Pacific Community
Communauté du Pacifique

RESCCUE

EFATE LAND MANAGEMENT AREA (ELMA) BIOBLITZ

Summary Report

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

FFEM FONDS FRANÇAIS POUR L'ENVIRONNEMENT MONDIAL

The operator in charge of the implementation of the RESCCUE project in Vanuatu under the supervision of both SPC and the Government of Vanuatu is: Opus International Consultants with Development Services, OceansWatch, Landcare Research, Live and Learn Vanuatu, C2O consulting and individual consultants.

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ELMA Bioblitz partners:

- Vaturisu Council of Chiefs
- Shefa Provincial Government Council
- Vanuatu Department of Forestry
- North Efate Tasivanua Environment Network
- Nguna Pele Marine and Land Protected Area Network
- Live and Learn Vanuatu
- WSP Opus
- Ecology NZ

Cover photo: *looking north from the Bioblitz site toward Moso island*
Credit: Groovy Banana, Vanuatu

Overview of the objectives and components of RESCCUE Project:

The RESCCUE (Restoration of Ecosystem Services and Adaptation to Climate Change) project is a regional project implemented by the Pacific Community (SPC).

The overall goal of RESCCUE is to contribute to increasing the resilience of Pacific Island Countries and Territories (PICTs) in the context of global changes. To this end RESCCUE aims at supporting adaptation to climate change (ACC) through integrated coastal management (ICM), resorting especially to economic analysis and economic and financial mechanisms.

The RESCCUE project operates both at the regional level and in one to two pilot sites in four countries and territories: New Caledonia, Vanuatu, Fiji and French Polynesia.

RESCCUE is funded primarily by the French Development Agency (AFD) and the French Global Environment Facility (FFEM) for a duration of five years (01/01/2014 to 31/12/2018). The project budget is 8.5 million Euros from AFD/FFEM.

Summary of RESCCUE Project in Vanuatu

The Vanuatu RESCCUE Project covers the northern side of the island of Efate beginning at the village Mangaliliu and ending with the village of Epao (inclusive). The islands of Nguna, Pele, Lelepa, Emao and Moso are also included in the project site. In total, the site covers around 50 km2 of marine ecosystems (coral reefs, seagrass beds, lagoons, mangroves and beaches), 180 km2 of terrestrial ecosystems (including forests) with a total population of approximately 8,000 (VNSO 2009). The project area also includes an established network of marine protected areas at Nguna-Pele, as well as multiple community-managed marine protected areas.

The RESCCUE Project is structured around five components:

Component 1: Integrated coastal management. This component aims at supporting ICM implementation "from ridge to reef" through ICM plans, ICM committees, coastal management activities concerning both terrestrial and marine ecosystems, capacity building and income generating activities.

Component 2: Economic analysis. This component aims at using the economic analysis toolbox to (i) demonstrate the added-value of ICM activities, and (ii) inform coastal management and policy decisions.

Component 3: Economic and financial mechanisms. This component aims at setting up economic and financial mechanisms to generate additional and sustainable funding for ICM: review of options (payment for ecosystem services, taxes, user fees, trust funds, quota markets, biodiversity offsets, carbon finance, labels…); feasibility studies; implementation; monitoring.

Component 4: Capitalization, communication, dissemination of project outcomes in the Pacific. This component aims at going beyond pilot sites activities to make RESCCUE a truly regional project, having impacts at the national and regional levels. This is done through fostering experience sharing between sites, providing cross-sectoral expertise, and communicating / disseminating the project outcomes.

Component 5: Project management. This component aims at implementing and coordinating the project, by providing technical assistance, organizing local and regional steering committees, conducting audits and evaluations (mi-term and ex-post), etc.

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1 INTRODUCTION

A mini biodiversity survey (Bioblitz) was undertaken within indigenous forest in the Efate Land Management Area (ELMA) on the northwestern side of Efate, Vanuatu from 6 to 10 November 2018. The Efate Land Management Area (ELMA) is a proposed environmental protected area in the central region of Efate, covering approximately twenty per cent of the island. The area encompasses historic cultural sites and important areas of indigenous forest. The ELMA covers ground within a variety of customary areas within Efate

The purpose of the Bioblitz was to:

- Establish a baseline inventory of plant and animal species present in one forest type in central Efate and conduct species-specific assessments where appropriate.
- Collect biological information to inform conservation decision-making about the ELMA.
- Identify any obvious threats to biodiversity in central Efate.
- Identify any obvious priority areas for conservation in central Efate.
- Establish and strengthen links between local communities and their local natural environment, strengthen their knowledge of local indigenous biodiversity and increase their understanding of the direct link between the health of their natural terrestrial environment and community resilience.
- Instigate interest of local community members in the management of their environment.
- Communicate back to village communities involved in the ELMA and RESCCUE projects about their environment and natural resources.
- Develop an understanding of the logistics of undertaking a larger scale BIORAP across ELMA lands should funding be found to undertake this.

Where possible, the Bioblitz survey was designed to follow SPREP BIORAP guidelines (Patrick et al 2014), albeit on a considerably smaller scale.

The Bioblitz was organised jointly by ELMA staff and RESCCUE project members. The project was funded by RESCCUE and planning and logistical organisation was led by Vanessa Organo (ELMA) and Roger MacGibbon and Rowan Dixon (both WSP Opus). Technical expertise in the field was provided by Simon Chapman (Ecology NZ; bats and reptiles), Presley Dovo (Department of Forestry; insects), Frazer Alo and Thomas Junior Doro (Department of Forestry botany team; plants); Andrew Toara Morris (birds); Roger MacGibbon (WSP Opus NZ; vertebrate pests and restoration).

2 LOCATION

The Bioblitz was undertaken across a study area of approximately 2km along a ridge top, rising in elevation from approximately 300m to 400m above sea level, within the proposed Efate Land Management Area (ELMA) conservation area (see Figure 2-1), and within the indigenous forest area of north-west Efate, some parts of which were disturbed and some parts of which were intact primary forest (Figure 2-22).

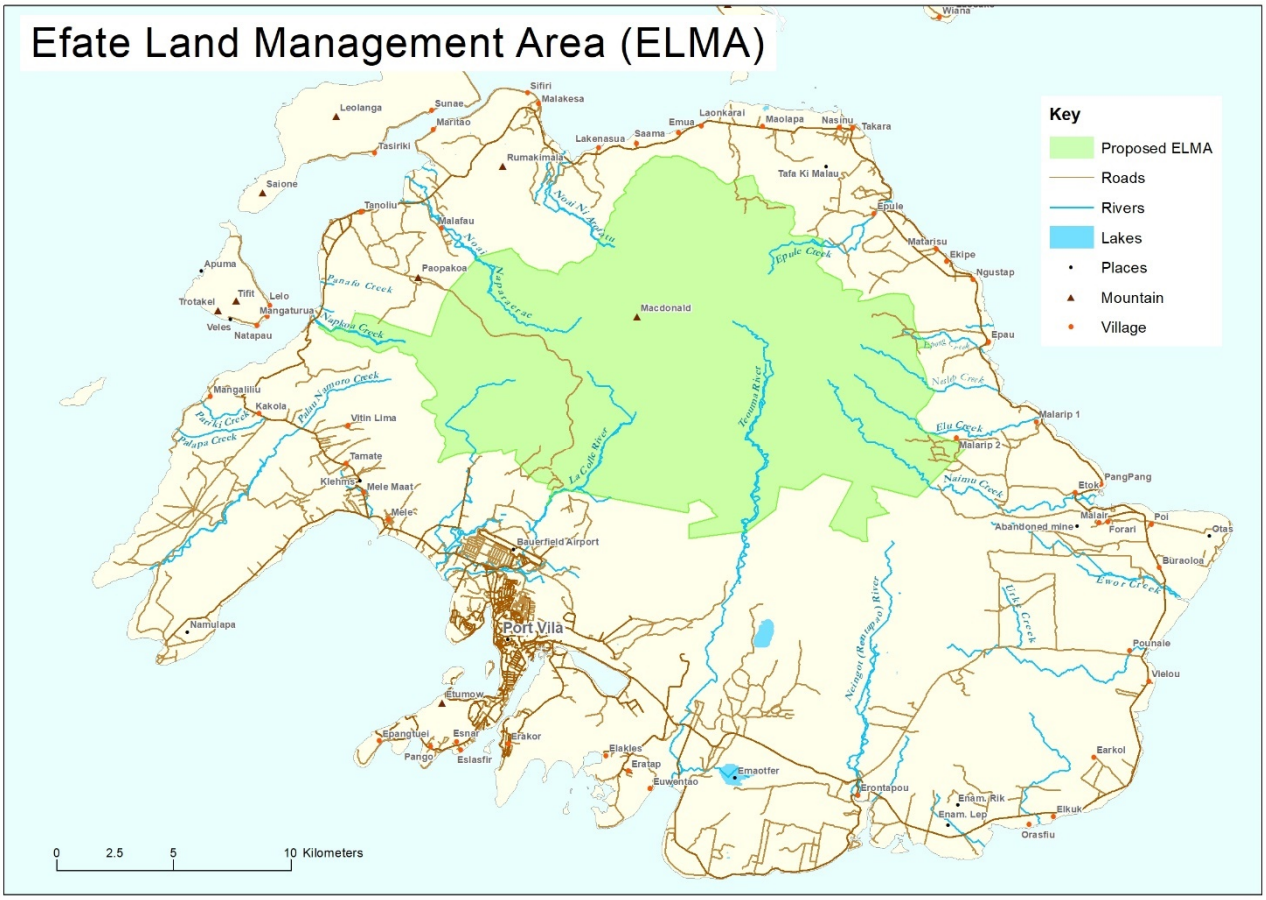

Figure 2-1 : Proposed Efate Land Management Area

This site was chosen because:

- It is accessible by vehicle enabling the survey teams to travel in and out from the Havannah Harbour base accommodation on a daily basis
- A reasonable proportion of the forest in this area has a mature tree canopy and indigenous plant dominated understorey and as such is likely to be habitat for a representative diversity of indigenous plants and animals
- An old walking track passes through this area which made cutting of a survey track through the forest beyond the vehicle track end an easier proposition
- The track passes close to an elevated bluff that looks out across a valley to the north and this vantage point provided ideal bat observation areas
- It is recognised by local communities as an important area of forest.

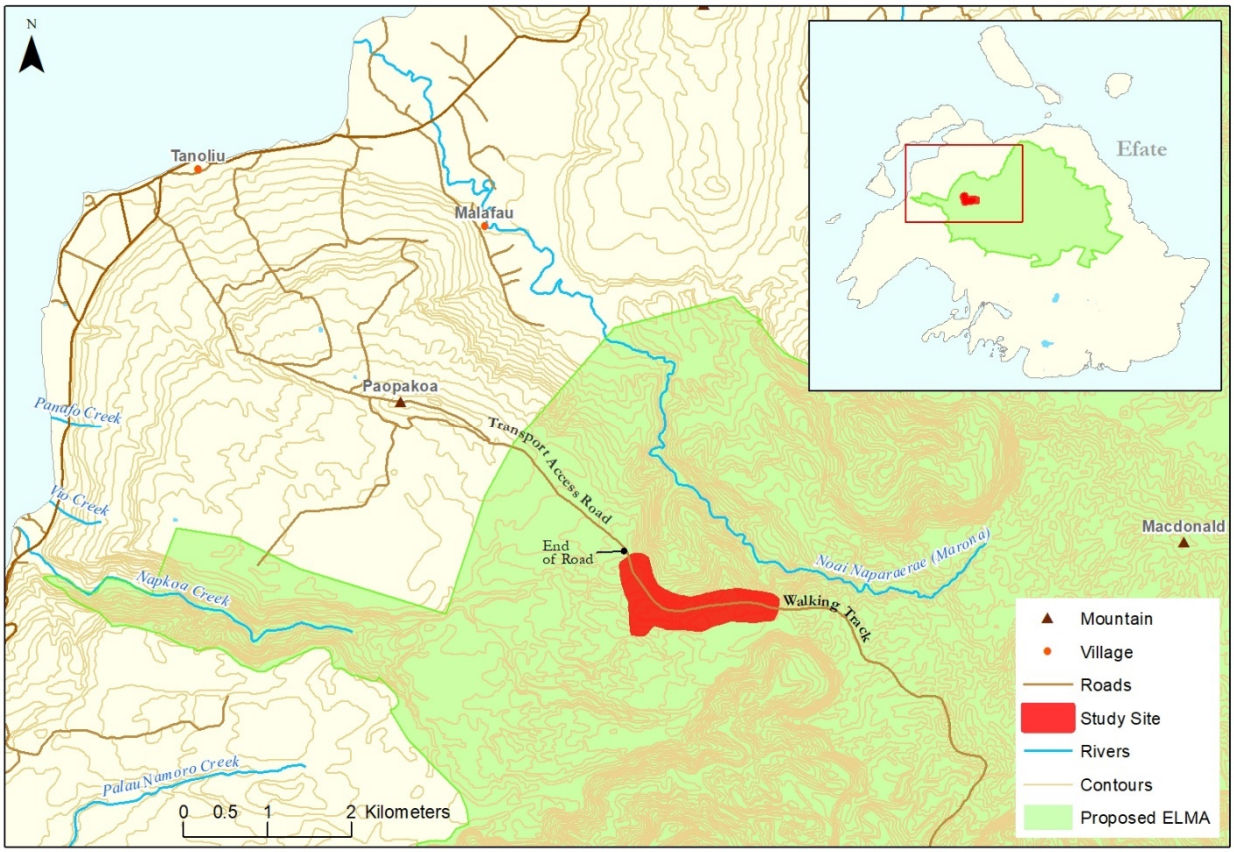

Figure 2-2 : Aerial location map of the Bioblitz survey site

The survey site did not have any permanent or ephemeral waterways flowing through it so no aquatic or wetland flora and fauna were surveyed for. If funding can be obtained to undertake additional ecological surveys or studies it is recommended that they focus in riparian zones, close to streams or within river valleys, in wetter environments, to include those species found in this landscape type.

The Bioblitz was undertaken near the end of the dry season and conditions during the week of field survey were predominantly dry. Rain fell on one occasion only.

3 METHODOLOGY

3.1 APPROACH

The principal objective of the Bioblitz was to find and describe as many species as possible along the transect line over the 5 days available for field work. The focus taxa were bats, birds, herpetofauna (reptiles and amphibians), insects, flowering plants (Angiosperms), and introduced rats. Identification down to species level was attempted or down to genus or family where species identification was not possible. Photographs and, where appropriate (eg. for plants and insects) samples were collected for later identification.

3.2 FIELD TEAMS

Field teams were established for each taxa to be surveyed (bats, birds, herpetofauna, and vegetation) and at least one taxa specialist accompanied each field team. The members of the teams included local experts and conservation network representatives and leaders from North Efate (See Appendix H for a full list).

Nineteen specialists and assistants took part in the Bioblitz. Most of the community and non-specialist assistants remained in the same team for the duration of the field work and, as a consequence, greatly increased their identification skills for the taxa in which they specialised.

3.3 TAXA-SPECIFIC SURVEY METHODS USED

3.3.1 Bats

Several techniques were used to detect, observe and identify bat species. The focus was mainly on nocturnal bat species, especially microbats rather than the more observable fruit bats. However, a record of fruit bats observed was made.

Eight automatic acoustic bat monitors (ABMs) were brought from New Zealand and used to detect and record the high frequency calls of nocturnal microbat species. Microbats emit calls at frequencies that humans are not able to hear but the ABMs are able to record the calls and specialised software can be used to display the frequencies of the calls. Each species has a different call frequency range. The ABMs are suspended on elevated objects, usually trees, along the suspected bat flight paths. They record continuously and have a range of up to 50 to 60 metres.

Figure 3-1 : A New Zealand Department of Conservation-made ABM used for monitoring bat calls (left) and mounted in a tree (right)

Handheld acoustic bat detectors were also available. These detectors can be set at a range of frequencies and convert high frequency calls into sounds that can be heard by humans. Bat team observers were each issued with these with each set at a different frequency to detect different bat species. Echo-locating bat species have a unique call frequency range and call pattern which enables different species to be identified from the acoustic data collected.

Figure 3-2 : Bat harp trap erected at a suspected bat flight path (left) and close up of the fine thread mesh (right) that snares the bats and the collection tray beneath into which they fall

A thermal imaging camera was also brought from New Zealand to film bats flying at night. The camera detects the body heat of warm blooded animals producing clear video footage of bats flying through pitch black conditions. The camera was set up at an elevated location that looked out over a forested valley that was thought likely to be favoured fruit and micro-bat habitat.

ABM acoustic data files were assessed and interpreted back in New Zealand to determine the number of species recorded (from the different call frequencies recorded), identification of the species detected (from previous research that aligned call frequency with particular species), and an overall assessment of the relative levels of at activity.

3.3.2 Birds

The bird team identified bird species using three methods: visual observation, listening to bird calls, and using acoustic recorders. Surveys were undertaken throughout the day, from soon after dawn until dusk, though the majority of observations focussed on the early hours of the morning.

