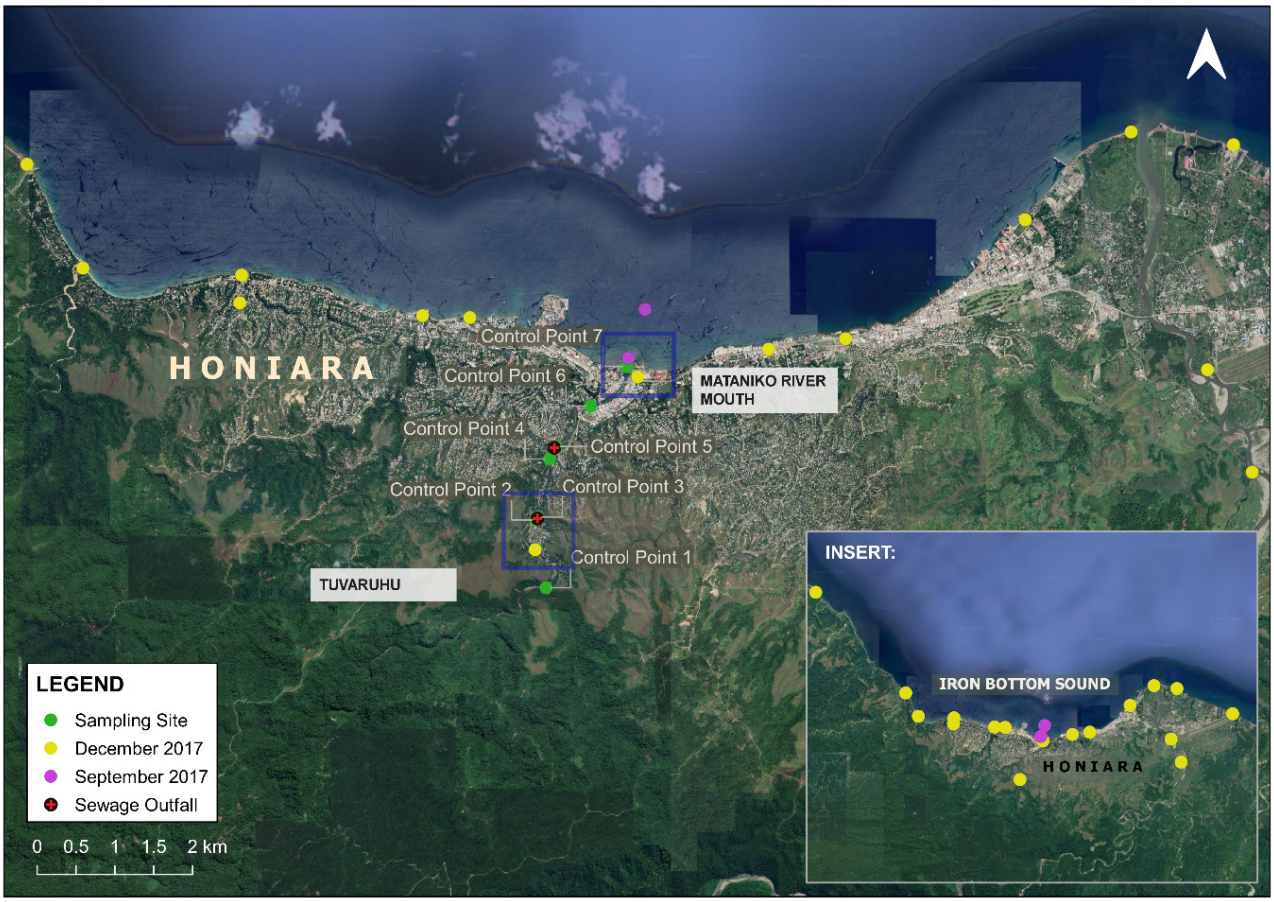

Figure 7. The nine sites along Mataniko River where physical parameters were measured, and water samples assessed for toxicity and total coliform counts

3.4 Indicator SE4 Exploitation of living resources

A questionnaire was designed (Annex 2) with questions related to the following subject areas:

- Habitat and fishing grounds
- Methods of harvesting
- Consumption patterns
- Targeted fish species and economic value

After consulting the Ministry of Fisheries staff, it was determined that the survey would be administered in three informal settlements that fish in the coastal areas off Mataniko River mouth: Lord Howe, Renlau and Fishing Village communities. A team of four enumerators was assembled and over the space of four days, 46 households were interviewed in Fishing Village, 29 households in Renlau and 18 households in Lord Howe settlement.

4.RESULTS

4.1 Indicator E1 Diversity

There were two types of vegetation observed: riparian and disturbed primary forest. A total of 76 plants was recorded in the plots (Annex 3), of which five were endemic species, one was an invasive, one was introduced, and the rest were native species. Dominant native species included the commercially important timber trees *Pommetia pinnata, Calophyllum peekelli, Vitex cofassus, Pterocarpus indicus and Celtis latifolia* (Figure 8). The rosewood tree, *Pterocarpus indicus*, is listed as Endangered on the IUCN Red List.

The endemic species observed included *Canarium salomonense, Ptychosperma solomonensis, Melastoma novae-georgiae, Physokentia insolita, Heterospathe solomonensis* and the endemic palm *Rhopaloblaste elegans.*

The invasive species was the paper mulberry tree *Brousonnetia papyrifera* and the introduced species was the balsar tree, *Ochroma lagopus*. The other main invasive tree in the catchment but recorded outside the plots was the African Tulip Tree, *Spathodea companulata*.

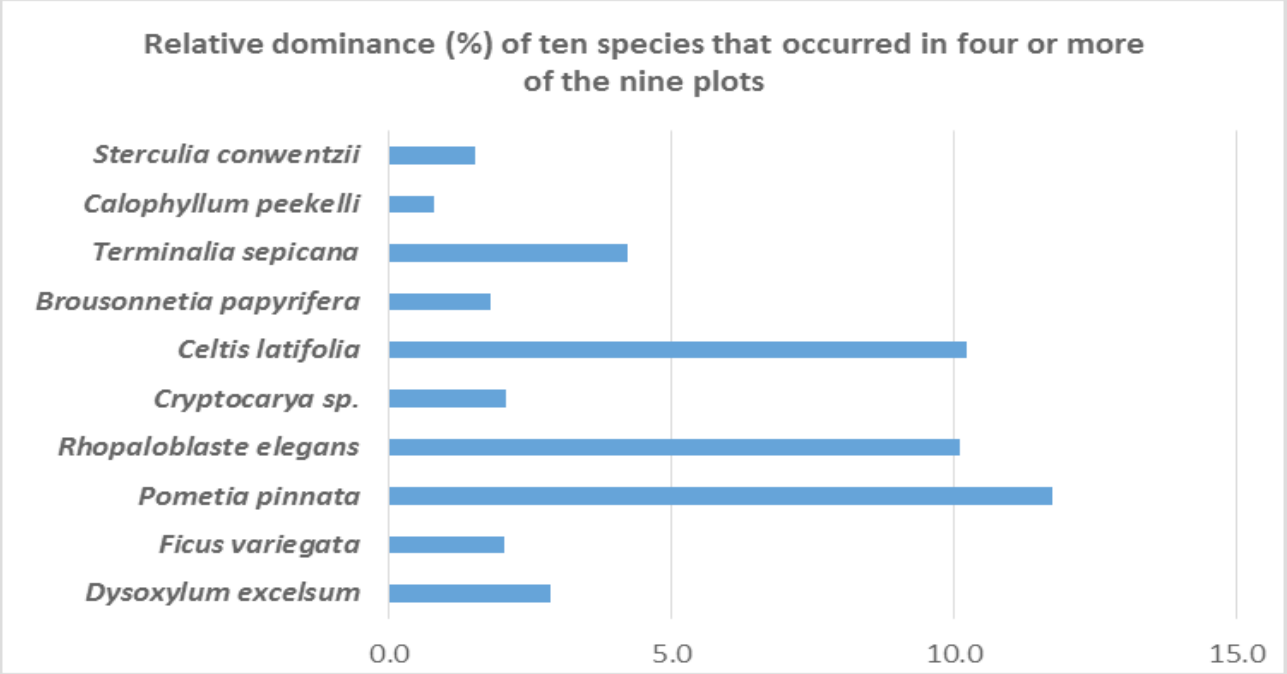

Figure 8. Relative dominance of commercially important timber trees that occurred in the upper Mataniko/ Barana catchments

Apart from the commercially important timber trees that formed a canopy layer, there were also native trees that provided other services (Figure 9). In each of the nine plots, native timber trees were relatively dominant in all except for one where the nut trees predominated (Figure 10). Endemism was relatively low at 7%.