Audio video tapes were used to train bird team members prior to the survey period and each day the team had refresher sessions to better recall the calls of particular species.

Acoustic recorders, very similar to the devices used for bat acoustic monitoring were used to record bird calls over several days (Figure 3-3).

The recorders were retrieved at the end of the survey period and the calls will be listened to and evaluated for species at a later date.

Figure 3-3 : Vanuatu bird expert, Andrew Toara, beside a bird recorder mounted in a tree

3.3.3 Herpetofauna / lizards

Lizards, especially ground dwelling skinks and geckos, and amphibians, particularly frogs, were surveyed using intensive visual ground searches. The survey team operated mostly during the warmer part of the day when lizards were most likely to be out basking in the sun, but night surveys were also undertaken. Logs and branches were also turned over to expose more secretive species.

Photographs were taken of species observed and, where possible, individuals were captured temporarily to facilitate identification.

Figure 3-4 : Lizard and bat expert, Simon Chapman, holding a giant gecko (Gehyra vorax)

3.3.4 Invertebrates / insects

The methods used to survey for invertebrates along the survey transect track are detailed in Appendix D Entomology Survey Report.

The invertebrate team focussed their efforts on three main collection techniques:

- Sweep netting for butterflies
- Tree shaking onto white sheets
- Forest floor debris collection

Sample locations were recorded with GPS readings and effort was made to take comparative samples from primary forest and secondary forest areas. Invertebrate samples were collected and separated into species following the completion of the field work.

Figure 3-5 : The insect team searching through forest floor debris

3.3.5 Vegetation

Vegetation samples were taken at a selection of sites along the full length of the transect track covering the more intact primary forest canopy areas, primary forest areas with reduced canopy cover due to damage caused by Cyclone Pam, and more open regenerating secondary forest areas.

All plants recorded and collected were identified down to species.

Details of the methodology can be viewed in Appendix F Botanical Survey Report.

Figure 3-6 : Members of the botany team recording plant collection details and packaging plant specimens for later identification back at the Department of Forestry office

3.3.6 Vertebrate pests

Visual observations of disturbance or physical damage caused by animals and larger vertebrate pests were recorded, particularly signs of cattle, horses and feral pigs.

In addition, 10 Black Trakka® tracking tunnels, with ink tracking cards, were placed at a selection of locations along the transect track for the duration of the field survey to detect rats. Normal practice is to position the tunnels in the field 3 weeks prior to placement of tracking cards to provide time for rats to become accustomed to them. There was not sufficient time to do this for this survey but the information gained is considered to be of value because a comparison can be made with rat tracking tunnel activity at Emua village (where tunnels and tracking cards were also placed simultaneously). Rat tracking tunnel activity at Emua was very high.

Figure 3-7 : Black Trakka tracking tunnel pinned in position along the survey line

3.3.7 Forest health assessment

Visual observations were made throughout the survey week of the relative state of health of the forest ecosystem. In particular, the intactness of the canopy especially in the mature primary forest, the diversity and vigour of canopy and sub-canopy species regeneration especially in areas damaged by the cyclone, and the presence and impact of introduced weed and animal pest species were all assessed.

4 NORTH EFATE BIODIVERSITY – BIOBLITZ RESULTS

Details of the Bioblitz findings can be found in the taxa-specific reports attached in the Appendices A through to F.

In summary the survey highlights were:

- Five different microbat species were identified from the call signatures on the Automatic Bat Monitors (ABMs). One of these species, the Little Bent-wing Bat (*Miniopterus australis*), was also captured in the harp trap. Two species, the Fijian Mastiff Bat (*Chaerephon bregullae*) and the Large-footed Mouse-eared Bat (*Myotis adversus*), are known to occur elsewhere in Vanuatu but have not been recorded as abundantly on Efate. The two additional microbat species detected on the ABMs are thought (based on their echolocation call peaks) to belong to the genera *Emballonura* and *Nyctophilus*.
- Two megabat species were observed: the first species was identified as Pacific Flying Fox (*Pteropus tonganus*) and a second smaller species was tentatively identified as Vanuatu Flying Fox (*Pteropus anetianus*).
- 27 bird species were described of which 25 were endemic. Nearly sixty percent (24 of 42) of bird species that are known to be present in the forest of Efate were identified in the three days of survey.
- Three bird species were identified that were not recorded in the last significant bird survey on Efate. They were the Vanuatu Megapode (a globally-threatened (Vulnerable) species), the Peregrine Falcon and the Brown Goshawk, although thorough analysis of acoustic recordings is yet to be undertaken to verify this observational data.
- 8 lizard species, one frog species and one snake were observed most were identified to species level;
- 167 species of invertebrates were collected and identified down to the taxonomic level of order or family. Beetles and ants made up the greatest number of species.
- 208 plant species were identified, with most identified down to species level. 14 species identified are endemic to Vanuatu.
- 14 invasive introduced plant species were recorded, most of them occurring along the walking track.
- Rats were tracked in only one tracking tunnel and only on one night (Rat Tracking Index [RTI] of 10%. This compares to an RTI of 100% at Emua in August 2017. No African snails were seen.

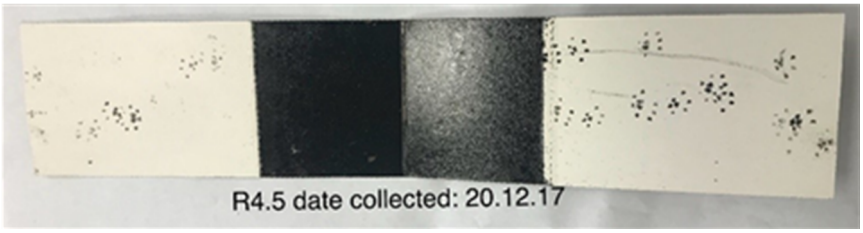

Figure 4-1 : Black Trakka ink tracking card showing the passage of one rat through the tunnel

5 OBSERVATIONS AND DISCUSSION

5.1 BIODIVERSITY ASSESSMENT

5.1.1 Overview

The major ecological objective of this Bioblitz was to undertake a rapid assessment of biodiversity present in section of North Efate forest, preferably with the ELMA, and to observe and identify as many species of target taxa as possible within a limited time period.

The second ecological objective was to use the Bioblitz exercise – planning, logistics, field operations and reporting – as a small scale trial to test the feasibility of undertaking a larger BIORAP over the full ELMA area at some future time. Both objectives were met or exceeded, and are discussed in greater detail below.

5.1.2 Biodiversity discovered

420 species were observed and recorded during the Bioblitz and many of these have been identified down to species level. Several more species are likely to be added to the list when the bird acoustic recordings are analysed and if further effort is put towards identifying more of the collected invertebrates down to species.

While no new species were discovered at least one species, the Vanuatu Megapode was believed to have been observed by the bird team, which had not been recorded in Efate for some time, and two microbat species were recorded that have not been acknowledged as abundant on Efate.

Considering the Bioblitz consisted of only 3 full days (and nights) in the field this result is excellent. It can be concluded that the area surveyed has a diverse indigenous flora and fauna, especially considering the survey was undertaken at the end of a long dry season and in an upland forest area.

5.1.3 Forest and habitat health assessment

The ELMA forest area surveyed is in surprisingly good health considering the devastating impact of Cyclone Pam in 2015 and the presence of a wide range of invasive plants and animals around the coast of Efate. The survey area appeared to show considerable signs of natural resilience to the potentially devastating effects of invasive plants and animals and cyclones. If the rest of the ELMA area is similar to the area surveyed then the forest in the ELMA warrants protection.

While invasive introduced plant species are present, most are confined to the track edge and there were no areas observed that were dominated by these species. Regeneration in areas where the canopy trees were felled by Cyclone Pam is predominantly of indigenous species and the sapling regrowth is substantial. The pockets of older canopy trees that were not damaged by Pam have a healthy diversity of understorey plants and bird, lizard and invertebrate fauna.

Rat numbers were very low compared to what is found in the villages around the coast. Although the tracking tunnels were only used for surveying rat numbers over 3 nights, and the tunnels were not positioned 3 weeks in advance as is best practice, an RTI of 10% is low compared to coastal areas and low compared to New Zealand indigenous forest for example (typically 30 to 60% RTI in uncontrolled forest).

The lizard and bat populations surveyed appear to be diverse and numerous, again suggesting that the impact of predators is not substantial and the condition of the habitat is reasonably healthy. The two hours of thermal imaging camera footage taken recorded several bat passes per minute for the full duration of filming. This is substantially greater than can expected anywhere in New Zealand forests where long- and short tailed bats exist.

5.1.4 *Forest threats*

The greatest threat to the ELMA forest area surveyed is from cattle from the neighbouring cattle farm. A herd of approximately 20 cows and calves were observed on the forest side of the fence and there was plenty of evidence that they move quite some distance up into the forest. Their semi-wild behaviour also suggested they had been present in the forest for quite some time.

There was evidence of trampling and browsing of palatable forest floor species in the areas occupied by the cattle, and the understorey was noticeably lower in plant species diversity and density.

Invasive weed species do occur along the access track although they do not dominate any of the areas surveyed. The lack of dominance of invasive plant species in areas where the canopy was damaged by Cyclone Pam is a positive observation, however some weed control of these species would be advisable to prevent this situation changing.

5.1.5 *Bioblitz logistics*

The logistics and cost to run the Bioblitz were as expected, summarised in Table 5-1 below. The planning was good and the exercise ran to budget with few operational problems encountered.

Table 5-1 : ELMA Bioblitz Costs

Item	**Cost (EURO)**
Travel	2,850
Accommodation	3,400
Food	1,700
Specialists (local and international) and community members	21,000
Equipment hire	2,000
Field costs	2,000
Site reconnaissance and preparation	1,200
Sample analysis and reports	10,000
Total	**44,150**

The Department of Forestry staff were major contributors to the success of the Bioblitz. The botany and invertebrate teams are experienced at undertaking field surveys and they organised themselves with efficiency and a high degree of competence. The technology and expertise provided by the New Zealand team members complemented the local teams with the result that there was tremendous interchange of ideas and knowledge. Vanessa Organo's efforts to organise the logistics and survey line meant that the survey teams were able to focus on finding and describing biodiversity rather than having to organise food and transport to site. The choice to have a single field base to sleep in and eat at proved to be a good one. Samples were able to be sorted in the evenings, which would not have been possible if the teams had camped in the bush, and all Bioblitz participants were able to mix and learn from each other.

The costs to complete the Bioblitz inform the costs of a large scale BIORAP in the future. From a logistical perspective, and on the basis of the lessons learned undertaking the Bioblitz, there is little doubt that a larger scale rapid biodiversity survey is achievable and would contribute substantially to improving the collective knowledge of Efate's biodiversity.

5.2 COMMUNITY PARTICIPATION IN THE BIOBLITZ

Six north Efate community members who are members of the North Efate Tasivanua Environment Network participated in the Bioblitz. They were active members of the survey teams and openly contributed their local knowledge to other team members.

A major objective of the Bioblitz was to begin the process of assisting local communities to better understand and recognise the indigenous plants and animals that live in their forests, to develop an understanding of the human-assisted threats to forest ecosystems (animal pests, invasive weeds, farm livestock, and forest clearance), and to help develop an understanding of the direct links between a healthy thriving forest ecosystem and a more sustainable and resilient livelihood for their communities (ecosystem services).

The local community members demonstrated keen powers of observation and contributed traditional knowledge, which complimented and added insight to the scientific knowledge of the team. It is advisable that any future assistance given to local communities in the field of biodiversity education, draws on this local knowledge and these skills.

On the final day of the field trip, a discussion workshop was held at which all community members talked about what they had learned over the Bioblitz week and what that meant to them. These comments can be viewed in Appendix G. Without exception, all members felt they had learned a great deal about the ecology of their forests and particularly about the inter-connections between plants and animals.

Throughout the Bioblitz Presley Dovo explained very well the importance of insects in the forest (eg, as decomposers, pollinators and food sources etc), and how damage to one part of the ecosystem has a cascading effect over all other parts of that ecosystem, including the provision of food and water to the villages and communities around the coast. This message had clearly been understood by the community members present and all spoke of their improved understanding of the importance to their own livelihoods of maintaining and protecting the forest environment of north-western Efate. One community member talked emotionally of the importance of the forest land to his community and how some of the links and traditional knowledge had been lost over the last generation.

The consensus was that the Bioblitz had been very effective at improving their knowledge of the ecology of their forests and that more of activities of this nature should be undertaken so other members of the Tasivanua communities could benefit.

A general discussion was held at the discussion workshop about the state or health of the forest area surveyed. The biodiversity experts present agreed that the forest was in a reasonably healthy state given the damage caused by Cyclone Pam in 2015. The low occurrence and impact of animal pests and invasive weeds, and the generally diverse and indigenous species dominant regeneration supported this view. There was general agreement that these forest areas needed to be protected and that the major threats to the forest should be managed actively, especially cattle and invasive weeds.

6 CONCLUDING DISCUSSION

North Efate has been identified as one of 27 Key Biodiversity Areas in the East Melanesian Islands Biodiversity Hotspot and is recognised as a biodiversity site that would benefit from some form of protection (University of the South Pacific 2012).

The 2012 report, entitled "Ecosystem Profile: East Melanesian Islands Biodiversity Hotspot", states that "Vanuatu supports fewer globally threatened species than the other two countries in the hotspot but it remains a high priority for global biodiversity conservation, because of the significant number of globally threatened species that are found nowhere else." The report also makes a number of investment recommendations that apply to Vanuatu and Efate:

- *Strategic Direction 1: Empower local communities to protect and manage globally significant biodiversity at priority Key Biodiversity Areas underserved by current conservation efforts*
    - *Investment Priority 1.1 Conduct baseline surveys of priority sites that build government-civil society partnerships and bridge political boundaries*
    - *Investment Priority 1.2 Raise awareness about the values of biodiversity and the nature of threats and drivers among local communities at priority sites*
- Strategic Direction 2: Integrate biodiversity conservation into local land-use and development planning

The just completed Bioblitz in north-western Efate has been successful in beginning the process of addressing these identified priorities. Its findings indicate that the forest has a high level of biodiversity and advocates for protecting the overall ELMA. Conducting additional Bioblitz or larger BIORAP activities across the ELMA would help in the design of specific conservation measures and serve as a baseline to monitor from.

Our own objectives for the Bioblitz – to learn more about the biodiversity of the forests of north-western Efate, and to stimulate community interest and awareness of the importance of indigenous biodiversity to community resilience and long-term sustainability – have both been achieved. The challenge now is to continue the momentum and increase the knowledge base across all of north Efate.

7 RECOMMENDATIONS / SUGGESTIONS

If further Bioblitz's are to be undertaken (which is recommended), it is suggested that the next one would best be located in a valley system containing a permanent river so that aquatic and riparian biodiversity can be assessed.

Small scale Bioblitz's, such as the one reported here, are an ideal size to enhance the knowledge of local people. Learning opportunities are better with smaller groups than would be the case with larger scale BIORAPs.

The knowledge gained from participation in a Bioblitz, especially development of an understanding of the inter-connectedness of plants and animals, can be used to assist communities to develop more effective and sustainable forest restoration projects. The protection and enhancement of community water supplies is an important topic for Efate communities and effective restoration of forest ecosystems in the water supply catchments would greatly improve the resilience of those water supplies.

A substantial BIORAP across all of the ELMA lands is justified if the funding can be found. The forests appear to be in sufficiently good health to support a diverse range of biodiversity but the true ecological value of ELMA will only be fully revealed if a comprehensive survey is undertaken and more taxa specialists are brought in to lead the surveys. The knowledge gained from a BIORAP is likely to strengthen the case for ELMA to be protected in one form or another.

8 ACKNOWLEDGEMENTS

Everyone who participated in the Bioblitz contributed in a substantial way to the success of the weeks activities and deserves acknowledgement.

A huge thank you to Roger MacGibbon (WSP Opus) for leading this Bioblitz and providing invaluable technical expertise and experience. His steady and wise leadership ensured the operation was collaborative, adaptive and safe.

Special mention must go to Vanessa Organo without whom the Bioblitz would never have occurred. Vanessa did most of the planning and behind the scenes organisation including finding willing participants, selecting and inspecting the field survey site, organising track cutters, guides and drivers, managing the project budget including payments to participants, arranging for dinner and lunch to be made for the team by the women of Tanoliu, and communicating all of the arrangements back to the NZ team. In addition, she was an active member of the bird survey team participating in dawn and dusk surveys on all 3 days.

Considerable thanks to the Department of Forestry botany team (Fraser, Thomas, Stephanie and Elisha) and entomology expert, Presley Dovo (also from the Department of Forestry) and Andrew Toara Morris for being available to participate in the Bioblitz and sharing their biodiversity knowledge with the other survey team members.

Thanks to Mark O'Brien from BirdLife International for developing training materials for the bird survey participants and for reviewing the data collected.

Live and Learn, and especially Emil Samuel, provided invaluable assistance in the planning stages, including selecting and marking the survey line, and Emil assisted the field team through the survey week.

Thanks also to Jenny Donlan for her assistance throughout the survey and to Priscilla Amkori Memi for her assistance to Simon and the bat team and for preparing an excellent report on the bat findings (see the appendices).

Special thanks to the New Zealand team for their considerable input and expertise. Simon Chapman's specialist expertise in bat and lizard ecology and taxonomy was hugely valuable and the successful use of his harp trap enabled several team members to view native bats close up for the first time. Rowan Dixon, the WSP Opus RESCCUE project manager provided valuable logistical support, enthusiasm and a previously undiscovered talent for finding lizards in the forest.

Thanks also to the women of Tanoliu who made our dinners and lunches, the track cutters and guides, and Karie Korah our Shefa driver who drove us daily to the survey site and collected supplies from Port Vila.

APPENDIX A
SIMON CHAPMAN BAT REPORT

Ecology New Zealand Limited
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Albany
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MEMORANDUM

Attention:	Rowan Dixon; Roger McGibbon
Company:	WSP | Opus
Date:	29 February 2018
From:	Simon Chapman
Project:	1708043-002: Efate BioBlitz

Dear Rowan and Roger,

Re: Efate Bioblitz – Bat Survey

1. Introduction and Background

1.1. Ecology New Zealand Limited (ENZL) was commissioned to carry out a rapid survey of the bat communities within the Efate Land Management Area (ELMA), Efate Island, Vanuatu, as part of a BioBlitz (a rapid biodiversity survey). This memo presents the results of the bat survey.

1.2. Vanuatu has generally been considered to have relatively low diversity of native terrestrial mammals in comparison to other islands areas within Melanesia. Bats are Vanuatu's only native mammals. Among the islands of the Vanuatu archipelago, Efate is considered to have lower bat diversity/abundance in comparison to some of the other larger islands (e.g., Santo) (Prié, 2011).

1.3. Vanuatu's known bat fauna is comprised of four megabat species (commonly known as flying foxes and/or fruit bats) and eight microbat species ('true' bats that use echolocation to navigate). Megabats are typically fruit, pollen and nectar eaters. They have large eyes as they use sight to navigate at night. Microbats are typically aerial insectivores. They have small eyes and intricate nose and ear structures because they navigate with sound (known as echolocation) rather than sight.

2. Methodology

2.1. The bat survey focused on a 2-3 km section of a forested ridge that runs north-west from Mount McDonald towards the coastal village of Tanoliu. A track along the ridge was utilised

as the survey transect. Bat surveys were carried out along the transect over three days and two nights from the 7th to the 9th of November 2017.

2.2. Five bat survey methodologies were utilised:

- *Visual Encounter Survey (VES)*
  The presence of any megabat species was noted during daytime and nocturnal surveys along the transect. VES observations are considered 'opportunistic' as they were made during surveys primarily targeting herpetofauna.

- *Automatic Bat Monitors (ABM)*
  Microbats use echolocation to navigate. Bat echolocation involves emitting calls as they fly and listening to returning echos to interpret their surroundings. ABMs are passive ultrasonic acoustic recorders that record bats' high frequency echolocation calls. The ABMs used (Model: DOC AR-4) record bat activity at frequencies up to 88 kilohertz (kHz) and at distances of up to 50 m (depending on species). Results are recorded a sonogram for each call or series of calls (termed a 'bat pass') which are interpreted to identify the bat species present (each species typically has a unique peak frequency and/or call 'shape'). A total of 7 ABMs were deployed along the transect during the survey period. Ultrasonic acoustic recorders do not detect megabat species (flying foxes / fruit bats) as those species do not echolocate.

An ABM set in a tree along the survey transect.

- *Hand-held bat detectors*
  Two Magenta Bat 4 Heterodyne Bat Detectors were used while carrying out two nights of nocturnal surveys (primarily for herpetofauna) along the survey transect. The hand-held detectors monitor one frequency at a time with a frequency range of 15-130 kHz. The detectors convert ultrasonic echolocation calls to lower frequencies that are audible to human hearing when emitted in real time from the detectors' built-in speaker. One unit was set to detect bats at 40 kHz and the other was set to 65 kHz. Those frequencies were selected to detect the widest range of forest-dwelling microbat bat species possible.

A hand-held bat detector.

- *Harp trapping*
  A harp trap (Austbat standard 4.2 m2 two bank harp trap) was used to trap bats over two nights of trapping. The trap consists of a 1.8 m x 2.3 m frame of aluminium tubes holding two banks of vertically strung, fine monofilament fishing lines, at 25 mm spacing. Bats are trapped when they fly into the monofilament banks and fall into a catch bag below the frame. Traps are set across known or suspected bat flight paths through confined areas (e.g., along forest tracks with closed canopy) to maximise the likelihood of capture.

A harp trap set up across a likely flight path through the forest.

- *Thermal imaging camera*
  A thermal imaging camera (Model Flir T650sc) was used to observe and record bat activity for approximately three hours of darkness on one night at a vantage point along the transect where the presence of very large trees increased the likelihood of high levels of bat activity. The footage was reviewed to informally assess bat diversity, abundance and behaviour at the site.

The thermal imaging camera used to record nocturnal bat activity.

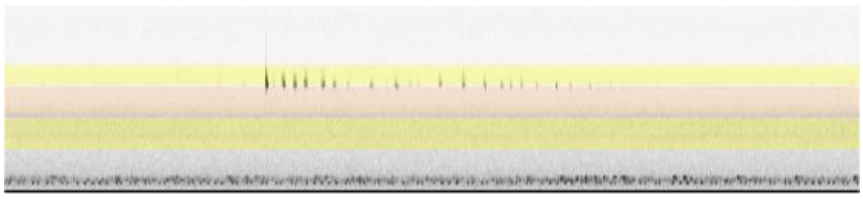
3. Results

3.1. Two megabat species were observed during opportunistic VES. The first species was identified as Pacific flying fox (*Pteropus tonganus*) and a second smaller species was tentatively identified as Vanuatu flying fox (*Pteropus anetianus*).

3.2. The ABMs recorded the echolocation calls of five microbat species. A lack of reference examples of calls for Vanuatu's microbats meant that identification of most of the species recorded was not possible for two species and should be considered tentative at best for the other three species. Two microbat species appeared to be particularly abundant within the survey area. One emitted echolocation calls peaking at approximately 65 kHz and the other had peaks at approximately 40 kHz. Those call peaks do not correspond with the peaks of the microbat species known to be abundant on Efate (bent-winged bats and horseshoe bats). The peaks do however correspond to species that occur elsewhere in Vanuatu and, on that basis, they were tentatively identified as Fijian mastiff bat (*Chaerephon bregullae*; 40 kHz peak) and Large footed mouse-eared bat (*Myotis adversus*; 65 kHz peak). A third species with relatively quiet calls peaking at approximately 50 kHz was initially identified as an unspecified bent-winged bat species (*Miniopterus* sp.). However, while the peak call frequency did not correspond directly to the *Miniopterus* species known to occur in Vanuatu, the calls were subsequently attributed to Little bent-winged bat (*Miniopterus australis*) based on the results of the harp trapping (see below). Two additional unidentified bat species had echolocation call peaks at approximately 28 kHz and 75 kHz (possibly indicative of bats in the genera (*Emballonura* and *Nyctophilus* respectively).

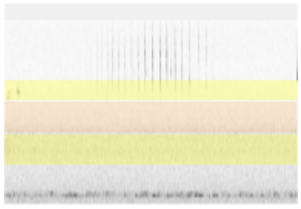
Sonogram showing bat echolocation calls with peak volume at approximately 40 kHz, tentatively identified as Fijian mastiff bat (*Chaerephon bregullae*).

Sonogram showing bat echolocation calls with peak volume at approximately 65 kHz, tentatively identified as large footed mouse-eared bat (*Myotis adversus*).



Sonogram showing bat echolocation calls with peak volume at approximately 50 kHz, tentatively identified as Little bent-winged bat (*Miniopterus australis*).

Sonogram showing echolocation calls of an unknown bat species with peak volume at approximately 28 kHz.



Sonogram showing echolocation calls of an unknown bat species with peak volume at approximately 75 kHz.

3.3. Two little bent-winged bats were captured in the harp trap on the evening of 9 November. Morphological characteristics such as weight (6-7 g) and tibia length (14-15 mm) of both individuals supported the identification. A third bat escaped from the trap and while it

could not be positively identified based on the brief observations made before it escaped, it appeared to be a noticeably larger microbat species compared to the bent-winged bats captured.

One of the two little bent-winged bats captured in the harp trap.

3.4. The thermal imaging camera footage did not confirm any further bat species identifications. The footage did however show a wide range of bat species (including both megabat and microbat species) foraging which provides a strong indication that the area supports high bat species diversity and abundance.

4. Discussion and Conclusion

4.1. Three of the seven bat species detected during the BioBlitz survey could not be positively identified (one megabat and two microbat species). Two of the microbat species identifications are highly tentative as those species have not previously been confirmed on Efate. The only confirmed species identifications for which there is no uncertainty are Pacific flying fox and little bent-winged bat. Further research is required to clarify exactly which bat species occur on Efate. Identifying microbat species with acoustic surveys is

difficult because there is no reference collection of echolocation calls of confirmed microbat species from Vanuatu.

4.2. While the survey was not a comprehensive assessment of the bat populations of the ELMA, and despite the lack of confirmed species identifications, the results have confirmed that the area has high bat diversity – especially among the microbats. The species most likely to have been missed by the survey are rare species, and the cave-dwelling species (e.g., horseshoe bat species). More detailed surveys across a wider range of habitats (e.g., valleys, riparian margins, canopy, caves, coastal, etc.) would almost reveal additional species possibly including rare, endangered and previously undiscovered species.

4.3. Due to the abundance of several bat species, bats appear represent a substantial component of the area's faunal biomass. On that basis, bats should be considered an important component of the forest ecosystem and essential to ecosystem functioning due to their various ecological roles. Megabats are important as pollinators and seed dispersers for many forest plant species. Microbats also play an important ecological role in suppressing invertebrate populations including nuisance species such as mosquitos.

5. Reference

Prié, V. 2011. Focus on bats, in Bouchet, P., Le Guyader, H. & Pascal, O. (eds), *The Natural History of Santo. Patrimoines Naturels 70*. Muséum national d'Histoire naturelle, Paris; IRD, Marseille; Pro-Natura International, Paris: 316–323.

Please do not hesitate to contact me (Phone: +6421436841 or E-mail: Simon.Chapman@ecologynz.nz) should you require further details.

Kind regards

Simon Chapman
Principal Ecologist

APPENDIX B
PRISCILLA AMKORI MEMI
BAT REPORT

BioBlitz ELMA Conservation Area, Mt McDonald, North Efate

From the 6th -10th of November, under the RESSCUE project we carried out a BioBlitz at the ELMA conservation area on Mt McDonald, North Efate. There were three different teams: the Botany & Insect team, the Bird team and the Reptile & Bat team and I was privileged to be part of the latter. The leader of the Reptile & Bat team was Simon Chapman, a lead ecologist from New Zealand. It was such a great experience because I got to hike again after so many months and I met new people but most importantly because I got to learn so much from Simon and the others.

Figure 1. The Bat team- Jenny Donlan (GIS specialist), Rowan Dixon (Logistics, OPUS), me (VESS), Emile (Live & Learn), the two local guides, Simon Chapman (Bat & Reptile Ecologist) and Kaloris (CSO). The picture was taken by Roger (Ecological Restoration Specialist, OPUS) on 8/11/17.

We left for the second Bat survey (I was not part of the first which occurred the previous night) at 3.30 pm and returned at 10 pm on 8th November. The drive from our base at Gideon's Landing to the entrance of the paddocks that would lead up to the ELMA area took around 3-5 minutes which was followed by a 30 – 45 minute bumpy ride through the paddocks to the end of the track inside the ELMA area. We then hiked for 1 – 1.5 hours to a spot around 200 m beyond the lookout (one of our reference points) where Simon and I then set up the harp trap.

The harp trap was set up in an old forest in a gap (about the length of the trap) between the stems of trees. Though a gap existed at the bottom, their canopy met over the top. The canopy 'blockage' at the top forces the bat to fly through the gap to get to the other side, getting caught in the trap during the fly-through. The harp trap, as shown in figure 2, contains strings that traps the bat when

it flies into them and causes the bat to fall into the net at the bottom. Between the net are two long plastic covers that prevent the bat from escaping once it gets into the net. The harp is a very effective trap because in addition to the micro bats' poor eye sights, the strings of the harp are very small that the bats often cannot see them so they fly straight into them.

Figure 2. The Harp Trap

Each bat echolocates at different frequencies thus by tuning our four hand-held bat detectors to different frequencies, we were able to detect and identify which bat species a certain echolating bat belonged to. Around five minutes after setting up the trap, one of our hand-held bat detectors got its first reading and it corresponded with the frequency that Prie (2011) stated for *Miniopterus australis*. The bat got caught in our trap and Simon removed him from the trap into a bat bag. Not long after, another bat got trapped. We waited for several minutes with the hope to trap more bats but unfortunately did not. So Simon carried out the required measurements of the two bats we

caught, one after the other while I recorded them (See figures 4 - 6). After taking the measurements, we let the bats go, pack the harp trap and hiked back.

The measurements of both bats corresponded with Flannery's (1995) and Prie's (2011) measurements of *M. australis* (Little Bent-wing Bat) as shown in table 1. Therefore we concluded that the two bats we caught, both adult females, were *M. australis* that lived in the old forest and depended on the old forest for survival.

Table 1: Compared biometry of M. australis from Santo and Efate

		Forearm (mm)				Tibia (mm)				
Island	Sex	Mean	Min	Max	N =	Mean	Min	Max	N =	Body Length (Mean)
Santo (Prie, 2011)	---	37.5	36.3	40	128	15.6	14.5	17	85	-----
Efate (Flannery, 1995)	F	37.5	37.4	40.4	5	14.7	13.8	15.7	5	39.1
Efate	F	38	37.5	38.5	2	14.5	14	15	2	43

Important things to remember:

- Tibia: Knee to ankle
- Wing depth: Length of middle finger
- Length: Base of tail to tip of nose
- Sex: Males have two testicles between their legs, females do not
- Age: Juvenile- Gap present on lower joint of first finger (<2 years)

  Adult- No gap (>2 years)

Figure 3. The two bats had a lot of fleas on them, though one more than the other

Figure 4. Simon explaining the different bat measurements we would be taking

Figure 5. Taking the bat ear measurements using a calibre

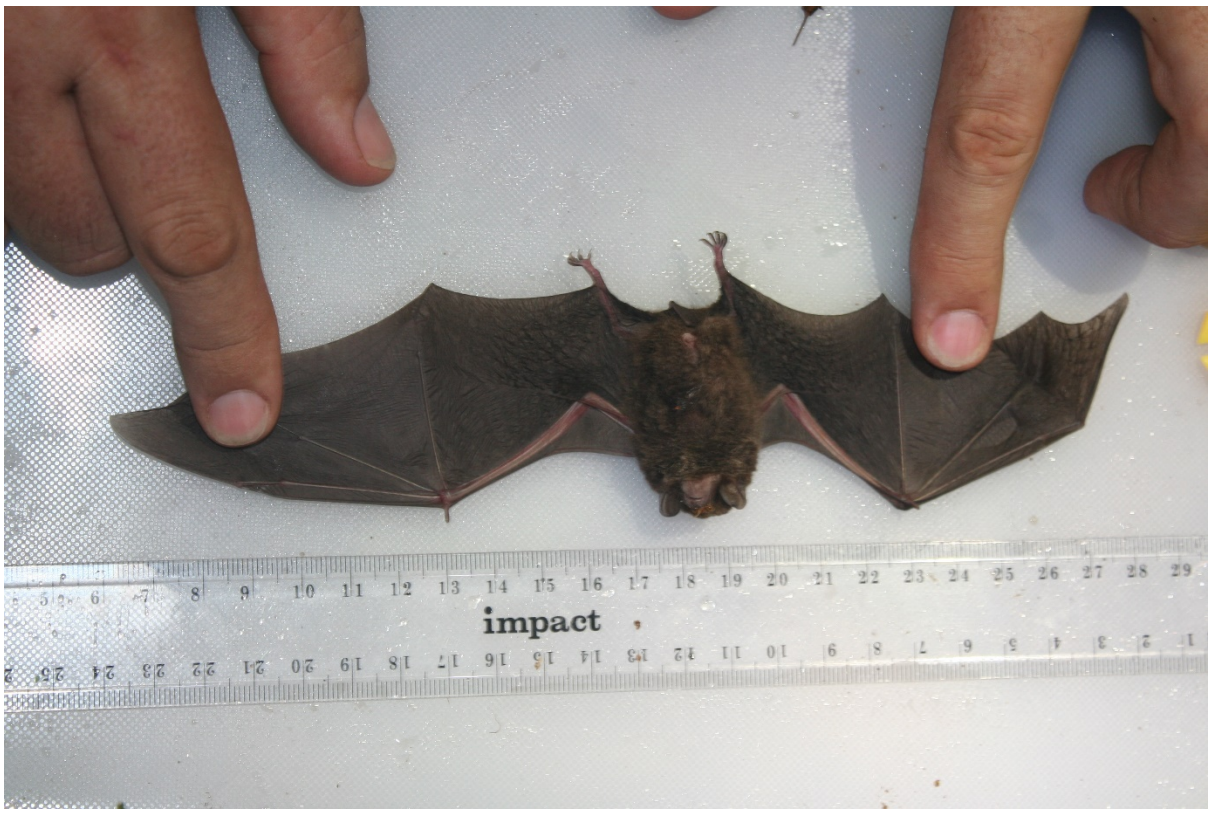


Figure 6. A full shot of one of the two bats

The next day we went back to the mountains and collected seven automatic bat monitors (ABM) that the team had installed on the 7th of November. The ABMs had been set to start recording one hour before sunset and each had a span of 13 hours. They had been installed on trees using a long wooden rod and an "S" hook. When we returned, Simon taught me how to analyse the recordings using a software app from New Zealand's Department of Conservation and I had a go at analysing them. Figures 7 and 8 below explain the different echolation call patterns of the micro bats when they are active. The ABMs from the forest showed many readings that fell within the *Miniopterus australis*, *Chaerephon bregullae* and *Myotis adversus* range of frequencies. However the bat detector installed at the base only recorded the frequencies of the *C. bregullae* and *M. adversus*.