Figure 9. Cananga odorata, a medicinal plant that has an essential oil used in perfume (Large tree in centre)

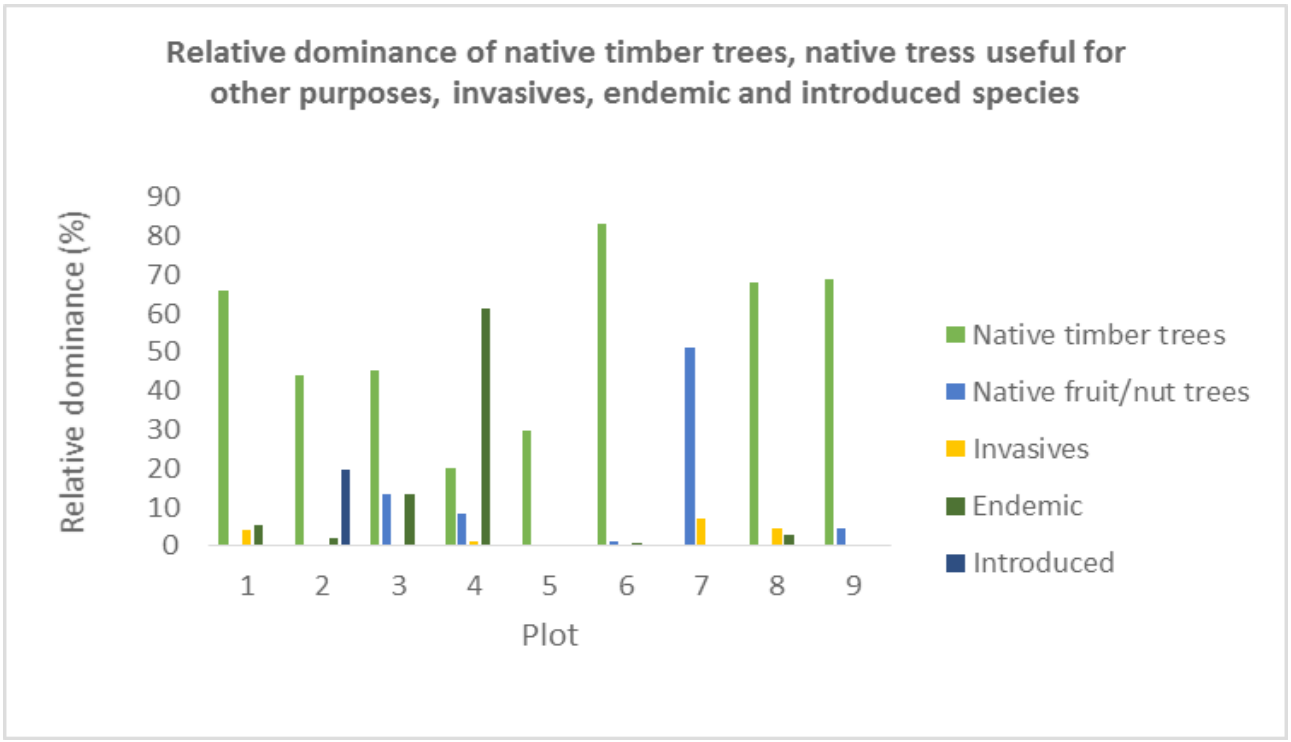

Figure 10. Relative dominance of native, endemic, introduced and invasive plants in upper Mataniko/Barana catchments

There were 125 floral species recorded in total in the upper Mataniko/Barana catchments, 49 of these were recorded outside the plots and included an endemic ginger plant, *Alpinia pomeraniae* (Fig 11, a & b).

Figure 11. Endemic ginger, Alpinia pomeraniae: (a) with red fruit (b) with white flower

4.2 Indicator E3 Habitat Quality

There were 44 taxa of freshwater fauna and 3 freshwater flora taxa recorded during the survey (Annex 4). Aquatic insects comprised more than half the taxa recorded followed in decreasing numbers by fish, molluscs and crustaceans (Figure 12). Of the terrestrial fauna there was a total of 33 taxa recorded with 9 recorded only during the day, 14 taxa were only nocturnal, and 10 taxa were recorded both during the day and night (Figure 13).

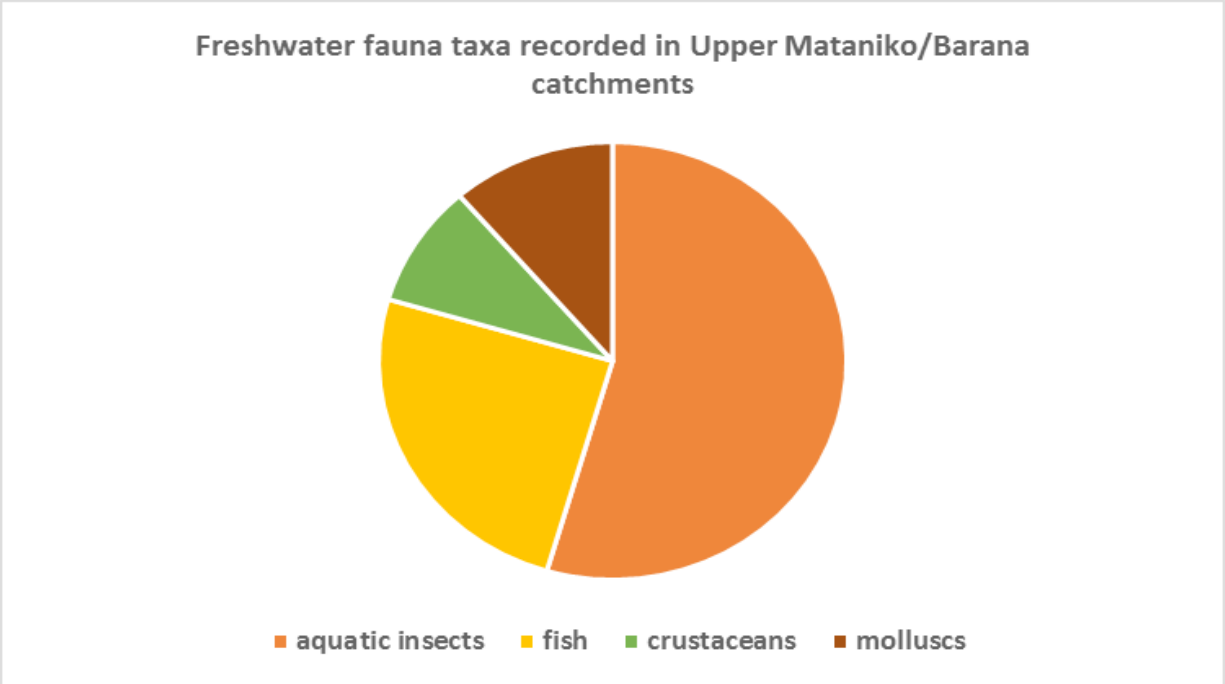

Figure 12. Proportion of different taxonomic groups of freshwater fauna recorded in Ngoti stream that feeds into Mataniko River