Early scientific papers had only reported *C. bregullae* on Santo, Aore and Malo and *M. adversus* on Aore and Malekula. Although there have been stories from locals on Efate claiming there were some rat-like bats that were seen after cyclone Pam in 2015, no scientific group have been able to confirm that the rat-like bats were *C. bregullae*. So this was a very interesting find for the team because we can confirm that the distribution range of both of these species of bats have been extended to Efate.

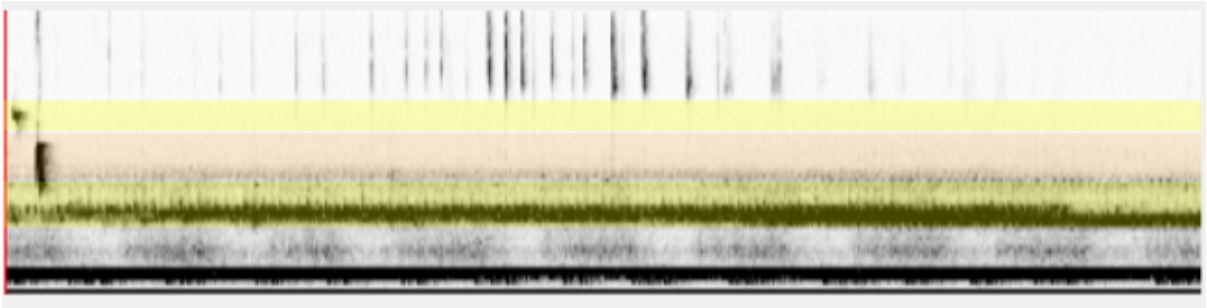


Figure 7. Frequencies that are far apart indicate general flying where the bat is trying to locate its prey.

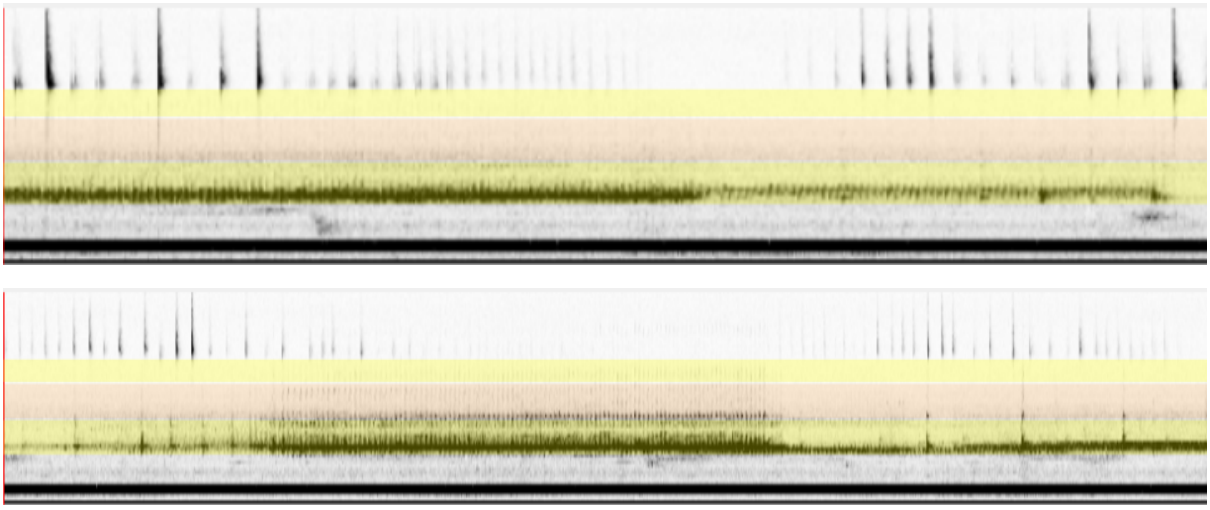


Figure 8. Closely spaced frequencies indicate that the micro bat has spot its prey and is flying towards it. A gap between closely spaced frequencies indicates that the bat has caught its prey and is feeding on it.

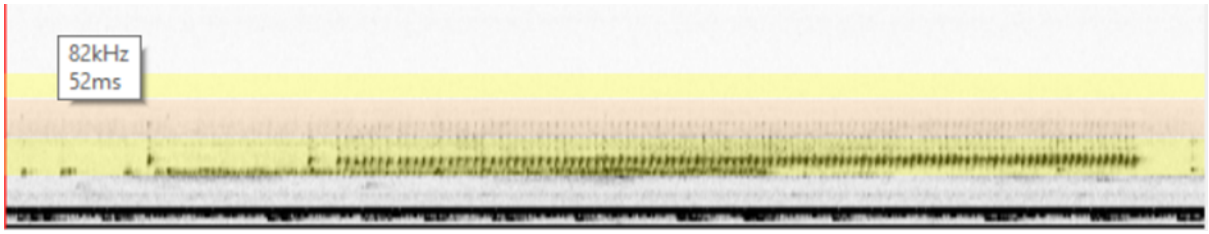


Figure 9. Insect calls show a definite pattern that is followed by a sudden stop

The BioBlitz was my first but it was a great one. It was good to be in the field and to learn from experts who have been doing ecological assessments for a long time. I look forward to carrying out more bat surveys in the future!

References

Flannery, T.F. 1995. *Mammals of the south-west Pacific and Moluccan Islands.* Cornell University Press: Ithaca, New York.

Prié, V. 2011 – Focus on Bats. *in* Bouchet P., Le guyader H. & Pascal O. (Eds), *The Natural History of Santo*. MNHN, Paris; IRD, Marseille; PNI, Paris. 572 p. (Patrimoines naturels; 70).

APPENDIX C
BIRD SURVEY REPORT

[NOTE: this report will be updated when the acoustic bird recordings are analysed]

EFATE LAND MANAGEMENT AREA (ELMA) BIRD IDENTIFICATION SURVEY

NORTH-WESTERN ELMA

7 – 9 November 2017

BirdLife INTERNATIONAL | Partnership for nature and people

USP THE UNIVERSITY OF THE SOUTH PACIFIC

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Abstract

This purpose of this report is to show the results of the bird identification survey undertaken in the north-west of the Efate Land Management Area (ELMA), which took place in November 2017. According to a latest research, forty-two bird species were formally known and expected to be present of Efate. Only twenty five of them could be identified within the area, with additional three species new to the area identified.

Carrying out this survey was required as part of an overall biodiversity survey in a small portion of the ELMA. The ELMA is a proposed protected environmental and cultural area in the interior of Efate, which is the vision of the chiefs from Efate and offshore islands.

The bird identification team spent approximately three days preparing and training for the survey, and three days collecting data in the study site, in the north-west of the ELMA. They used forms to record bird species they heard or seen. They also used acoustic recorders to record bird sounds in order to cross check for some bird songs which were not recognisable when heard.

This report presents a summary of the data collected, and concludes that 60 percent of birds known to be present on Efate were found during the survey in the ELMA. It identifies the bird species that were most commonly present in the area with reference to time and space.

Keywords

Efate Land Management Area (ELMA); biodiversity; bird species; habitats; Bioblitz; Tasivanua; waypoint; restricted range species; endemic species; introduced species; indigenous species.

Technical Editor

Dr. Mark O'Brien, Regional Program Coordinator – Pacific Region, BirdLife International

Academic Editor

Vanessa Organo, ELMA Office, Vaturisu Council of Chiefs and Shefa Provincial Government

Introduction

The Efate Land Management Area (ELMA) is an initiative established by the Efate Vaturisu Council of Chiefs to protect and to conserve the cultural and historical resources of Efate, including water catchments and the biodiversity, for the benefit of present and future generations who reside on Efate.

For the purposes of effective community consultation and decision-making, scientific data is required for the ELMA project, in order to identify and record the type of biodiversity existing in the ELMA.

In November 2017, a Bioblitz activity was undertaken from the 6th to 10th November to record all living species in the study area and surrounds. The Bioblitz team was divided into four groups: the botany team, the insect team, the reptile/bat team and the bird team.

This report is to show the results of the research from the bird team. The aim of the bird survey was to identify the number and types of bird species present in the study area. This report also identifies the most to least common species across various habitats in the area.

A team of four people have helped in the survey including some community volunteers. The bird team was composed of two female volunteers from the North Efate Tasivanua Environment Network (NETEN), the ELMA Office and the team leader, an environmental science undergraduate from the University of the South Pacific, representing the BirdLife International specialist in Vanuatu.

The geographic location of the surveyed area (Figure 1) was the rain shadow on the leeward side of Efate island due to the effect of the prevailing south-east wind. The site included approximately 2 kilometres of track on a ridge top. There were also rainforests on higher mountains and on slopes to either side of the ridge. These changes in elevation resulted in microclimates and thus had great impacts on different types of forests throughout the site, which were habitats of diverse bird species.

The bird survey team did their bests to reach various habitats as much as possible. They used forms (Appendix 1) to record bird species they heard or saw. They also used acoustic recorders to record bird sounds in order to cross check with some bird songs they did not recognise and to provide a more robust method of data collection and analysis.

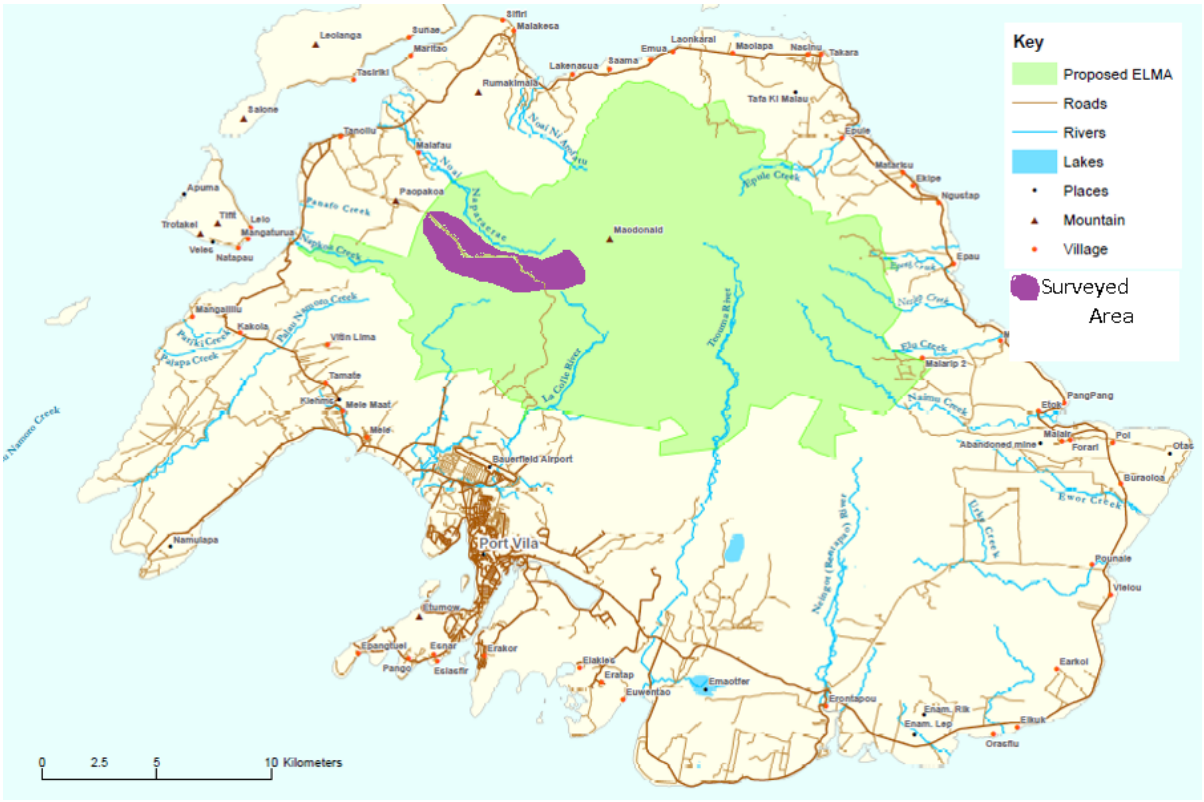

Figure 1: Map of Efate, including the proposed ELMA in green and the study area marked in purple.

Methods

The bird survey team referred to a list of 42 bird species (see Appendix 1) - bush birds known to be present on Efate - in order to carry out identifications. An identification guide (comprising bird song provided by the British Museum of Natural History, and images, provided through the eBird portal, and supplemented from Google Images) was established as a Powerpoint presentation and used to train surveyors prior to the surveys.

The surveyors used standard forms (Appendix 2) to record the species of bird they heard or saw directly for 5 minutes, after which an acoustic recording device was set up to record bird songs for the same amount of time, to be analysed for validation of direct identifications. Records for each site comprised simply whether, or not, the species had been recorded – and whether the observation was visual or audio. Discussion as a group helped to verify observations. The intervals of each recording location were 200 meters along the track and the same track was repeated at different times but the locations of recordings were in-between the previous GPS waypoints. The timing of three surveys was during early morning, between 5:30am and 10:00am, and one survey was conducted during the late afternoon and early evening.

Bird sounds could be recorded 200 meters away from each waypoint. Acoustic recorders were also programmed to record bird sounds for approximately 2-3 hours at dusks and dawn at different locations. Please note that at the time of report writing, analysis of the bird recordings has not been completed, and so this initial report is based on birds seen and heard and recorded on the forms during the survey. The report will be updated and re-issued on analysis of the recorded data.

The waypoints of each recording location were recorded via GPS devices as well as on paper.

A track of approximately 2 kilometres was followed twice for recording along a ridge which extended from the north-western boundary of the ELMA down south, towards Mt MacDonald. The ridge's environment was quiet dry and consisted of forest, disturbed since the category 5 Tropical Cyclone Pam of 2015, with sections of both closed and open canopy cover. Some mature secondary forests, recovered from logging, were also disturbed by the cyclone. Four transects were established, perpendicular to the track, to reach different habitats as much as possible. Some healthy rainforests could be found in the valleys just besides the ridge, in which data was also recorded.