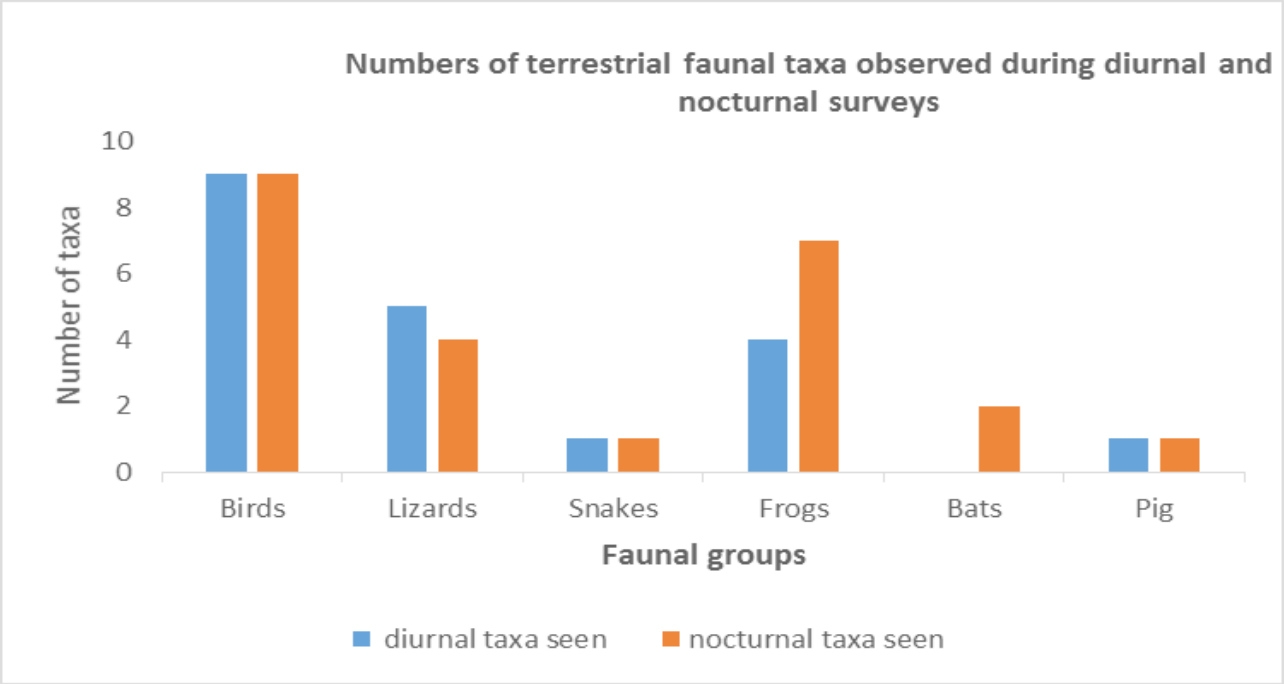

Figure 13. Terrestrial faunal groups recorded diurnally and nocturnally at upper Mataniko/Barana catchments

Of the 13 bird species recorded during the diurnal and nocturnal surveys, three were endemic species. One of the species, the Guadalcanal boobook (*Nixon granti*) is endemic to Guadalcanal and is a permanent resident of the watershed. Another endemic species, the Solomon Sea Eagle (*Haliaeetus sanfordi*), is a totem bird for Barana villagers and is listed as Vulnerable on the IUCN Red List. The diadem leaf-nosed bat (*Hipposideros diadema*) and the Solomon tube-nosed bat (*Nyctimene vizcaccia bougainville*) were the only native mammalian species seen and only at dusk.

Cane toads (*Rhinella marina*) and giant African snails (*Lissachatina fulica*), both invasive species, were seen in large numbers in the streams.

4.3 Indicator E6 Water Quality

The results of physical parameters measured at the seven sites on Mataniko were combined with the results of measurements taken at an additional eight freshwater sites in rivers east and west of Honiara and are shown in Table 1.

Table 1. Results of physical parameter measurements from 15 freshwater and 15 marine sites in September 2018 (reproduced by permission of Smith et al. 2018).

Ranges	pH	Salinity (psu)	Conductivity (ms/cm)	Dissolved Oxygen (%)	Dissolved Oxygen (mg l-1)	Temperature (°C)
FW	7.2 - 8.5	0 - 2.9	161.3 - 1311.0	2.7 - 113.0	0.21 - 8.7	27.1 - 31.2
Marine	8.0 - 8.2	27.8 - 34.2	NA	87.1 - 119.9	6.56 - 9.12	29.1 - 31.0

Based on the ANZECC & ARMCANZ (2000) water quality guidelines, the values for the Mataniko sites and other river sites are all within normal range.

20 marine sites were tested with most of them showing extra growth rather than reduced growth. This may be caused by excessive nutrients in the water compared to the test media. Samples ranges

from 3% to 50% higher luminescence than the control. 15 freshwater sites were also tested. These were generally similar to controls, ranging from a variance of -2% to +20% from control growth. Overall, the sites tested did not display signs of toxicity in the Microtox test, although several showed additional growths in the organism, *Vibrio fischeri*, which may suggest increased nutrients (Figure 14).

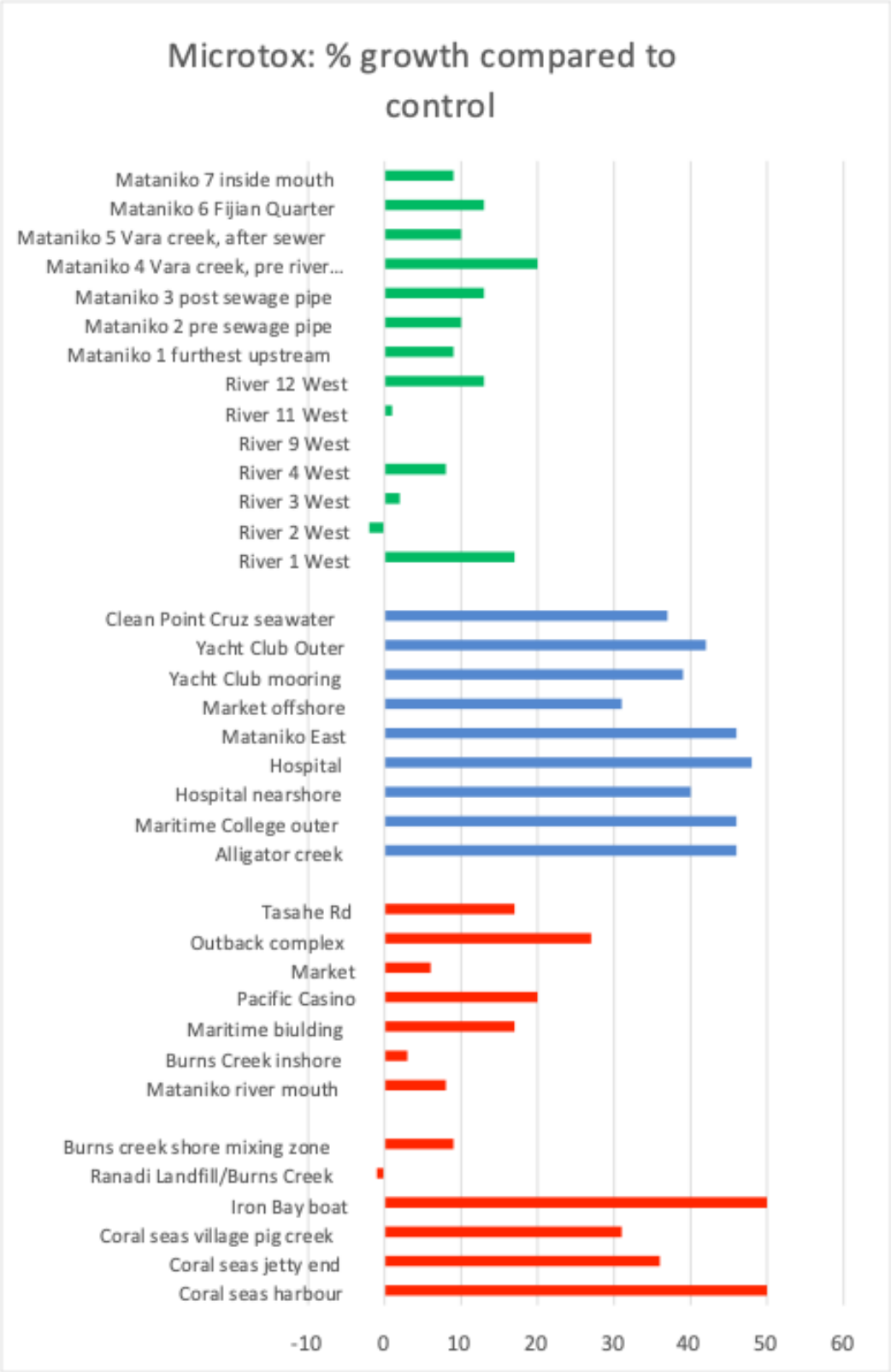

Figure 14. Microtox test results from 20 sites. Data represents the values generated using the 15-minute, 89.1% assessment protocol on a Modern Water Deltatox II machine. Green sites = Rivers. Blue sites = Open sea. Red Sites = nearshore (reproduced by permission of Smith et al. 2018)

The total coliform counts for six of the seven sites exceeded the 500 cfu/100 ml guideline for European Bathing waters while three sites exceeded the mandatory limit of 10,000 cfu/100 ml

(Figure 15). The three sites were at the Mataniko River mouth and sites after sewage pipe outfalls from Tuvaruhu and Vara Creek informal settlements. The only site that showed low coliform levels was the one furthest upstream away from human influence.