Results

Table 1. Summary results of the bird identification survey

The status of a particular species is shown by the following code letter or symbols

R *Restricted range species*

e *Endemic species*

******* *Introduced species*

? *Status uncertain due to lack of information*

i *Indigenous species*

Species Number	BIRD SPECIES	IDENTIFICATION TYPE		Number of time(s) a species was seen and heard at the same location	Species Status	Total number of locations identified
		SIGHT	SOUND			
		Number of Locations seen	Number of Locations heard			
1	(Vanuatu) Streaked Fantail		**3**		**e,R**	**3**
2	Brown Goshawk	**1**			**?**	**1**
3	Falcon Peregrine	**1**	**1**	**1**	**?**	**1**
4	Grey Fantail		**13**		**R**	**13**
5	House Sparrow	**1**	**1**		*****	**1**
6	Island Thrush		**1**		**i**	**1**
7	Long-tailed Triller	**3**	**8**	**2**	**R**	**9**
8	Mackinlay's Cuckoo-Dove	**2**	**1**		**R**	**3**
9	Melanesian Flycatcher	**1**	**9**	**1**	**R**	**9**
10	Pacific Emerald Dove	**1**			**R**	**1**
11	Pacific Imperial-pigeon	**2**	**2**		**e**	**4**
12	Pacific Kingfisher		**7**		**i**	**7**
13	Polynesian Triller	**3**	**2**	**1**	**i**	**4**
14	Rainbow (Coconut) Lorikeet		**1**		**i**	**4**
15	Red Junglefowl	**1**	**8**		*****	**9**
16	Red-bellied Fruit-dove		**16**		**R**	**16**
17	Satin (Glossy) Swiftlet	**5**	**2**	**1**	**R**	**6**
18	Silver-eye	**2**	**5**	**1**	**i**	**6**
19	South Melanesian Cuckooshrike	**1**	**1**	**1**	**R**	**1**
20	Southern Shrikebill		**1**		**R**	**1**
21	Tanna Fruit-dove	**1**	**19**		**e,R**	**20**
22	*Unknown Little Black Bird*	**1**	**2**	**1**	**?**	**2**
23	Vanuatu (Yellow-fronted) White-eye	**7**	**13**	**5**	**e,R**	**15**
24	Vanuatu Megapode		**5**		**e**	**5**
25	Vanuatu Whistler		**3**		**e,R**	**3**
26	White-breasted Woodswallow	**2**	**4**		**i**	**6**
27	White-rumped Swiftlet	**1**			**i**	**1**

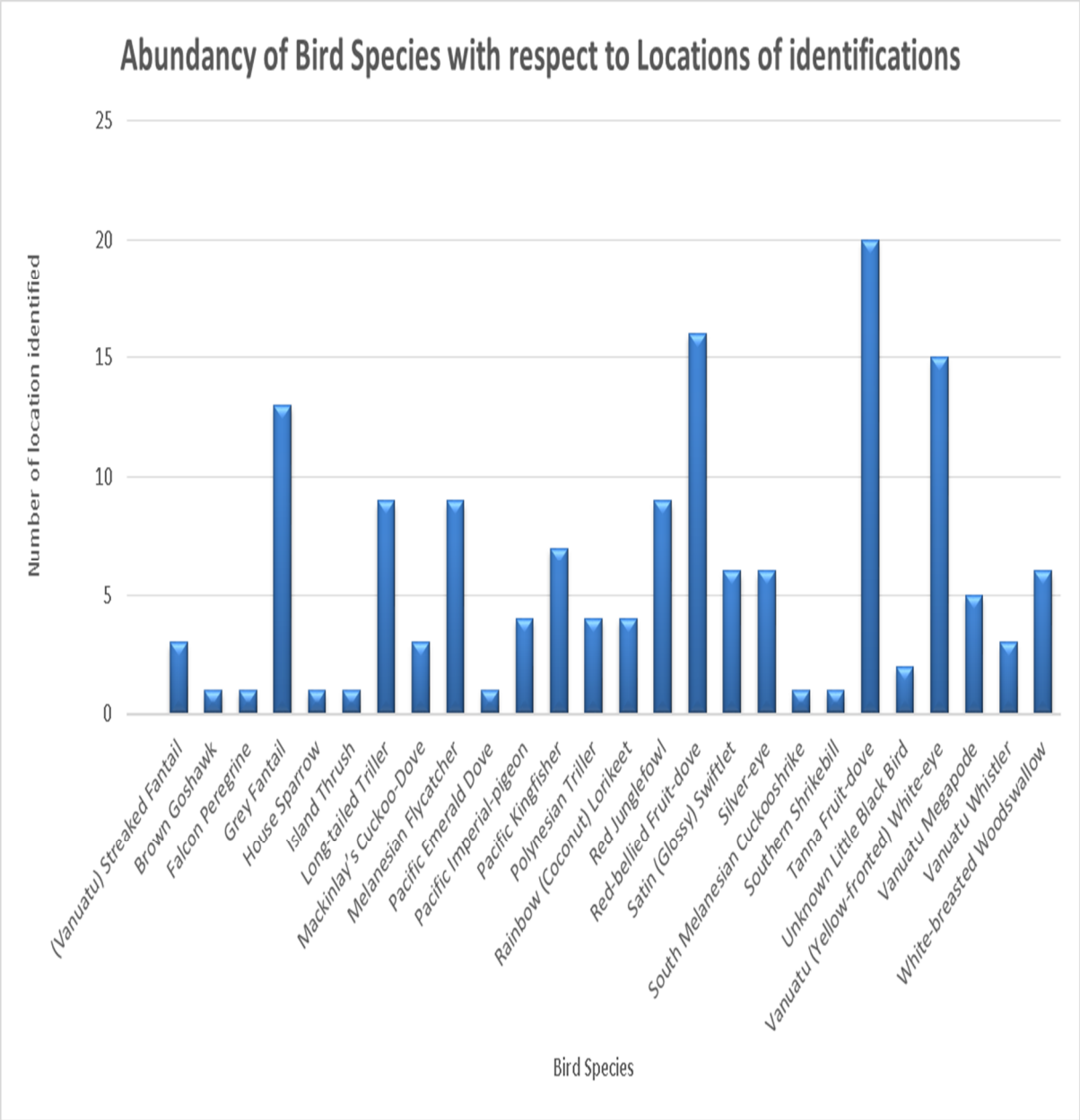

Figure 2: Number of recorded observations by bird species

Table 2: Locations and times particular bird species are recorded

Date	Time of the day	Habitat Description	Waypoint/ location of habitat	Birds Species Identified
7/11/17	?	?	WP14	Red Junglefowl, White-breasted Woodswallow
7/11/17	?	?	WP20	Grey Fantail, Tanna Fruit Dove, Long-tailed triller, Vanuatu (Yellow-fronted) White-eye, Vanuatu megapod, Pacific kingfisher, red Junglefowl, White-breasted Woodswallow, Polynesian triller
7/11/17`	?	?	WP22	White-rumped Swiftlet, Grey Fantail, Tanna fruit Dove, Vanuatu (Yellow-fronted) White eye, Vanuatu megapod, Red bellied fruit Dove, Satin (Glossy) Swiftlet, Pacific Emerald Dove, Red Junglefowl, White-breasted Woodswallow
7/11/17	?	?	WP24	Grey Fantail, Tanna Fruit Dove, Long-tailed triller, Vanuatu (Yellow-fronted) White Eye, Red Junglefowl, South Melanesian Cuckooshrike, brown Goshawk
7/11/17	?	?	WP25	Grey Fantail, Tanna Fruit Dove, Red-bellied Fruit Dove, Red Junglefowl, White-breasted Woodswallow, Melanesian flycatcher
7/11/17`	9:00	?	WP26	Tanna Fruit Dove, Vanuatu (Yellow-fronted) White Eye, Satin (Glossy) Swiftlet
	9:40	Woodland and Shrubland	WP27	Tanna Fruit Dove, Pacific Kingfisher, Red bellied Fruit Dove, Satin (Glossy) Swiftlet, falcon peregrine
	10:06	Woodland	WP28	Grey Fantail, Tanna Fruit Dove, Melanesian Flycatcher, Rainbow (Coconut) Lorikeet, Red bellied Fruit Dove,
7/11/17	10:30	?	WP29	Silver Eye, Red bellied fruit Dove, Tanna Fruit Dove, Pacific Imperial Pigeon
7/11/17	10:50	?	WP30	Grey fantail, Tanna Fruit Dove, Vanuatu (Yellow-fronted) White Eye, Pacific Kingfisher, Polynesian Triller, Streaked fantail, *(Little Black Bird?)*
	12:47	Woodland and shrubland near the valley	WP35	Grey Fantail, Silver-eye, Tanna Fruit Dove, Mackinlay's Cuckoo-Dove, long-tailed Triller, Melanesian Flycatcher, Vanuatu (Yellow-fronted) White-eye, Pacific Imperial-pigeon, Red bellied Fruit Dove, Vanuatu Whistler, Red Junglefowl, White-breasted Woodswallow, Island Thrush
8/11/17	8:10	?	WP36	Grey fantail, Tanna Fruit Dove, Mackinlay's Cuckoo-Dove, Long-tailed Triller, Melanesian Flycatcher, Vanuatu (Yellow-fronted) White Eye, Red-bellied Fruit Dove,
8/11/17	8:50	?	WP38	Grey Fantail, Tanna fruit Dove, Long-tailed Triller, Pacific Kingfisher, Pacific Imperial Pigeon, Red Bellied Fruit Dove, Streaked Fantail, Satin (Glossy) Swiftlet
8/11/17	9:25	?	WP41	Tanna Fruit Dove, Long-tailed Triller, Melanesian Flycatcher, Vanuatu (Yellow-Fronted) White Eye, Red-bellied Fruit Dove, Streaked Fantail, White-breasted Woodswallow,
8/11/17	10:25	?	WP44	Grey Fantail, Tanna Fruit Dove, Red bellied Fruit Dove

8/11/17	11:20	?	WP45	Grey Fantail, Silver Eye, Tanna Fruit Dove, Melanesian Flycatcher, Vanuatu (Yellow-fronted) White Eye, Red bellied Fruit Dove, Red Junglefowl
	11:50	Near undisturbed Forest down valley	WP46	Grey Fantail, Tanna Fruit Dove, Melanesian Flycatcher, Silver-eye, Vanuatu (Yellow-fronted) White-eye, Red bellied Fruit Dove, Satin (Glossy) Swiftlet, Vanuatu Whistler
	12:10	Disturbed forest with shrubs	WP47	Tanna Fruit Dove, Mackinlay's Cuckoo-Dove, long-tailed Triller, Melanesian Flycatcher, Vanuatu (Yellow-fronted) White-eye, Pacific Imperial-pigeon, , Red bellied Fruit Dove, (Vanuatu) Streaked Fantail
8/11/17	12:30	?	WP49	Silver-eye, House Sparrow, Long-tailed Triller, Vanuatu (Yellow-fronted) White-eye, Pacific Kingfisher, Red Bellied Fruit Dove, Red Junglefowl
8/11/17	13:00`	?	WP50	Grey Fantail, Silver Eye, Tanna Fruit Dove, Long-tailed Triller, Vanuatu (Yellow-fronted) White-eye, Vanuatu Megapod, Pacific Kingfisher, Polynesian Triller, Red bellied Fruit Dove, Red Junglefowl
09/11/17	16:44	Disturbed Forest near dried swamp	WP54	Tanna Fruit Dove, Melanesian Flycatcher, Pacific Kingfisher, Red Bellied Fruit Dove, Vanuatu Whistler

Discussion of Results

We documented 27 bird species during our surveys (Table 1). Twenty five were endemic, restricted range and indigenous, whereas two were introduced species (the Red Junglefowl and the House Sparrow).

The most common birds were the Tanna Fruit Dove followed by the Red Bellied Fruit Dove (Figure 2). They were present in all habitat types at any time of the day; followed by the Vanuatu White Eye, Grey Fantail, Long-tailed Triller, and Red Junglefowl.

The South Melanesian Cuckooshrike was identified twice outside the ELMA boundary.

The Common Myna, Metallic Pigeon, Buff-banded Rail and Dark brown Honeyeater were not found in the north-west of the ELMA but were seen on the route to the area that was outside the ELMA.

The Barn Owl might be present in the area but could not be observed since it is a nocturnal species and the survey took place during the day.

The Rainbow (Coconut) Lorikeet was seen only once in the LMA whereas it is commonly seen outside the area.

Among the 27 species, three additional species which were not expected to be found were observed. A previous survey on Efate had identified forty two bird species (Anderson et al. 2017). We only recorded 24 of these, but added 3 extra species which were the Vanuatu Megapode, the Peregrine Falcon and the Brown Goshawk (Table 1). These three species had been reported as present on Efate, Dutson (2011). Even Bregulla (1992) recorded the Vanuatu Megapode in Efate but not the Falcon Peregrine and the Brown Goshawk. The Vanuatu Megapode is endemic to Vanuatu, and is considered to be a globally-threatened (Vulnerable) species with excessive harvesting of the eggs being the main threat. The continued presence of the species on Efate is encouraging – and every effort should be made to better understand the current distribution and any factors that might help to conserve the species.

Conversely, some species commonly reported by Anderson et al (2017), e.g. the Buff-bellied Monarch and Swamp Harrier were not recorded on the current survey. The proximity of the Anderson study area to the current site, and yet the difference in species, composition emphasises that many of the species of birds in the bush in Vanuatu are patchily distributed even within bush areas. Further surveys targeted at identifying which habitat features might best be used to predict bird distribution would be very useful.

It would be anticipated that more time surveying would have increased the number of species recorded, while many of the transects proved difficult to access due to limited given time frame and lots of braches and trunks which were blown down by the 2015 Tropical Cyclone Pam. Note that the analysed results presented here were simply from the data on paper. The sound recordings are yet to be analysed. The members of the team did not consider themselves bird experts, and so confirmation of reports using the recordings will help to confirm the records, particularly of some of the less common species on Efate. The team members were sufficiently confident of the outcomes of the survey due as much to their local knowledge, as to their academic qualifications. The majority of the surveyors grew up in the rural areas of Efate.

Conclusion

Sixty percent of bird species that are known to be present in the bushes of Efate were identified in the northern Efate Land Management Area in the three days of survey. The two most commonly observed species in various habitats were the Tanna fruit Dove and the red-bellied Dove. Anderson et al (2011) stated in their research paper that they recorded forty two bush bird species in Efate excluding the Vanuatu Megapode, the falcon peregrine and the Brown Goshawk. Bregulla (1992) recorded the Vanuatu Megapode on Efate but did not find either the Peregrine Falcon or the Brown Goshawk. Dutson (20110) confirmed the presence of these three additional species in Efate. All the bird species identified by the team had previously been recorded on Efate by previous researches. Some records of other species remain to be confirmed on assessment of the sound recordings made at the same time as the surveys.

We recommend that it would be very useful to consult local experts' knowledge in the nearby village prior to undertaking future surveys. While local community members do not consider themselves experts at bird identification they are very aware of the species present in the local area and are able to identify most birds with little trouble. Knowledge of the local names of birds (as used in the Appendix) is essential for this to be of help.

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Bregulla, H. (1992). Birds of Vanuatu. Shropshire, England: Anthony Nelson.

Dutson, G. (2011). Birds of Melanesia. New Jersey, NJ: Princeton University Press.

Anderson, Michael, J., Fatdal, Lilly, Mauck, William, & Smith, Brian, T. (2017). An ornithological survey of Vanuatu on the islands of Éfaté, Malakula, Gaua, and Vanua Lava. The journal of biodiversity data, Checklist 13 (6), 755-782. https://doi.org/10.15560/13.6.755

Acknowledgements

We would like to share our gratitude to Dr. Mark O'Brien from BirdLife International who assisted us in the trainings to carry out this survey. Without him the survey would be a very costly exercise to hire some foreign bird experts. MOB would like to thank Cheryl Tipp, Curator, Wildlife and Environmental Sounds, Sound and Vision, The British Library for making previous recordings of bird song from Vanuatu available.

We are also grateful for the voluntary participation of the two Tasivanua Conservation Body members, namely Joelyne N. Alick and Majorie Lulu from Emua village. They were very supportive during the survey.

Appreciations for Vanessa Organo as the Shefa Provincial Council Environmental and Scientific officer who was coordinating the overall project but chose to be part of the bird survey team. She had great influence on the technical planning of the survey.

Thanks to the bird team leader, Andrew T. Morris as the BirdLife representative bird specialist in Vanuatu as well as an undergraduate Environmental Science student in the University of the South Pacific. His local knowledge on birds of Efate were really impacted the outcomes of the survey.

We also acknowledge the part-time participation of Chief Thomas Nemal of Epau, Jeffrey Pakoa from Tanoliu and Topen Lore from Mangaliliu.

Special thanks go to Jean-Pierre Popovi for coordinating the track cutting and Danny Popovi and his guide team from Tanoliu for their manpower energy in clearing the bush for the track. Without their efforts, this survey would not have such outcomes. Thanks to Chief Wilson Popovi for permitting us to carry out the survey on this land.

Appendices

Appendix 1 Bird survey training materials

Appendix 2 – Bird identification form (Bislama version)

ELAMA BIRDS SURVEY FORM

Name: ..... **Organisation:** .....

Location/ Coordinates: ..... **Date:** .....

Nem blo Pijin	Tally Namba blo		Total Namba blo		Total namba
	Lukim	harem	Lukim	Harem	
Sako					
Kuskus					
Smol Trick Pijin					
Bigfala Trick pijin					
Black Trick pijin					
Nalaklak					
Grey Nalaklak					
Sot leg					
Woodswallow					
Nasiko					
Parot					
Grin Pijin					
Red jes grin Pijin					
Grey Cowboy Pijin					
Smol Cowboy Pijin					
Pacific Swallow					
House Sparrow					
Melanesian Flycather					
Nambilak					
Nawimba					
Vanuatu Wistler					
Metallic Pijin (Taro)					
Wild Faol					
Long-tailed Triller					
Polynesian Triller					
Longtail/ Dove					
Red Hed					
Ork Night					
Diamond Bird					

APPENDIX D

ENTOMOLOGY SURVEY REPORT

ENTOMOLOGY REPORT-ELMA CONSEVATION AREA

Presley Dovo

Department of Forest

Port Vila Vanuatu

INTRODUCTION

Forests and protected areas in Vanuatu provide multiple benefits to the people in the form of goods and services such as protection of water resources, protection from soil erosion, timber and non-timber forest products and a high quality environment that contributes to agriculture, fisheries and tourism sectors. Conservation plays a vital role in sustaining the livelihood of the people in the communities and also increases the production of resources which benefits the communities and landowners. Since population is rapidly expanding people are putting more pressure on the resources and also degrading the forest resources without the clarity of managing the forest resources in a sustainable way. **Article 7 (d) of the Constitution stated that every person has the fundamental duty to "protect the Republic of Vanuatu and to safeguard the natural wealth, resources and environment in the interests of the present generation and of future generations.** Article 7 empowered this fundamental duty so the responsibility should be implemented by everyone in the country and in community level and provincial level to safeguard the resources.