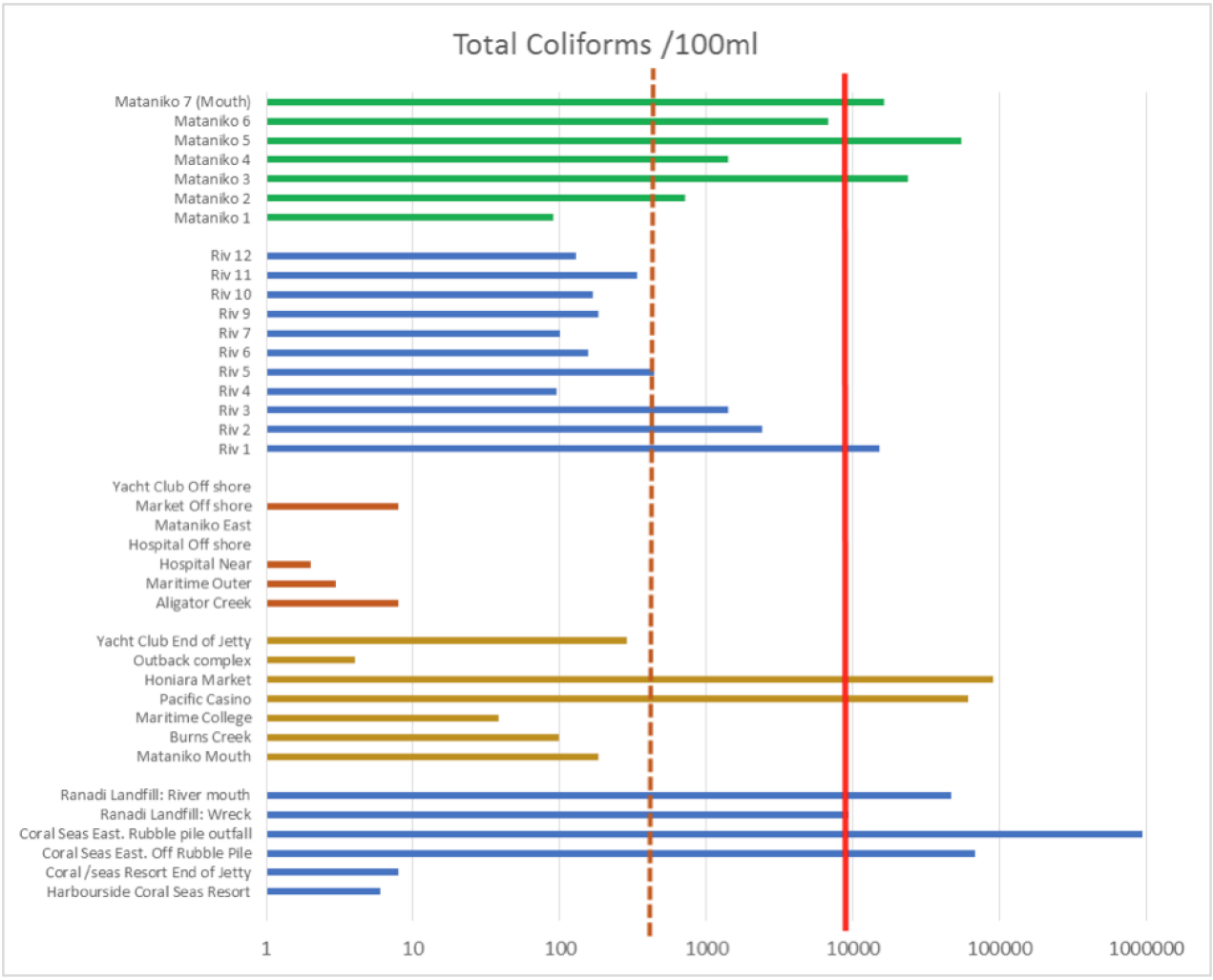

Figure 15. Total coliform counts in the seven Mataniko R sites and a number of other sites (reproduced by permission from Smith et al. 2018

4.4 Indicator SE4 Exploitation of Living Resources

4.4.1 Habitat and fishing grounds

The interviewees from the Lord Howe and Renlau Settlements fished in coastal reefs and at the Mataniko River mouth whilst those from Fishing Village ventured offshore to the areas shown in Figure 16.

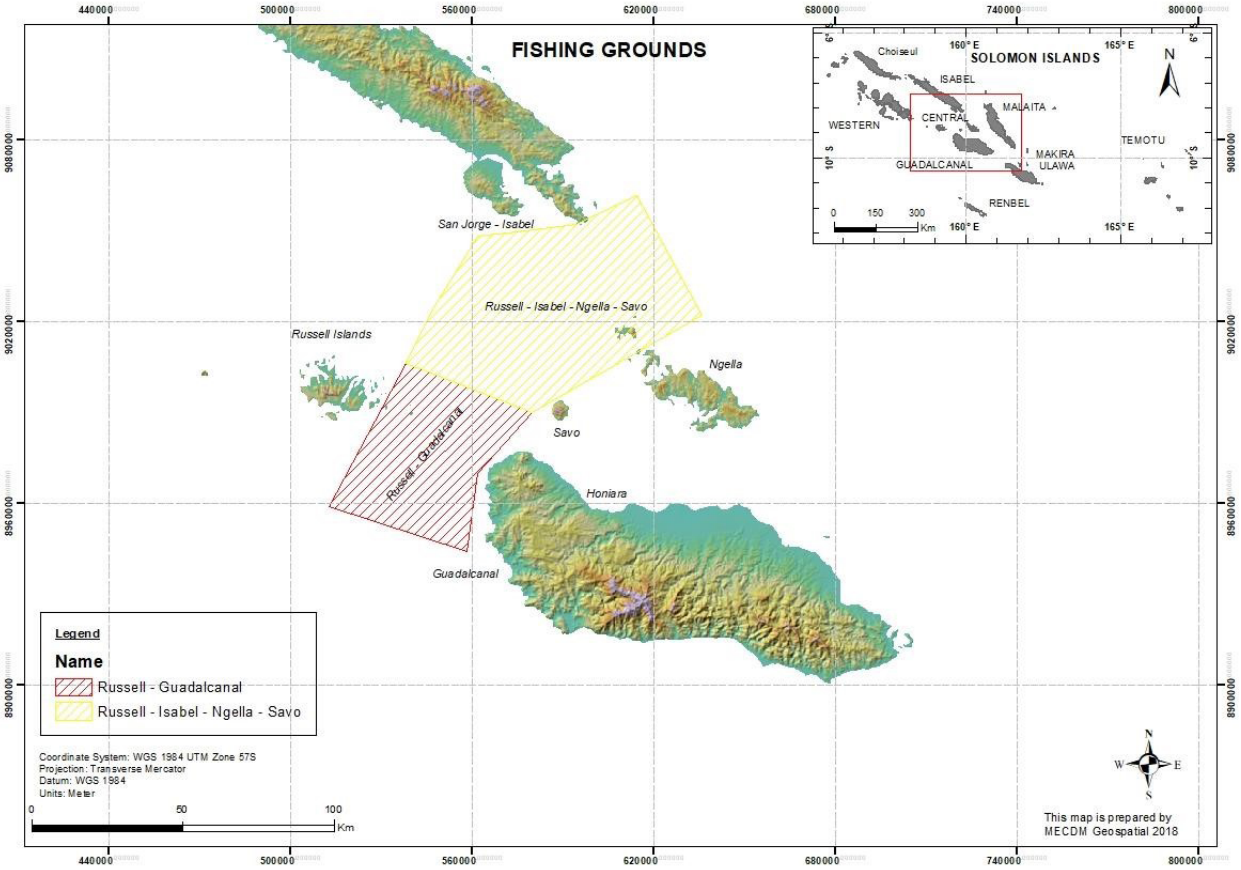

Figure 16. Fishing grounds for fishermen from Fishing Village shown as shaded areas. They target Fish Aggregation Devices in Russell Islands.

4.4.2 Methods of harvesting and frequency

There was a clear difference in the vessels used between the fishermen of the three settlements with those from Fishing Village using motorised boats to access the fishing grounds and those from Renlau and Lord Howe using canoes. Methods used were the same, namely vertical line, handline, cast nets and night fishing. Trolling while going to the fishing grounds was also employed. There is significantly greater participation of both men and women in Fishing Village, so it is a daily occurrence. For those from Renlau, most fish once or twice a week whilst from Lord Howe, the men fish three to five times a week.

4.4.3 Consumption patterns

In the Renlau community, fishing is for subsistence, and any surplus is sold to community members. Of the 13 Renlau women surveyed, more than half fish for subsistence, whereas of the 16 men interviewed, approximately half sold their catch to fellow community members.

Lord Howe is a Polynesian community, so the women are normally not allowed to fish thus, of the 18 interviewees, only four fish for subsistence. Of the 14 males interviewed, more than half fish solely for subsistence and a few sell surplus catch to community members.

There were 21 women and 25 men interviewed in Fishing Village, all of whom are from Malaita. All but one of the 46 interviewees fish commercially. The catch is sold to the general public and at road markets.

Of the three communities, Lord Howe community members fish the least and mainly for subsistence, while members of Fishing Village are active fishers and it is their main source of income.

4.4.4 Targeted fish species and economic value

The target species for Renlau and Lord Howe communities are scad, mullet and coastal reef fish. For Fishing Village, the target species are skipjack, yellowfin tuna, deep water snapper, and the larger pelagic species such as marlin, king fish and trevally. The economic value varies greatly but the larger pelagics such as king fish are more lucrative and can retail for SBD 250 per fish.

5. DISCUSSION

5.1 Indicator E1 Diversity

Solomon Islands has six forest types namely: grassland and other non-forest areas, saline swamp forests, freshwater swamp and riverine forests, lowland rainforests, hill forests and montane forests; and some 5000 plant species, making it second only to Papua New Guinea in floral diversity in the region (Toki et al. 2017). The forest in upper Mataniko and Barana catchments is classified as riparian due to the riverine influence and lowland rainforest. The riparian vegetation includes herbs, ferns, palms and trees. The primary forest showed signs of disturbance from logging, which occurred in the 1980s, and more recent timber felling for house construction and vegetation clearing for food gardens, roads and tracks. As a result, there is largely secondary forest and extensive grassland. Lowland rainforest is also subjected to extreme climatic events, which clear areas that allow invasive plants such as the paper mulberry tree (*Brussonetia papyrifera*) to establish itself. The paper mulberry tree was recorded in five of the nine plots. Large timber trees such as *Pometia pinnata, Calophyllum peekeli, Vitex cofassus* and *Schizomeria serrata* are common species in such forests (Toki et al. 2017) and all were recorded repeatedly in the nine plots.

The vegetation of lowland forests provides a number of important ecosystem services to the community, which include construction timber, fuelwood, food, *kastom* medicine and other domestic uses. *Canarium indicum* from which the widely eaten ngali nut is sourced, was common in the forest. The endemic wild nut *Canarium asperum,* was recorded in one of the plots as was *Barringtonia sp.* which produces cut nut. Fruit trees such as the wild mango (*Mangifera indica*) were also dominant in one of the plots. Medicinal plants seen included the native *Endospermum medullosum* and the ginger *Alpinia purpurata* (Figure 17).

Figure 17. Alpinia purpurata, a ginger used for medicinal purposes

At least a third of all 125 species recorded in the catchment have uses known to local communities, making it an area of high conservation value. The BMU-funded PEBACC project implemented by SPREP and the Solomon Islands Government has plans to establish a community nature park in Barana as an Ecosystem-based adaptation (EbA) option to reduce flooding and soil erosion in the catchment. Thus, the findings of this botanical survey will be useful in the development of the nature park.

5.2 Indicator E3 Habitat Quality

The 44 taxa of freshwater fauna recorded in the Ngoti stream system that feeds into the Mataniko River is impressive when compared to neighbouring catchments like the Kovi catchment, which is a sub-catchment of the Kongulai catchment in northern Guadalcanal and which supplies much of Honiara's potable water. A similar freshwater faunal assessment of the Kovi catchment found only five freshwater fauna taxa (Boseto 2012). The total number of freshwater fishes in Guadalcanal is 47 species from 39 genera and 23 families. This survey of the Ngoti stream system recorded 11 species of fish, which represents 23% of known freshwater fish species on Guadalcanal compared to the 1% recorded in Kovi catchment.

The presence of the giant mottled eel, *Anguilla marmorata*, is evidence of the connectivity between the stream, Mataniko River and the ocean. Eels have a catadromous life cycle where they live in freshwater but travel to the ocean to spawn after which the larvae return to the stream to settle. The six goby species and four crustacean species recorded in Ngoti stream have an amphidromous life cycle where they lay eggs in the stream but once eggs are hatched, larvae are transported to the ocean where they spend four to twelve weeks before returning to the stream as juveniles, again proving the stream−ocean connectivity.

The larger freshwater fish such as jungle perch and gudgeons are in the stream although they were not recorded by the field team. The eels, fish and prawns in the stream system constitute an important subsistence fishery for Barana and Lele villages. The larger eels are sometimes sold to the Chinese restaurants in town as a source of income.

The two invasive species, the cane toad (*Rhinella marina*) and the giant African snail (*Lissachatina fulica*), are a matter of concern because of their abundance. The African snail is considered a conservation threat in many islands in the Pacific because of the high numbers and their destruction of native vegetation and competition with native snails. The biological controls introduced on some islands to eliminate the African snail have in themselves created more problems as the introduced species have threatened the native snail population (Cowie 2000). The introduction of the cane toad in the Solomon Islands was by the US Military during World War II to control mosquito larvae but has become a pest itself (Eldredge 2000).

The common practice of using weedicides for prawn fishing is also a major concern that needs to be addressed. The use of chemicals is a very destructive fishing method as it indiscriminately kills other fauna. Awareness raising with the local communities on the deleterious effects of such fishing should be actively pursued. The mayfly species recorded in the Ngoti stream system, *Deliatidium* sp. and *Prosopistoma* sp., are bio-indicators of good water quality (B. Rashni, pers. comm.). The freshwater assemblage found in the stream would indicate a healthy system, but this could be undone by the continued use of chemicals in harvesting freshwater prawns.

The 16 herpetofauna species and 13 bird species seen in Mataniko catchment would indicate lower terrestrial faunal biodiversity compared to the 10 insect species, 17 herpetofauna species and 30 bird species seen in Kovi catchment (IUCN 2012). The forests of Kovi are primary forest, which is the likely reason for the greater terrestrial faunal biodiversity.

5.3 Indicator E6 Water Quality

The three sites that exceeded the mandatory limit of 10,000 cfu/100 ml for European bathing waters were at the Mataniko River mouth and sites downstream of sewage pipe outfalls from Tuvaruhu and Vara Creek informal settlements. The only site out of the seven sites that showed low coliform levels was the one furthest upstream away from human influence. The sewage pipes from the informal settlements discharge untreated sewage into the river, thus the excessively high coliform counts. Unfortunately, there were no faecal coliform counts measured but one can assume that they would be high. In a separate study by Cefas, water samples from East Mataniko, Mataniko River mouth and Mataniko beach were analysed for faecal coliform and faecal streptococci (Devlin et al. 2018).

All three sites showed faecal coliform levels that exceeded the threshold set under the EU Bathing Waters Directive. Sewage pollution is a major concern in the lower Mataniko River and poses a public health risk. The Mataniko Baseline report (Telios Consulting 2015) conducted total and faecal coliform (*E. coli*) measurements at 15 sites along the length of the river and its tributaries. The study found that even the control site in the upper catchment still showed traces of faecal contamination, but the total coliform levels and faecal coliform levels increased progressively from upstream to downstream Mataniko River. Faecal coliform levels downstream exceeded the maximum detection limit of 2419.6 MPN/100 ml and the main source is sewage effluent from settlements along the river.