The Efate Land Management Area is more than 19,000 ha of forested land at the center of Efate island. The protection of this land has been promoted as both a sanctuary for the island's water supply and natural biodiversity as well as one of the nations largest protected carbon sinks. The provincial government, with the help from numerous aid organizations, aim to create a national forest reserve which is managed at the national, provincial, and local levels. ELMA protected area also contains Efates water catchment, encompassing the heads of the six major rivers of Efate, and supplying over 400,000L per year to the capital, Port Vila. The area contains significant endemic flora and fauna species and ecological communities. It is a source of custom medicine for the indigenous people of Efate, and the last area of unleased custom ground on Vanuatu's most-developed island. Due to the threats that the area currently faces from illegal logging, unauthorised settlements and unregulated urban growth, the resources within the ELMA are in need of preservation to ensure that Efate has a sustainable future.

Vanuatu is listed as one of five oceanic countries important for their wealth of biodiversity. In comparison to these countries however, very little is known about Vanuatu's biodiversity prior to the year 2005. Only a few detailed studies, on few genera, and few studies of the biota of smaller or less accessible islands were carried out. In order to determine the status of a protected area a biodiversity survey needs to be carried out. With the importance of the biodiversity to consider Entomology survey was carried out from 6^{th} -10^{th} of November 2017 to determine the status of the protected area. A baseline survey was carried out with the primary aim of determining the general diversity of insects within the areas of ELMA conservation area in Efate. The survey targeted a diversity of habitats such as (slopes, flats, ridges and vegetation types (lowland and upland within primary and secondary forests)

The field survey carried out is prominent because insects may dominant food chains and food web in both volumes and numbers which are essential to the following functions

- Maintenance of plant community composition and structure, via phytophagy including seed feeding
- Food for insecectivores vertebrates such as many birds, mammals, reptiles and fish

- Maintenance of animal community structure through transmission of diseases of large animals and predation and parasitism of smaller ones
- Plant propagation, including pollination and seed dispersal
- Nutrients cycling, vai leaf litter and wood degradation, dispersal of fungi, dispersal of carrion and soil tunner

With the survey carried out it will help us to understand animal social organisation and behaviour and also assist to understand physiology and biology of other animals.

Acknowledgments

The survey could not be accomplished with the assistance from the following people who contribute in one way or the other.

- The National Coordinator for the ELMA project in Vanuatu Vanessa Orange for organizing and ensuring that the biodiversity field work must be completed in time and also his trust in us to do the job.

- Mr. Tate Hanington, Director of Forestry in Vanuatu for his constructive advice and direction for allowing us to conduct the biodiversity field work

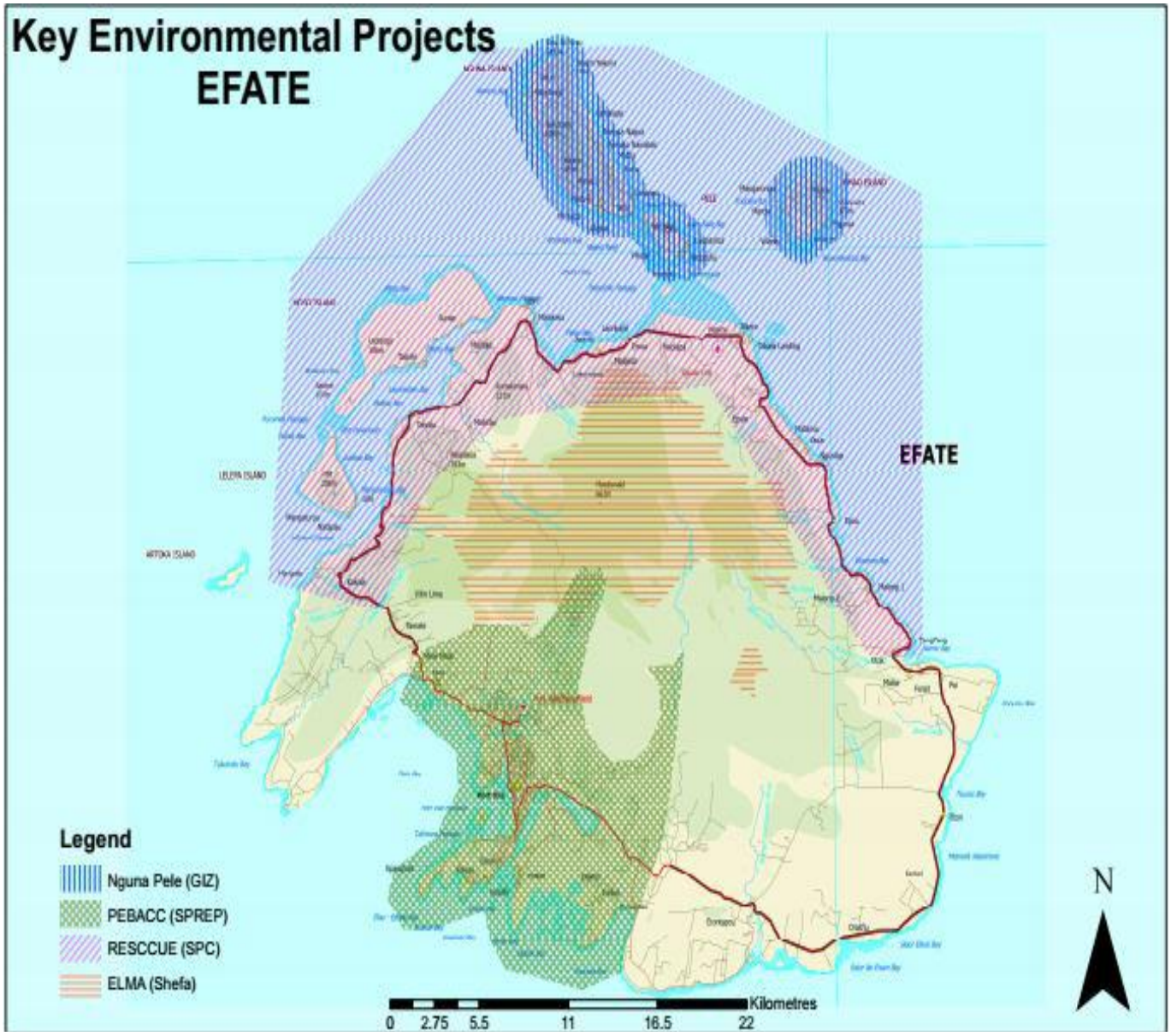
- The Ecology team from New Zealand for providing financial assistance in supporting Shefa province for the biodiversity assessment to be carried out

- The Vaturisu council of chiefs for their support in allowing the project to be implemented in their respective areas

- The local guides for providing information and also their support as porters in the field

VEGETATION MAP OF VANUATU

MAP OF ELMA CONSEVATION AREA-



Source-Vanesa Orange

Methodology

Site selection and habitat considerations

The team identified *a* number of key habitat types to be surveyed to maximise the chance of encountering individuals of focal species as well as to adequately sample the diversity of insects. The location of each survey site has been plotted out with a GPS and a variety of collection techniques such as (tree shaking, debris collection and general collection were applied to determine the status of the insects in ELMA protected area. The general diversity of insects and those species of higher conservation value (i.e. focal species) were sampled as an indicator of the status or health of the forest within the area.The collection was done in primary and secondary forest which also requires slope and flat plain areas in the protected area.

Butterfly Collection



The butterflies of Vanuatu were studied in 2004 by John Tennent and study confirmed a total proportion of 70 species for Vanuatu which are primarily widespread genera and species. Many of these species have widely dispersed throughout the Pacific region. The assessment team used a sweep net to collect insects from grass and small trees which are swept back and forth through vegetation. Sweeping the net through grasses target butterflies and species collected were identified and placed inside a special plastic paper. Assessment result of the Elma protected area shows that four species were collected in the disturbed areas which are common throughout Vanuatu. Yellow butterfly was also spotted in the secondary and primary forest which is common in Vanuatu with other six species

Butterfly species trap on butterfly net


GPS COORDINATES COLLECTED FOR TREE SHAKING AND DEBRIS COLLECTION

Day 1 collection

1. Tree shaking and Debris collection -S.17.61244,E 168.30699 & 363m ASL
2. Tree shaking and Debris collection -17.61535, E168.30812 & Found on lantana
3. Tree shaking and debris collection S.17.61732,E 168.30957,E 168.30957 &E 404mASL
4. Tree shaking and debris collection S 17.661746,E 168.31454 & 452m ASL
5. Tree shaking and debris collection S 17.61674 E 165.31633 & 465m ASL

Day 2 collection

1 Tree shaking and Debris collection S17.61754, E 168.32272 & 445m ASL
2. Tree shaking and Debris collection S 17.61796, E168. 32202 & 455m ASL
3. Tree shaking and Debris collection S17.61880, E168. 32161 & 464 ASL

Day 3 collection

1. Tree shaking and Debris collection S17.61370, E168.30670 & 384m ASL
2. Tree shaking and Debris collection S17.61464,E 168.30760 & 377 ASL

Tree species identified for tree shaking in the protected area

Scientific name:	Family name:	Common name:	Tree form	Tree Height
Pouteria costata	Sapotaceae	None	*Tree*	*3m*
Premna serratifolia	Verbenaceae	Na-aro	*Tree*	*3m*
Syzygium clusifolium	Myrtaceae	Wael nakaviga	*Tree*	*3m*
Garuga floribunda	Anacardiaceae	Namalaus	*Tree*	*4m*
Dysoxylum arborescens	Meliaceae	Stingwud	*Tree*	*4m*
Erythrina variegata	Leguminaceae	Narara	*Tree*	*3m*
Cryptocaria sp	Lauraceae	None	*Tree*	*3m*
Bischofia javanica	Euphorbiaceae	Nakoka	*Tree*	*4m*
Antiaris toxicaria	Moraceae	Melektri	*Tree*	*4m*
Anthocarapa nitudula	Meliaceae	Wael stingwud	*Tree*	*4m*

DEBRIS COLLECTION

Debris collection was carried out within four areas mainly secondary forest, primary forest with slopes and steep areas within the protected areas. Identified trees with so many leaves were shaken while a piece of white cloth was placed underneath for insect collection. Coleoptera were recorded within the study area, as well as a high abundance of ants (Formicidae). These taxa provide critical ecosystem services in forest systems such as soil processing, decomposition, herbivory, pollination and seed dispersal.

SORTING OUT SPECIMEN

The specimen collected in the field was sorted out in the office particularly in orders

Total number of insects collocated during tree shaking, debris collection and general collection in the Elma protected area

Scientific name	English common name	Total number of species observed
Hymenoptera-(Formicidae)	Ants Dragon fly Bees	44 8 1
Lepidoptera	Butterflies Larva Moths	7 1 3
Araneae	Spiders	9
Gastropoda	Snails	1
Orthopetera	Grass hopers	5
Phasmatode	Stick insects	3
Blattodeo	Croaches	7
	Weevils	5
Diptera	Hornets Flies	9 12
	Secada	10
Hempitera	True bags	10
Oligochaeta	Worm	1
Isoptera	Termites	1
Scorpion		1
Coleoptera	Scarabaeidae Elateridae Cullionidae	18 4 3

Chilopod	Milliped	4
Total		**167**

GENERAL COLLECTIONS-DAY 1

Names	**Orders**	**Total**
Beetles	Coleoptera	18
Ants	Hymenotera	7
Bugs	Hemiptera	5
Spiders	Araneae	5
Grass hoper	Orthopetera	5
Worm	Oligochaeta	1
Total		41

DEBRIS COLLECTION-DAY 1

Names	**Orders**	**Total**
Ants	Hymenoptera	5
Larva	Lepidoptera	1
Fly	Diptera	1
Total		8

Day 1-TREE SHAKING

Names	Orders	Total
Ants	Hymenoptera	4
Cockroaches	Blatodea	2
Larva	Coleoptera	1
Fly	Diptera	1
Millipide	Chilopoda	4
Total		12

TREE SHAKING DAY 2

Names	**Orders**	**Total**
Beetle	Coleoptera	1
Spider	Araneae	15
Caterpillar	Lepidoptera	1
	Indet	9
Ants	Hymenoptera	5
Termites	Isoptera	1
Springtail	Indet collembola	3
Stick insects	Phasmatodea	3
Total		**38**

DAY 2 COLLECTIONS- TREE SHAKING

Names	**Orders**	**Total**
Beetle	Coleoptera	3
Spider	Araneae	1
Snail	Gastropoda	1
Termites	Isoptera	1
Ants	Hymenoptera	2
Centipede	Dipolopoda	1
Total		**9**

TREE SHAKING DAY 3.

Names	**Orders**	**Total**
Ants	Hymenoptera	13
Beetle	Coleoptera	1
Larva	Lepidoptera	2
Snail	Gastropoda	1
Spider	Araneae	1
	Indet	1
Total		19

TREE SHAKING DAY 3.

Names	**Orders**	**Total**
Ants	Hymenoptera	5
Beetle	Coleoptera	2

Larva	Lepidoptera	2
Springtail	Collembola	1
Spider	Araneae	1
Fly	Diptera	1
Bugs	Hemiptera	1
Total		13

DAY 3-DEBRIS COLLECTION

Names	**Orders**	**Total**
Ants	Hymenoptera	**8**
Earwigs	Dermaptera	1
	Scorpion	1
Springtails	Collembola	1
Bugs	Hemiptera	4
Total		15

Butterflies were sampled from different locations on three days with fine weather. A total of 6 individual butterflies were collected and around 7 others sighted within these locations. Butterflies sampled were from different species. The most common taxa encountered were the order Coleoptera with a total of four families amongst which a rare member of the family .Total insect collection of the day was 167 with coleopteran dominating the insect range in the ELMA conservation.
The tree sampling proportion is much higher than the ground or debris collection. This is due to dry season where insects could not survive. Insect dominating the tree collection is the coleoptera.

RECOMENDATIONS

Overall the survey findings support a recommendation for protection of the area.

- Ongoing community awareness programs are recommended to discuss the value of and the mechanisms for protecting the area.
- Demarcating and managing the protected area should take into account ecological connectivity of habitats and the threats posed by logging and invasive species.

- Furthermore more entomology survey work is required for a more comprehensive report on the biodiversity of the area, and a community needs assessment and oral history documentation are also recommended for the ELMA project.

- An increased sampling effort is required for the mount MacDonald and other parts of the protected area to ascertain the true status of the forest health.

CONCLUSION

The island of Efate is overpopulated and definitely needs conservation measures to sustain the population livelihood and also sustainable use of resource to be applied. In order for conservation to be effective in communities' people must reduce degradation and destructive utilization of forest and set aside these valuable forest areas for conservation. Communities around also need to strategize and cooperate to achieve the targets of conservation. In order for the resources to be conserved in a sustainable manner institutional frame work must be effective in place to safe guard the resources at the community level. The clarity of resources management must be well understood in community so that protection and management of Elma resources are sustainably managed and conserved in appropriate manner.

Conservation should be a priority and logging should not be permitted in this area if you take into account the true value of the site in terms of its ecosystem function, biodiversity, cultural and spiritual importance, all of which are invaluable monetarily. Rehabilitation activities on degraded and erosive land areas must also be immediately implemented by relevant sectors including the Forestry department in assistance with the communities involved. Forest and forest biodiversity continue to play a significant role in the daily livelihood of all community and also responsible for balancing the ecosystems that support the terrestrial environment. For this reason the department of Forestry is making sure that the biodiversity within the ecosystems is conserved protected and managed in a manner that will ensure its survival so that it may continue services to communities

APPENDIX E

HERPETOFAUNA SURVEY REPORT

Ecology New Zealand Limited
9F Beatrice Tinsley Crescent
Albany
Auckland
Email: info@ecologynz.nz

MEMORANDUM

Attention:	Rowan Dixon; Roger McGibbon
Company:	WSP | Opus
Date:	29 February 2018
From:	Simon Chapman
Project:	1708043-001: Efate BioBlitz

Dear Rowan and Roger,

Re: Efate Bioblitz – Herpetofauna Survey

1. Introduction and Background

1.1. Ecology New Zealand Limited (ENZL) was commissioned to carry out a rapid survey of the terrestrial herpetofauna communities (i.e., reptiles and amphibians) within the Efate Land Management Area (ELMA), Efate Island, Vanuatu, as part of a BioBlitz (a rapid biodiversity survey). This memo presents the results of the herpetofauna survey.