Unsealed pit toilets are common in the informal settlements and leach into the Mataniko River. Sewage pollution is an acute problem in Honiara where domestic wastewater for 75% of the population is discharged through 14 outfalls along the shore (Devlin et al. 2018). The sewage, combined with the staggering volume of solid waste due to poor disposal practices of the residents, make for an extremely polluted river that poses a public health risk.

5.4 Indicator SE4 Exploitation of living resources

There were distinct differences seen in the utilisation of marine resources by the three settlements surveyed and some of it may be attributed to cultural norms. The residents of Fishing Village who are originally from Malaita use motorised boats and venture further offshore to fish, which is evident from the composition of their catch. Their target species are the pelagic species and reef fish that live in deeper water and their catch is sold to the general public. Fishing is the main source of livelihood and women are actively engaged in the commercial fishery.

In Lord Howe settlement, where the residents are of Polynesian origin, the survey found that women are not encouraged to fish and the men rarely fish. The residents of Lord Howe buy salted fish from Noro cannery and value add by selling fish and chips. They also barter with Asian fishermen and exchange fruit and vegetables for fish.

Those from Renlau settlement fish in the Mataniko River mouth and the shallow coastal waters. heir catch is largely the smaller coastal species such as mullet and scad and most fish for subsistence.

The average number per household was: six persons in Fishing Village, eight in Renlau and nine in Lord Howe settlement. One interviewee from Lord Howe settlements stated that his household had 24 members.

Of all three settlements, the Lord Howe settlement is the most vulnerable to coastal erosion, riverine flooding and sewage pollution. Combined with the high population density and minimal fishing activity, the resilience of the community to future climatic events should be given attention to prevent further loss of life and property. The current level of fishing activities of Fishing Village residents might warrant management plans being developed to prevent overexploitation of resources on the outer reefs that they exploit.

It should be noted that the creel survey was the weakest link in this rapid coastal assessment, with scant information gathered by the enumerators. A more detailed socioeconomic study would be useful to gauge the resilience of the three communities in the face of any future extreme climatic events.

6. CONCLUSION AND RECOMMENDATIONS

The PEBACC project has prioritised Ecosystem-based Adaptation (EbA) options that it plans to implement in Solomon Islands, which will provide opportunities for collaboration between the PEBACC and R2R projects. PEBACC plans to implement river rehabilitation/restoration activities on the Mataniko River and its tributaries and to develop an information centre to improve environmental awareness within the community. The R2R project has done significant environmental awareness raising activities with the informal settlements in Mataniko so the two projects could certainly collaborate on this option.

Another EbA option that the R2R project can complement the efforts of the PEBACC project is in supporting the Honiara Botanical Gardens to be a formal protected area with its own management plan. The R2R project in Tagabe catchment is working closely with the Vanuatu Forestry Department in the re-establishment of a national botanical garden in Tagabe catchment. It is a component of the Tagabe Catchment management plan that was launched in March 2018. The HURCAP has acknowledged Tagabe Catchment Management Committee as a model worth replicating in Honiara's catchments so there is opportunity for information exchange between the Vanuatu R2R project and the PEBACC project that can be facilitated by the Solomon Islands R2R project.

The Mataniko and Tagabe catchments share similar characteristics in that both are close to urban centres so there is development pressure, both have serious solid waste and sewage disposal problems, both have large informal settlements, yet both boast biodiversity that is of high conservation value. Both catchments have the PEBACC and the Commonwealth Marine Economies Programme for the Pacific being implemented in-country.

It is recommended that:

i. The two national R2R project managers look for opportunities where they might work together and strengthen partnerships with the other two projects to assist them in the implementation of their workplans. The partnership with PEBACC and Cefas is already working very well in the case of the Solomon Islands R2R project, but there is room for improvement in Vanuatu. The collaboration between national projects will ultimately assist in implementing the R2R programmatic approach.

ii. In terms of monitoring to assess the effectiveness of an intervention, permanent sampling plots be established and marked, and standardised methodology be adopted (for all taxa sampled) to allow for replication and monitoring of data over a period of time.

iii. Assessments for other potential indicators listed from available datasets such as E2, E5, G4 and G6 indicators could strengthen the RapCA assessments.

iv. Communities be trained in water sampling and use of bio-indicators to monitor stream health beyond the lifetime of the project. Communities need to be empowered to take ownership for the sustainability of the project.

v. An invasive species assessment protocol be developed: a monitoring protocol is needed to assess the incursion of the invasive species, i.e. Cane toad (*Rhinella marina*) and giant African snail (*Lissachatina fulica*), further upstream.

REFERENCES

ANZECC & ARMCANZ. 2000. Australia and New Zealand guidelines for fresh and marine water quality. Retrieved from: https://www.waterquality.gov.au/anz-guidelines..

Boseto, D. 2012. Aquatic fauna survey of the Kovi water catchment, Guadalcanal Island, Solomon Islands. IUCN, Suva 21pp.

Cowie, R.H. 2000. Non-indigenous land and freshwater molluscs in the islands of the Pacific: conservation, impacts and threats. pp 143-167. In Sherley, G.(ed) Invasive Species in the Pacific: A Technical Review and Draft Regional Strategy. Apia, Samoa: SPREP.

Devlin, M., Bacon, J., Haverson, D., Graham, J., Smith, A. et al. 2018. Pacific Water Quality and Resilience Framework – Year 2 report. Cefas, UK. 94p.

Dutson, G. 2011. Birds of Melanesia: Bismarcks, Solomons, Vanuatu and New Caledonia. Bloomsbury Publishing.

Eldredge, L. 2000. Non-indigenous freshwater fishes, amphibians and crustaceans of the Pacific and Hawaiian Islands. Pp173-190. In Sherley, G.(ed) Invasive Species in the Pacific: A Technical Review and Draft Regional Strategy. Apia, Samoa: SPREP.

Haynes, A. 2001. Freshwater snails of the tropical Pacific Islands. Institute of Applied Sciences, the University of the South Pacific, Suva, Fiji.

IUCN 2012. Biodiversity assessment and ecotourism plan development for improving community livelihoods in Kovi catchment, Solomon Islands. Project Implementation Report, ORO, Suva, 10pp.

Marinov, M., and Pikacha, P. 2013. On a dragonfly collection from the Solomon Islands with overview of fauna from this Pacific archipelago (Insecta: Odonata). International Dragonfly Fund eV.

Polhemus, D. A., Englund, R. A., Allen, G. R., Boseto, D. and Polhemus, J. T. 2008. Freshwater biotas of the Solomon Islands: analysis of richness, endemism and threats. Honolulu: Bishop Museum Technical Report, 45.

Sirikolo, M. and Pikacha, P. 2011. Biodiversity values of the Kovi Watershed and surround forests, Guadalcanal Island, Pacific Horizon Consultancy Group, Honiara, 28pp.

Smith, A., Powell, A. and Davis, S. 2018. Cefas CEMP South Pacific Water Quality Data Summary. 5pp.

SPREP 2018. Planning for ecosystem-based adaptation in Honiara, Solomon Islands. A synthesis report by the Secretariat of the Pacific Regional Environment Programme, Apia, Samoa. 16pp.

Telios Corporate and Consultancy Services. 2015. Mataniko Environment Baseline Report. Honiara, 125pp.

Toki, B., Leger, L., Richards, S., Hipkin, S., Lorimer, J. and Coulton, R. 2017. Solomon Islands Ecosystem and Socio-economic Resilience Analysis and Mapping (ESRAM). Apia, Samoa: SPREP. 118pp

Trundle, A. and McEvoy, D. 2016. Honiara Urban Resilience and Climate Action Plan, RMIT, Melbourne, 93pp.

ANNEXES

Annex 1: Plant checklist for upper Mataniko/Barana catchments

Table 2. List of all trees recorded in the nine plots

Column 1	Species Name	Column 2	Species Name	Column 3	Species Name	Column 4	Species Name
1	*Dysoxylum excelsum*	20	*Phyllanthus ciccoides*	39	*Planchonella firma*	58	*Flueggea flexuosa*
2	*Ficus variegata*	21	*Celtis latifolia*	40	*Macaranga dioica*	59	*Hibiscus tiliaceus*
3	*Pometia pinnata*	22	*Physokentia insolita*	41	*Alaia ganggo*	60	*Rhus taitensis*
4	*Gomphandra sp.*	23	*Pterocarpus indicus*	42	*Tmonius sp.*	61	*Endospermum medullosum*
5	*Rhopaloblaste elegans*	24	*Brousonnetia papyrifera*	*43*	*Caryota rumphiana*	62	*Ficus wassa*
6	*Melastoma novae-georgiae*	25	*Vitex Cofassus*	44	*Glochidion sp.*	63	*Barringtonia sp.*
7	*Cyathocalyx petiolatus*	26	*Ochroma lago-pus*	45	*Sterculia par-kinsonii*	64	*Parinari glaberrima*
8	*Gironniera sp.*	27	*Finschia chloroxantha*	46	*Osmoxylon novo-guineensis*	65	*Timonius pulposus*
9	*Litsea perglabra*	28	*Celtis phillipinensis*	47	*Heterospathe solomonensis*	66	*Finschia waterhousiana*
10	*Macaranga dioica*	29	*Ficus variegata*	48	*Sterculia conwentzii*	67	*Brownlowia argentata*
11	*Canarium asperum*	30	*Cananga odo-rata*	49	*Syzygium nemorale*	68	*Myristica fatua*
12	*Cryptocarya sp.*	31	*Schizomeria serrata*	50	*Macaranga tanarius*	69	*Antiaris toxicaria*
13	*Teysman-niodendron ahernianum*	32	*Canarium indi-cum*	51	*Dysoxylum caulostchyum*	70	*Mangifera indica*
14	*Semecarpus forstenii*	33	*Myristica irya*	52	*Parinari noda*	71	*Timonius timon*
15	*Canarium solo-monense*	34	*Terminalia sepi-cana*	53	*Buchanania arborescense*	72	*Alstonia brassii*
16	*Macaranga similis*	35	*Calophyllum peekelli*	54	*Commersonia bartramia*	73	*Diospyros sp.*
17	*Pullea sp.*	36	*Fagraea race-mosa*	55	*Gonystylus macrophyllus*	74	*Alstonia spect-abilis*
18	*Dendrocnide rechingeri*	37	*Elaeocarpus sp.*	56	*Ptychosperma solomonensis*	75	*Elaeocarpus sphaericus*
19	*Planchonella thyrsoidea*	38	*Elaeocarpus floridanus*	57	*Unidentified sp.*	76	*Unidentified sp.2?*

Annex 2: Freshwater and terrestrial fauna checklist for Ngoti stream system

Table 3. Freshwater Fauna recorded during diurnal survey of Ngoti stream, 16–18 October 2018

Common Name	Scientific Name	Conservation Status
Macro-invertebrates		
Mayfly	Deleatidium sp.	Native
	Prosopistoma sp.	Native
	Unidentified species	
	Unidentified species	
	Unidentified species	
Caddisfly	*Unidentified* species	
	Unidentified species	
Diving Beetle	*Platynectus sp*	Native
Water strider	*Limnometra sp.*	Native
Dragonfly	*Agriocnemis femina*	Native
	Agrionoptera insignis similis	Native
	Diplacodes bipunctata	Native
	Ischnura heterosticta	Native
	Lathrecista asiaticca	Native
	Neurothemis stigmatizans bramina	Native
	Nososticta salomonis	Native
	Protorthemis woodfordi	Native
	Rhinocypha liberate	Native
Damselfly	Coenagrionidae	Native
	Rhynocypha sp.	Native
	Unidentified species	
	Unidentified speies	
Butterfly	*Mycalesis sp*	Native
	Phaedyma fissizonata	Native
-	Taenaris phorcus phorus	Native
Fishes		
Giant mottled eel	*Anguilla marmorata*	Native
Dark margined tail	*Kuhlia marginata*	Native
Rock flagtail	*Kuhlia rupestris*	Native
	Belobranchus segura	Native
	Giuris margaritaceus	Native
Red tailed goby	*Sicyopterus lagocephalus*	Native

Common Name	Scientific Name	Conservation Status
	Sicyopterus stiphodonoides	Endemic
	Sicyopus zosterophorum	Native
Palauan stiphodon goby	*Stiphodon pelewensis*	Native
Golden-red stiphodon	*Stiphodon rutilaureus*	Native
Cobalt blue goby	*Stiphodon semoni*	Native
-		
Crustaceans		
Shrimps and prawns		
Green lace shrimp	*Atyoida pilipes*	Native
Bamboo shrimp	Atyopsis spinipes	Native
Giant jungle prawn	Macrobrachiun lar	Native
Crabs		
-	Labuanium trapezoideum	Native
Mollusca		
Snails		
	Clithon chlorostoma	Native
	Melanoides torulosa	Native
	Melanoides tuberculata	Native
	Neritina canalis	Native
Giant African Snail	*Lissachatina fulica*	Introduced
Algae		
	Chlorophyta	
	Cyanobacteria	
	Xanthophyta	

Table 4. Terrestrial Fauna recorded during survey of Ngoti Watershed Area

Common Name	Scientific Name	Conservation Status
Birds		
Blyth's Hornbill	*Aceros plicatus*	Native
Buff-headed Coucal	*Centropus milo*	Native
Eclectus Parrot	*Eclectus roratus*	Native
Glossy Swiftlet	*Collocalia esculenta*	Native
Island Imperial Pigeon	*Ducula pistrinaria*	Native
Long-tailed Myna	*Mino kreffti*	Native
Oriole Whistler	*Pachycephala orioloides*	Native
Yellow-bibbed Lory	*Lorius chlorocercus*	Native
Lizard		
Solomon's Blue-tailed Skink	*Emoia pseudocyanura*	Native
Pacific Black Skink	*Emoia nigra*	Native
Elegant Forest Skink	*Sphenomorphus concinnatus*	Native
	Sphenomorphus solomonis	Native
Schmidt's Crocodile Skink	*Tribolonotus schmidi*	Native
Snakes		
Solomons Tree Snake	*Dendrelaphis calligaster*	Native
Frogs		
Solomon Island eye-lash frog	*Cornufer guentheri*	Native
Giant-webbed frog	*Cornufer guppyi*	Native
San Cristobal Frog	*Papurana kreffti*	Native
Cane Toad	*Rhinella marina*	Introduced
Pig		
Pig	*Sus scrofa*	Introduced

Table 5. Totem or tabu species for the people of Barana and Lelei Villages

Common Name	Scientific Name	Local Name
Solomon Sea Eagle	*Haliaeetus sanfordi*	Manuchacha

Table 6. Terrestrial Fauna recorded during nocturnal survey of Ngoti Watershed Area

Common Name	Scientific Name	Conservation Status
Birds		
Blyth's Hornbill	*Aceros plicatus*	Native
Eclectus Parrot	*Eclectus roratus*	Native
Glossy Swiftlet	*Collocalia esculenta*	Native
Uniform Swiftlet	*Aerodramus orientalis*	Native
Nankeen Night Heron	*Nycticorax caledonicus mandd-ibularis*	Native
Guadalcanal Boobook	*Nixon j. granti*	Endemic
Red-knobed Imperial Pigeon	*Ducula r. rubricera*	Native
Solomons Cockatoo	*Cacatua ducorpsii*	Native
Buff-headed Coucal	*Centropus milo*	Native
Skinks		
Crane's Skink	*Sphenomorphus cranei*	Native
Geckos		
Ring tail gecko	*Cyrtodactylus salomonensis*	Native
Sago gecko	*Gekko vittatus*	Native
Solomons slender-toed gecko	Nactus multicarinatus	Native
Snakes		
Solomons Tree Snake	*Dendrelaphis calligaster*	Native
Frogs		
Solomon Island eye-lash frog	*Cornufer guentheri*	Native
Giant-webbed frog	*Cornufer guppyi*	Native
Solomon's Wrinkled Ground Frog	Cornufer solomonis	Native
Fauro Sticky-toed Frog	*Cornufer vertebralis*	Native
Weber's Wrinkled Frog	*Cornufer weberi*	Native
San Cristobal Frog	*Papurana kreffti*	Native
Cane Toad	*Rhinella marina*	Introduced
Bat		
Diadem Leaf-nosed bat	*Hipposideros diadema*	Native
Solomon tube-nosed bat	*Nyctimene vizcaccia bougainville*	Native
Pig		
Pig	*Sus scrofa*	Introduced