1.2. Vanuatu has generally been considered to have relatively low herpetofauna diversity compared to other Pacific Island areas (Ineich, 2011). Among the islands of the Vanuatu archipelago, Efate is thought to have lower diversity in comparison to other islands such as Santo, Torres and Banks Islands.

1.3. The known terrestrial herpetofauna of Vanuatu is comprised of one introduced frog species, two snake species (one introduced, and one possibly introduced), and up to 28 lizard species (two introduced). The frog and snake species are known to occur on Efate, but the number of lizard species present on Efate is unknown.

2. Methodology

2.1. The herpetofauna BioBlitz survey focused on a 2-3 km section of a forested ridge that runs north-west from Mount McDonald towards the coastal village of Tanoliu. A track along the ridge was utilised as the survey transect. Herpetofauna surveys were carried out along the transect over three days and two nights from the 7th to the 9th of November 2017.

2.2. Two Visual Encounter Survey (VES) methodologies were employed to survey herpetofauna communities. Manual searches were carried out during daylight hours (three surveys of 6-10 hours), and nocturnal spotlighting was undertaken at night (two surveys of 4-5 hours). Manual searches involve walking slowly along the transect and searching for herpetofauna in potential habitats such as foliage, tree/shrub branches/trunks, leaf litter, and woody debris. Nocturnal spotlighting targets active nocturnal herpetofauna and inactive diurnal herpetofauna. During VES, herpetofauna are typically detected by their movement, body shape, or eye shine.

2.3. Herpetofauna encountered were photographed and a GPS location for the sighting was recorded. Where possible and safe, herpetofauna were captured and detailed photographs and morphometric measurements were taken to facilitate accurate identification.

3. Results

3.1. Nine herpetofauna species were identified during the BioBlitz survey including one frog species, one snake species and seven lizard species (two geckos and five skinks). Up to three additional *Emoia* skink species were captured and photographed but could not be positively identified.

3.2. The frog species found is an introduced species originating from Australia. There is some uncertainty about the origin of the Pacific tree boa but at least one study considers it to be native to Vanuatu (Ineich, 2011). All of seven lizard species identified during the survey are native to Vanuatu and while none are endemic to Efate Island, at least two are endemic to Vanuatu (Sanford's tree skink and Vanuatu silver vineskink).

3.3. The herpetofauna species identified during the survey included:

Green and Golden Bell Frog (*Litoria aurea*)

Pacific tree boa (Candoia bibroni)

Giant gecko (Gehyra vorax)

Slender-toed gecko

Pacific Blue-tailed Skink (*C. caeruleocauda*)

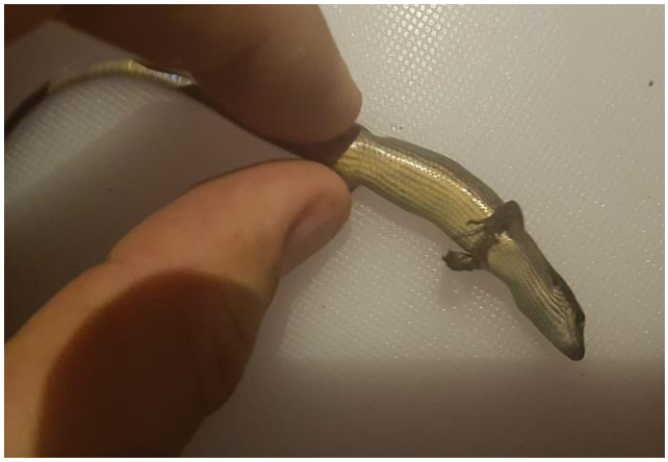
Copper-tailed skink (*Emoia cyanura*)

Teal Emo Skink (*Emoia cyanogaster*)

Sanford's Tree Skink (*Emoia sanfordi*)

Vanuatu Silver Vineskink (*Emoia nigromarginata*)

Unidentified *Emoia* spp. skinks



4. Discussion and Conclusion

4.1. While the survey cannot be considered a comprehensive assessment of the herpetofauna of the ELMA, the results have confirmed that the area has high herpetofauna diversity – especially among the skinks. The species most likely to have been missed by the survey are the rare and endangered species that are of greatest conservation significance. More detailed surveys across a wider range of habitats (e.g., valleys, riparian margins, canopy, caves, coastal, etc.) would almost reveal additional species possibly including rare, endangered and previously undiscovered species.

4.2. Due to the abundance of several skink species, herpetofauna appear represent a substantial component of the area's faunal biomass. On that basis, herpetofauna should be considered an important component of the forest ecosystem and essential to ecosystem functioning due to their various ecological roles such as predators, prey, pollinators and seed dispersers.

5. References

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Please do not hesitate to contact me (Phone: +6421436841 or E-mail: Simon.Chapman@ecologynz.nz) should you require further details.

Kind regards

Simon Chapman
Principal Ecologist

APPENDIX F
BOTANICAL SURVEY REPORT

VATURISU
KAONSEL BLONG OL CUSTOM JIFS EFATE
COUNCIL OF CHIEFS EFATE - CONSEIL DES CHEFS EFATE

Shefa Provincial Government Council
V•A•N•U•A•T•U

ELMA Proposed Conservation Area Bioblitz Biodiversity Assessment

Botanical Assessment Report

6 – 10 November 2017

The Botanical Team

Content Page

Acknowledgement

Without the funds provided by RESCUE project this botanical survey would not be successfully carried out, therefore the botanical team really appreciate you help.

Thanks a lot to Vanessa Organo for arrangement and logistic that was fairly done understandable among the team. Many thanks Board members, local guides and Philip as our field guides for assisting us with the track and knowledge about plants through the forest.

Introduction

Efate Land Management Area (ELMA) is a site chosen by **RESCCUE Project** for Bioblitz Biodiversity assessment to be done which begin at an elevation of 354 meters up to 636 meters that is the highest peak (Mac Donald) of Efate. The area was accessible with good network among government, NGO and communities to carry out the assessment and provide some best practices for better sustainability of their Biodiversity resources.

The ELMA is a proposed protected area in the central region of Efate, covering approximately twenty per cent of the island. The ELMA is very mountainous and includes a number of ridgelines with views across Efate. It also includes the highest point within Efate, Mt McDonald at 627 meters.

There is growing focus in the international conservation community that sustainable protection of the environment should encompass a complete landscape/seascape focus, and the ELMA provides this opportunity, to link terrestrial and aquatic environments together using ridge-to-reef management approaches.

The National Forestry Policy calls for forest conservation and environment with a specific objective to conserve forests with high biological, cultural spiritual, and historical values are conserved and protected. Thus, any institution and organisation engaged in conservation

activities is fully supported by the department of forest. With conservation activities the department of forests is dedicated to implement activities by the any given organization.

Efate Land Management Area (ELMA) – Project Outline

What is the ELMA?

The ELMA is a proposed protected area in the central region of Efate, covering approximately twenty per cent of the island. The ELMA is very mountainous and includes a number of ridgelines with views across Efate. It also includes the highest point within Efate, Mt McDonald at 627 meters.

There is growing focus in the international conservation community that sustainable protection of the environment should encompass a complete landscape/seascape focus, and the ELMA provides this opportunity, to link terrestrial and aquatic environments together using ridge-to-reef management approaches. The proposed boundary of the ELMA is indicated on the attached map, though it should be noted that this boundary is interim and will be reviewed in the near future after further feasibility assessments.

What is the significance of the ELMA?

The area is both environmentally and culturally significant. It contains the majority of the island's water catchment, with over eight watersheds and the heads of the six major rivers on Efate. Many of these water sources supply water to villages located close to the Efate coastline. One of Efate's largest rivers, the Tagabé River is located within the ELMA and supplies the majority of drinking water to the entire population of Port Vila, with environmental flows of over 400,000L per year. The area contains significant endemic flora and fauna species and ecological communities, and the potential exists to discover more species not currently known. It is a source of custom medicine for the indigenous people of Efate, and the last area of unleased custom ground on Vanuatu's most developed island.

How did the idea for the ELMA originate?

The ELMA project is the vision of the Vaturisu Council of Chiefs and the communities of Efate, to preserve and protect the natural resources and land within the last area of unleased

custom ground in the central part of the island of Efate. As the custodians of the environment and natural resources of Efate, the Vaturisu Council of Chiefs strongly believes that this project is vital for the sustainable future of Efate, and Vanuatu as a whole.

The implementation of the project is supported by both the national Council of Ministers, and the Shefa Provincial Government Council. The Vaturisu Council of Chiefs have also recently met and signed an agreement endorsing the ELMA project.

Why is the ELMA needed?

With the capital of Port Vila located on Efate, the island acts as the economic centre for Vanuatu. As such, Efate attracts large numbers of local and international immigrants, and subsequently has one of the fastest population growth rates of any city in the Pacific region. The increasing population of Efate, and its dependence on local resources is causing stress to the natural environment of Efate. Key environmental pressures include an increasing number of unauthorised settlements, illegal logging, water pollution, and loss of native plants and animals. The ELMA seeks to protect and conserve the terrestrial and aquatic environments

within the protected area, whilst ensuring that local people, particularly Man Efate (people originally from Efate) are able to use the area in a sustainable manner to support subsistence lifestyles and local livelihoods and economies.

Both community consultation and discussions with the Vaturisu Council of Chiefs have highlighted the urgency of the problem, and the desire within communities to legally protect the area. By preserving and rehabilitating the ecosystems within the ELMA, Efate will have a much stronger chance to adapt to climate change from an ecological perspective.
In turn, protecting the interior of the island will be a chance for Efate to protect its links to custom and custom governance. With the influx of foreign influences in Efate, the deterioration of custom has led to the exacerbation of issues within villages at a scale not experienced on other islands. The process of setting up the ELMA is an opportunity for citizens of Efate to reconnect with local governance and decision-making, which will improve the social resilience of Efate's communities.

How would this project be implemented?

It is intended that the ELMA project would be governed and managed in both a top-down and bottom up approach, with the area envisioned to become a legislated protected Community Conservation Area under Vanuatu's *Environment Protection and Conservation Act 2002* or the *Water Resources and Management Act*, enabling legislative mechanisms to assist in the management of the area.
At the grassroots level, a community representative body called the ELMA Network, has recently been established, comprising community members from each of the 20 villages involved in the project. The Network will become a Civil Society Organisation, to act as a group of project representatives who are go-to points in their communities, and who will represent the voices of their communities in the planning and decision-making to come in the project's future.
It is envisioned that the area will be managed by local communities, potentially through a local ranger program, consisting of volunteers/staff who would assist in enforcing management principles defined in a proposed draft ELMA Management Plan, which would outline measures through which the area would be managed. Management options for the park would be decided upon by local communities who would be involved in extensive consultation on the management plan and governance options.

How will the ELMA project benefit local communities?

The project is intended as a wholistic sustainability project, with the aim that local communities would create sustainable social and economic opportunities from the setup of the ELMA. Particular opportunities such as eco-tourism operations are seen as a particularly viable and attractive option, and would provide the chance for ongoing livelihood benefits in an autonomous and lasting way. In addition, it is hoped that the ELMA may eventually allow for the creation of a scientific research station, to allow for further study of biodiversity in central Vanuatu.

Environmentally, ecosystem services would be provided sustainability, with long-term benefits for the capital city of Vanuatu and rural Efate. Protecting the upper and midstream water catchments of Efate would provide vital water security for the ever-growing population of Efate, in the face of oncoming climate change impacts and more exacerbated regional weather patterns such as El Nino and La Nina. Connection to custom and ground would also be provided through a community-led project such as this, as outlined above. The ELMA would be the first large-scale conservation area of its kind in

Vanuatu and across the Pacific, and presents an important opportunity for empowered indigenous environmental management and development of sustainable livelihoods

<u>Pictures showing the general forest structure of Elma Proposed conservation area</u>

Objective

The general objective of this assessment is to find out the biodiversity of flora species present in the proposed Elma conservation area. It is intended to carry out the Bioblitz biodiversity assessment where the botanical team have assess and survey flora in the area and to determine the status of biodiversity and plants in Elma area, Thus, the objectives are;

- Make plant inventory of flora that exist in Elma proposed conservation area.
- Finding out the dominated species in Elma Proposed area.
- Identify endemic, rare, native, endanger and invasive species present in the Propose area.
- Identify new species in the area.
- Collect and make pictures of flowering plants including fern present in the area.
- Identify the threats that affect the vegetation in different location in the proposed area.
- Make recommend of the management, rehabilitation and also reduce the effect of threats.

Methodology

The methodology of this bioblitz biodiversity survey is a rapid assessment which we went through each forest type and collect data information on the plant ecosystem and identification of plant species.

Survey method

We carried out the rapid assessment survey by working through Elma proposed conservation area over the three days beginning from high elevation to low elevation. The survey involves recording of plant species;

- Scientific name (Species/ family)
- Bislama or common names of the plants
- Vernacular names of the plants
- Flowering plant are collected as specimen for PVNH

Discussion

The forest of Elma Propose conservation area contains a high diversity of biodiversity significantly and is regarded as one of the best high land forest found in western part of Efate. The quality of the forest determines high diversity of species found. There are also some other coastal species found along the ridge which are the good indicator of the old settlement of our ancestor thus, include syzygium clussifolium, pouteria costata, Instia bijuca. Birds Reptiles and Insect found are the good indicator of healthy forest so their presents in the forest determines that the ELMA Proposed conservation area is healthy.

Vegetation Types

The vegetation of Elma Propose conservation area is different compare to other part of Efate. It is very good vegetation structure when working towards the interior land that was towards Mount Mark Donald. The vegetation have been disturb at 346 elevation, cattle and human activity like road construction and also natural have contribute a lot the change in the vegetation (cyclone Pam). The vegetation of Elma have recover after the cyclone with dominated species of Magaranga that dominated the sampling found in the proposed area.

The ground cover is 85% where the regeneration of sampling is 80% and the canopy cover is 50% that was because of the disturbance happening in the Elma propose area some of the location have good canopy cover while some location have bad canopy cover. This massive destruction have done by cyclone and also some logging activity had also contribute to this over the years. The forest is on the way to recover from all those massive destruction.

List of plants Found in Elma proposed conservation Areas

Scientific Name	Family Name	Common Name	Language Name	Plants Form
Schizaea Dichotoma	Schizaeaceae	None	None	Fern
Selagenila durvilei	Selagenilaceae	None	None	Fern
Desmodium ormocarpoides	Fabaceae	None	None	Tree
Psychotria milnei	Rubiaceae		None	Tree
Veitchia arecina	Araliaceae	Palm tree	None	Tree
Semecarpus Vitiensis	Anarcadiaceae	Red Nawalas	None	Tree
Syzygium Meryandenum	Myrtaceae	Nakavika	None	Tree
Syzygium sp	Myrtaceae	Nakavika	None	Tree
Cyrtandra efatensis	Gesneriaceae	None	None	Shrub
Rapanea lecardii	Primulaceae	None	None	Tree
Macaranga dioica	Euphorbiaceae	Navenue	None	Tree
Malaxis	Orchidaceae	None	None	Grass
Ficus Wassa	Moraceae	Nabalango	None	Tree
Astronidium aneitiensis	Melastomataceae	None	None	Tree
Epipremnum pinnatum	Araceae	Nawalu	None	Vine
Glochidion ramiflorum	Phyllanthaceae	Wael namamao	None	Tree
Asplenium nidus	Aspleniaceae	None	None	Fern
Lygodium reticulatum	Lygodiacea	None	None	Fern
Psychotria trichostoma	Rubiaceae	None	None	Small Tree
Dysoxylum aneityensis	Meliaceae	Stingwood	None	Tree
Malaisia scandens	Moraceae	None	None	Tree
Melodinus neoebudicus	Apocynaceae	None	None	Tree
Psychotria trichostoma	Rubiaceae	None	None	Tree

Lomagrama Brackenridgei	Dryopteridaceae	None	None	Fern
Bischovia Javanica	Phyllanthaceae	Nakoka	None	Tree
Freycinetia tannaensis	Araliaceae	None	None	Palm
Dysoxylum sp	Meliaceae	Stingwood	None	Tree
Shefflera neo-ebidica	Araliaceae	None	None	Tree
Davalia solida	Davalliaceae	None	None	Fern
Davallia repens	Davalliaceae			
Alpinia sp	Zingiberaceae	None	None	Shrub
Streblus pendulina	Moraceae	None	None	Grass
Nephrolepis hirsutula	Lomariopsidaceae	None	None	Fern
Hemigraphis repans	Acanthaceae	None	None	Grass
Mikania Macrantha	Asteraceae	Wan dei rop	None	Vine
Christella	Thelypteridaceae	None	None	Fern
Criptocarya tannae	Loraceae	None	None	Tree
Elatosttachys falcata	Sapindaceae	None	None	Tree
Arytera brackenridgei	Sapindaceae	None	None	Tree
Cupaniopsis leptobotrys	Sapindaceae	None	None	Tree
Piper austral-caledonicum	Piperaceae	None	None	Shrub
Homalanthus nutans	Euphorbiaceae	None	None	Tree
Stephania japonica	Menispermaceae	None	None	Climber
Baccaurea stylaris	Phyllanthaceae	None	None	Tree
Pandanus sp	Pandanaceae	Pandanus	None	Tree
Myristica fatua	Myristicaeae	Nadaedae	None	Tree
Freycinetia impavida	Arecaceae	None	None	Tree
Claoxylon fallax	Euphorbiaceae	None	None	Tree
Marratia smithii	Marattiaceae	None	None	Tree
Pteris ensiformis	Pteridaceae	None	None	Tree
Elaeocarpus angustifolius	Elaeocarpaceae	None	None	Tree
Crateva religiosa	Capparaceae	None	None	Tree
Ficus septica	Moraceae	None	None	Tree
Elatostema beccari	Urticaceae	None	None	Shrub
Elatostema macrophyllum	Urticaceae	None	None	Shrub
Lecosyke australis	Urticaceae	None	None	Tree
Drendrocnide latifolia	Urticaceae	Wael Nangalat	None	Tree
Ficus adenosperma	Moraceae	None	None	Tree
Graptophyllum pictum	Acanthaceae	None	None	Shrub
Strongylogo lucidus	Fabaceae	None	None	Tree
Cayratia trifolia	Vitaceae	None	None	Vine