Annex 3: Suggested List of Governance, Socio-economic and Environmental Indicators for State of the Coasts Report and Rapid Coastal Assessment

D=drivers P=Pressures S=State I=Impact R=Response

Code	Indicator	Measurement	Type/Focus					Collection Techniques	Existing Data
			D	P	S	I	R		
G1	Legislation	o Existence of legislation for R2R						- Document review	-
		o Adequacy (matrix) of legislation (including gender assessment)						- Interviews with NRM managers and other experts	
		o Ratification of MEAs and regional policies and frameworks							
		o Protected areas						- Surveys	
G2	Traditional	o land tenure type						- Document and record review	-
	Governance	o presence of traditional governance mechanisms							
G3	Coordinating	o Existence of coordinating mechanisms for various sectors (or cross-sectoral) and legal basis						- Document review (meeting records etc)	-
	Mechanism	o Participation						- Interviews with NRM managers and members	
		o Stakeholder representation							
G4	Management plans	o Existence, characteristics, and status of NRM plans						- Document review	-
		o Extent (percentage) area covered by NRM plans						- Interviews	
G5	Active management	o Level of implementation of plans						- Document review	-
		o Procedures, legal tools, and monitoring and sanctioning applied to enforce NRM plans/actions						- Interviews	
		o Level of enforcement of, or compliance with, NRM plans						- Surveys	
G6	Monitoring and evaluation	o Monitoring programs at sites						- Document and record review	-
		o Existence of an operational monitoring and evaluation system with related indicators within NRM Plans							

		o Consideration of results and adjustments in NRM initiatives								
G7	Stakeholder Participation	o Community practice in landcare, coastal care and marine care groups (e.g. LMMA)						- Interviews - Surveys - Document review	-	
G8	NGO and CBO activity	o Existence and characteristics of NGOs and						- Document reviews	-	
		community organisations active in land, coastal, marine and biodiversity conservation o Level of activity of NGOs and community organisations						- Interviews		
G9	Knowledge and Training	o Education and training programmes that incorporating ICM/ IWRM/NRM						- Document and record review	-	
		o Number of communities receiving relevant information						- Surveys		
		o Number and % of community practices informed by information and evidence						- Interviews		
G10	Risk Management	o Availability of hazard maps						- Document and record review	-	
		o Availability and coverage of emergency response plans								
		o Institutional mechanism for emergency response o Availability and coverage of risk based urban planning						- Interviews		
SE1	Demographics	o Population size, distribution						- Database	-	

		o Levels of education (sex disaggregated) o Levels of employment (sex disaggregated) o Site specific total income						- Document review		
SE2	Human pressures	o Population density						- Monitoring programs	- DEM and land use –	
	on habitats	o Land use/land cover patterns						- Databases	Ministry of Ag. and	
		o High impact fishing gear practices						- Interviews	Forestry	
		o Number and location of ports o Extractive resource use (sand mining, dredging, mangrove harvesting)						- Surveys		
		o Number and location of waterways extraction (dredging, mining) o Tourism (?)								
SE3	Pollutants and introduction	o Population % access to improved functioning sanitation						- Monitoring programs	-	
								- Databases		
		o Number, location and estimate volume of point source discharges (coastal and surface water)						- Document review		
								- Surveys		
		o Non-point source nutrient loading (fertiliser imports) o Number and location of informal settlements						- Interviews		
SE4	Exploitation of living resources	o Consumption patterns (marine and terrestrial resources)						- Document review	-	
								- Database		
		o Economic value						- Interviews		
		o Targeted species (fauna and flora) o Harvest and fishing areas o Frequency of harvest/fishing o Methods of harvest/fishing						- Surveys		

SE5	Coastal protection	o % of shoreline with natural protection						- Surveys	-	
		o % of shoreline with human-made protection (proportion ad hoc or engineered)						- Document review		
E1	Diversity	o Occurrence of special species (marine and terrestrial)						- Species inventory	- Birdlife International for Atolls	
								- Sampling		
		o Occurrence of invasive species (marine and terrestrial) o Richness of fish communities o Richness of coral communities						- Monitoring programs	- Pacific Invasive Learning Network- PROCFISH – SPC	
E2	Abundance	o Juvenile coral						- Monitoring programs and surveys	- Turtle Database	
		o Marine flora							- SPREP	
		o Biomass (key fisheries) o Number of individuals (marine mammals)							- PROCFISH	

Annex 4: Fishing and Marketing Survey (Creel Survey Form)

Creel survey carried out by (enter organization/ department):

HQ N0. Village: ……	Name of Interviewer: …… Date of Interview: …….....
First Name: …… Last Name: …… Male/ Female/other (circle your answer) Age (refer to age range) …… Home island: ……	No. of members of household: …… Man/Woman (25-60 yrs.): …… 61 yrs > (Man/Woman): …… Who fishes in the household, M/W? ……

Section A: Habitat and Fishing Ground

1. Which areas do you fish?
    a. Coastal Reef
    b. Outer reef
    c. Mangrove
    d. Reef Flat

Site	Location (on map, lat/long, or distance to each fishing ground
1.	
2.	
3.	
4.	
5.	

2. Do you go to only one habitat per trip?

3. If, not how many and which habitats do you visit during an average trip?
    a. Coastal Reef
    b. Outer Reef
    c. Mangrove
    d. Reef Flat
4. How often do you fish in each of the habitats visited?
    a. Days
    b. Weeks
    c. Month

Section B: Methods of Harvesting

1. Fishing method/ gear used for each species group *(separate pelagic fish, reef fish, crabs, lobsters, etc.) how many people involved and how much time spent doing each activity?*

Methods	Species group	Number of people in your household involved in each fishing trip	Men/Woman	No. hours in each fishing trip/month	No. of fishing trips per week/month	Period (Night or Day)
Use canoe						
Nets (circle appropriate) Cast net / seine net						
Vertical Line (deep down)						
Boat with engine						
Spear gun						
Reef gleaning						
Hand line/ Pole line						
Other fishing gears						

2. Do you use more than one technique per trip for this habitat? If yes, which ones usually? *(Specified from the above)*

Section C: Consumption Patterns

3. **What type of Fish you usually catch for your family and for marketing?**

Market (Commercial)

Common Name	Language Name

Family (Subsistence)

Common Name	Language Name

4. **How many hours spent on the fishing trip each today for commercial purposes? _____Hrs**

5. **How many hours spent on the fishing trip each day for subsistence purposes?_____ Hrs**

6. **Are there annual seasons/periods that you engage intensely in fishing?**

    a. **Months**

7. **How many kilos of fish do you usually catch in one trip? (*Tick*)** *For this table if they don't give you the weighed amount just write down the number of fish caught.*

Methods	**1-5 kg**	**6-15kg**	**15-30kg**	**Over 30 kg**
Use canoe				
Nets (circle Appropriate) Cast net/ Seine net				
Vertical Line (deep bottom)				
Spear gun				
Reef gleaning				
Boat with engine				
Hand line/ Pole line				
Other fishing gears				

Section D: Targeted Fish Species and Economic Value

8. **What type of fish you normally catch/target during a fishing trip and how many?** (*Ask for number of fish in One plastic*)

Type of fish you catch	Kg/ number of the catch	Kg/ number of fish caught	Kg/ number of fish sold	Expected income from overall catch sold?

9. **If you market the fish, who are the buyers of your fish?**
   a. **Your community members**
   b. **Other community members**
   c. **Road Market?**
   d. **General Public?**
   e. **Other**

10. **What types of fish is highly demanded by purchasers?** (*Rank them from high to low demand))*

Type of Fish	Ranks of Demand

Fishing Activities

1. Fishing gears	2. Method (use of canoe or boat or wade)	3. Number of this gear you have		4. Targeted fishes	5. Period of use (month. Season, etc)
		Today	Before		
Fishing line					
Nets (circle appropriate) Cast net/ Seine net					
Spear gun					
Boat with engine					
vertical line (deep bottom)					
Reef gleaning					
Other					

6. User (age, gender, status)	
7. Purposes of fishing (rank) Food (F); Kastom (K); Sold (S) – Nature of Sales?	
8. Catch (rank- per year)	
9. Effectiveness (rank- per hour)	