Salacia chinensis	Celastraceae	None	None	Tree
Boehmenia	Urticaceae	None	None	Vine
Cupaniopsis stipular	Sapindaceae	None	None	Tree
Smilax vitiensis	Smilacaceae	None	None	Vine
Alangium villosum	Cornaceae	None	None	Tree
Meryta neo-ebudica	Araliaceae	None	None	Tree
Geissois dehnamii	Cunoniaceae	None	None	Tree
Coleus scutellarioides	Lamiaceae	None	None	Tree
Glochidion stipulare	Phyllantaceae	None	None	Tree
Diospyros samoensis	Ebenaceae	None	None	Tree
Ficus granatum	Moraceae	None	None	Tree
Calamus vanuatuensis	Arecaceae	Wael ken	None	Tree
Hedycarya dorsteinioides	Monimiaceae	None	None	Tree
Derris elegans	Fabaceae	None	None	Vine
Tapeinosperma	Primulaceae	None	None	Tree
Gnetum gnemon	Gnetaceae	None	None	Vine
Phaleria Penticostalis	Thymelaeaceae	None	None	Small tree
Murrya paniculatum	Rutaceae	NoneNone	None	Small Tree
Micromelum Minutum	Rutaceae	NoneNone	None	Tree
Alphitonia zizzoides	Rhamnaceae	None	None	Tree
Gardenia taitensis	Rubiaceae	None	None	Tree
Neonauclea forsteri	Rubiaceae	None	None	Tree
Polyscias sp	Araliaceae	Nalalas	None	Tree
Garcicnia pseudogutifera	Clusiaceae	None	None	Tree
Phyllanthus	Phyllanthaceae	None	None	Tree
Polyscias cissodendron	Araliaceae	Nalalas	None	Tree
Geinostoma rupestre	Loganiaceae	None	None	Tree
Garcinia platyphylla	Clusiaceae	None	None	Tree
Scaevola neoebudica	Goodeniaceae	None	None	Tree
Tremna orientalis	Canabaceae	None	None	Tree
Stachytarpheta jamaicensis	Verbenaceae	None	None	Shrub
Solanum dorvum	Solanaceae	Biko	None	Shrub
Commelina diffusa	Commelinaceae	None	None	Tree
Ficus prolixa	Moraceae	None	None	Tree
Dillenia biflora	Delliniaceae		None	Tree
Macropiper latifolia	Piperaceae	Wael kava	None	Shrub

Bleasdelae lutea	Proteaceae	None	None	Tree
Cleidion neoebudicum	Euphorbiaceae	None	None	Tree
Indigofera suffruticosa	Fabaceae	None	None	Tree
Alyxia efatensis	Apocynaceae	None	None	Tree
Ixora aneityensis	Rubiaceae	None	None	Tree
Earina Valida	Orchidaceae	None	None	Tree
Serianthes ebudarum	Fabaceae	None	None	Tree
Joinvillea Plicata	Arecaceae	None	None	Palm
Hugonia neocaledonica	Linaceae	None	None	Vine
Passiflora	Passifloraceae	None	None	Vine
Hoya australis	Apocynaceae	None	None	Small Tree
Flacourtia rukam	Salicaceae	None	None	Tree
Barringtonia edulis	Lecythidaceae	Navel	None	Tree
Palaquim neoebudicum	Sapotaceae	Pencil cedar	None	Tree
Ipomeo sp	Convolvulaceae	None	None	Vine
Ipomeo sp	Convolvulaceae	None	None	Vine
Pterocarpus indicum	Fabaceae	Bluewota	None	Tree
Syzygium malccenses	Myrtaceae	Nakavika	None	Tree
Pseuderanthemum longitifolium	Acanthaceae	None	None	Shrub
Pittosporum campbelli	Pittosporaceae	None	None	Tree
Oxera efatensis	Lamiaceae	None	None	Tree
Acacia simplex	Fabaceae	None	None	Tree
Acacia spirorbis	Fabaceae	None	None	Tree
Delarbrea collina	Myodocarpaceae	None	None	Small tree
Mangifera indica	Anarcadiaceae	Mango tree	None	Tree
Hibiscus tiliceus	Malvaceae	Burao	None	Tree
Antiaris Toxicaria	Moraceae	Melektri	None	Tree
Caesalpinia major	Fabaceae		None	
Calanthe chrysantha	Orchidaceae		None	
Callophyllum inophillum	Calophyllaceae	Tamanu	None	Tree
Codieum variegatum	Euphorbiaceae	Nahahali	None	Shrub
Corymborchis veratrifolia	Orchidaceae	None	None	Grass
Corynocarpus similis	Corynocarpaceae	None	None	Tree
Croton levatis	Euphorbiaceae	None	None	Tree
Desmodium umbellatum	Fabaceae	None	None	Tree

Diplazium proliferum	Woodsiaceae	None	None	Fern
Dracontomelon vitiense	Anacardiaceae	Nakatambol	None	Tree
Entada phaseloides	Fabaceae	None	None	Vine
Tabernaemontana pandacaqui	Apocynaceae	None	None	Tree
Euphorbia atoto	Euphorbiaceae	None	None	Tree
Euphorbia hirta	Euphorbiaceae	None	None	Tree
Faradaya lehuntei	Lamiaceae	None	None	Vine
Grewia mallococca	Malvaceae	None	None	Tree
Cordia subcordata	Boraginaceae	None	None	Tree
Gyrocarpus Americanus	Hernandiaceae	Canoo tree	None	Tree
Hymenophyllum	Hymenophyllaceae	None	None	Fern
Kleinhovia hospita	Malvaceae	Namatal	None	Tree
Lantana camara	Verbaceae	None	None	Shrub
Litsea imthurnii	Lauraceae	None	None	Tree
Lindsaea pulchra	Linsaeaceae	None	None	Tree
Lycopodium nummularifolium	Lycopodiaceae	None	None	Fern
Allophylus timorensis	Sapindaceae	None	None	Tree
Morinda citrifolia	Rubiaceae	Noni	None	Tree
Muntingia calabura	Muntingiaceae	None	None	Tree
Parsonsia	Apocynaceae	None	None	Tree
Paspalum congugatum	Poaceae	None	None	Tree
Paveta opulina	Rubiaceae	None	None	Tree
Pemphis acidula	Lythraceae	None	None	Tree
Piperomia pallidinervis	Piperaceae	kava rope	None	Vine
Planchonella	Sapotaceae	None	None	Tree
Polyalthia nitidissina	Annonaceae	None	None	Tree
Pometia piñata	Sapindaceae	Nandao	None	Tree
Premna corymbosa	Lamiaceae	None	None	Tree
Procris pedunculata	Urticaceae	None	None	Tree
Pueraria lobata	Fabaceae	None	None	Tree
Rhus taitensis	Anarcadiaceae	None	None	Tree
Rivina Humilis	Phytolaccaceae	None	None	Grass
Robiquetia minus	Orchidaceae	None	None	Tree
Rubus rosifolius	Rosaceae	Wael strawberry	None	Shrub
Salvia occidentalis	Lamiaceae	None	None	Tree
Stictocadia tilifolia	Convolvulaceae	None	None	Tree
Tectaria crenata	Tectariaceae	None	None	Fern
Wikstroemia indica	Thymelaeceae	None	None	Tree

Sonneratia	Lythraceae	None	None	Tree
Jasminium didymum	Oleaceae	None	None	Tree
Commersiona	Malvaceae	None	None	Tree
Ochrosia alyoides	Apocynaceae	None	None	Tree
Pipturus incamus	Urticaceae	None	None	Tree
Vitex negundo	Lamiaceae	None	None	Tree
Nervilia aragoana	Orchidaceae	None	None	Grass
Liparis layardii	Orchidaceae	None	None	Grass
Nothocnide repandra	Urticaceae	None	None	Tree
Ficus tinctoria	Moraceae	None	None	Tree
Volkameria internis	Lamiaceae	None	None	Tree
Melicope latifolia	Rutaceae	None	None	Tree
Belvisia mucronata	Polypodiaceae	None	None	Tree
Mallotus repandra	Euphorbiaceae	None	None	Tree
Acalypha grandis	Euphorbiaceae	None	None	Shrub
Pisonia aculeata	Myctaginaceae	None	None	Tree
Smythea lanceata	Rhamnaceae	None	None	Tree
Melochia odorata	Malvaceae	None	None	Tree
Cordia sugimura	Boraginaceae	None	None	Tree
Pollia secundiflora	Commelinaceae	None	None	Tree
Wedelia uniflora	Asteraceae	None	None	Grass
Homalium aneityensis	Salicaceae	None	None	Tree
Portulaca oleracea	Portulacaceae	None	None	Tree
Sida acuta	Malvaceae	Brum grass	None	Grass
Harpullia arborea	Sapindaceae	None	None	Tree
Pouteria linggensis	sapotaceae	None	None	Tree
Gouania efatensis	Rhamnaceae	None	None	Tree
Anthocarapa nitidula	Meliaceae	None	None	Tree
Achyranthes aspera	Amaranthaceae	None	None	Grass
Vittaria elongata	Pteridaceae	None	None	Tree
Fagraea berteriana	Loganiaceae	None	None	Tree
Neuburgia corynacarpa	Loganiaceae	None	None	Tree
Leea indica	Vitaceae	None	None	Tree
Pyrrosia lanceolata	Polypodiaceae	None	None	Tree
Sphaerostephanos invisus	Thelypteridaceae	None	None	Fern
Tarenna efatensis	Rubiaceae	None	None	Tree
Pycnarrhena ozantha	Menispermaceae	None	None	Tree
Spathodea campanulata	Bignoniaceae	none	None	Tree

Picture of the flowering Plants Found Elma Propos Conservation area

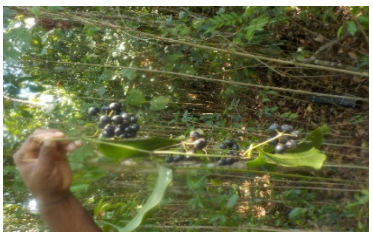
Elatostema

Schefflera neo-ebudica

Stachitarpheta

Delarbrea collina

Dendrocyde



Smilax

Melochia

Tabernaemontana anguinea

Solanum

Maesa

Macaranga Tanarius

Pseuderanthemum oppositifolium

Gardenia Vitiensis

Faradaya

Piptirus argenteus

Geniostoma

Sida Acuta

Micropiper

Hemigraphis

Commersionia

Micromelon

Hallophylum

Alpinia Pupunda

Morinda citrifolia

Entada Vitiensis

Antiaris toxicaria

Pittosporum cambellii

Endemic species found in ElMA proposed Conservation Area

Scientific name	Family name	Common name	Plant form
Phaleria penticostalis	Thymelaeaceae	none	Small tree
Cyrthandra efatensis	Gesneriaceae	None	Shrub
Meryta neo- ebudicum	Araliaceae	None	Tree
Calamus vanuatuensis	Arecaceae	Wael ken	Climber
Graptophyllum pictum	Acanthaceae	None	Shrub
Claoxylon fallax	Euphorbiaceae	None	Tree
Dysoxylum arboresence	Meliaceae	Wael stingwood	Tree
Litsea aneityensis	Lauraceae	None	Tree
Glochidion ramiflorum	Euphorbiaceae	Wael namamao	Tree
Psychotria milnei	Rubiaceae	None	Shrub
Nothonoides repada	Urticaceae	None	Climber
Psychotria fosteri	Rubiaceae	None	shrub
Smilax vitiensis	smilaxaceae	None	Liane
Corynocarpus similis	Corynocarpaceae	None	Tree

Invasive species found in ELMA proposed Conservation Area

Scientific name	Family name	Common name	Plant form
Sida acuta	Malvaceae	Brum grass	Shrub
Solanum torvum	Solanaceae	Biko	Shrub
Mikania macrantha	Asteraceae	Mael-minit	Vine
Mimosa pudica	Fabaceae	Grass nill	Herb
Achyranthes aspera	Amaranthaceae	None	Herb
Stachytarpheta jamaicensis	Verbanaceae	None	Herb
Psidium guajava	Myrtaceae	Wael guava	Shrub
Arundo donax	Poaceae	Wael ken	Shrub
Passiflora sp	Passifloraceae	Wael passion fruit	Climber
Leucaena leucocephala	Fabaceae	Kasis	Tree
Rubus rosifolius	Rosaceae	Wael strawberry	Shrub
Ipomoea indica	Convolvulaceae	None	Vine
Lantana camara	verbenaceae	None	Herb
Anodendron paniculata	Apocynaceae	None	Liane

Conclusion

ELMA site is one of the area that is observe and regarded as one of the most area that is rich in biodiversity in terms of ecology, plants species,birds and cultural values to people of Efate. With the collaboration of local communities and RESCCUE project the implemented survey has successfully discover some threats such as logging, improper farming practices and natural disaster which need to be address and recommend some best solution that will safe guard and strengthen the ecosystem for future livelihood. The survey also improve the knowledge of the local people about the importance of forest and the role of other living organism living in the Forest. Also other valuable information has been desseminated to build the local capacity that will further strengthen awareness in the communities to take responsibility about the care of ELMA site.

Recommendation

- Encourage reafforestation to the people in the communities.
- Remove the cattle and good fencing should be done to restore the re-generation of the Forest.
- More awareness should be carry out in the communities about the importance of Forest.
- It is necessary to carry out the assessment also on other sites of ELMA to discover other species in the Forest.
- We need to set up some permanent transect to assess the changes in vegetation types 5-10 years.

APPENDIX G
COMMENTS AND FEEDBACK

Provided by the Bioblitz community participants and specialists at the concluding meeting
(10 November 2017)

Appendix G: Comments and Feedback

Provided by the Bioblitz community participants and specialists at the concluding meeting (10 November 2017)

CHIEF THOMAS NEMAL:

He is very glad this project has happened.

He wishes that the Bioblitz survey had happened earlier.

He thinks that everyone on Efate needs to know what are the roles of insects, birds and all

animals so people can understand how the environment works.

People will then understand why it's important to conserve the environment for future

generations, especially to preserve the water.

He would like for there to be a detailed report on the baseline data and that this should be distributed widely for everyone to know about.

People don't understand that everything in nature is there for a reason. People impact the

environment detrimentally because they don't understand.

It would be beneficial to make this more clear to everyone on Efate.

Some children's environmental knowledge is poor and they are not aware of what special species are in the upland forest.

TOPEN:

He was in the insect team and prior to the survey, was not aware of the insects in the upland forest.He now knows about these species and appreciated the opportunity to learn about them.

He now understands that if the bush is not preserved, species loss may occur.

He was glad to work with Presley and learn information from him as a local expert.

He believes it is beneficial for the community volunteers to communicate their learnings to the communities regarding the forest and the survey.

Next time when there is a survey he believes it would be better to sleep in the bush to experience that part of the survey and also to minimize going up and down from the coast each day, which he found was hard for the group.

Suggested that the track-cutting team could dig a bush toilet in the forest for the survey team.

PHILIP:

He learnt a lot that he didn't previously know.

He wants to raiseawareness in his community about Efate's environmental features.

Roger has taught him a lot during this Bioblitz.

He's learnt what it's like in the forest and why it's important to conserve the forest.

He will take his messages about environmental conservation back to his community.

Everything in the forest is there to help the forest stay healthy.

***KALORIS**:*
The chiefs just sit around and talk about environmental protection but actually, they don't know what was happening in the forest.

The community participants will go back and relay the information from the survey to the Chiefs.

If we don't protect the forest, we will not have a sustainable future for the island.

There should have been a survey before TC Pam, then we would have a baseline.

JOELINE AND MARJORIE:

They learnt about birds and how many birds there are.

They are very happy to have learnt about this, and to now be able to identify the native bird calls.

Thanked the group for the cooperation of the team members.

Next time, they want to understand more about the biology of the birds and the roles of the bird life in the forest.

They'll go back to the communities and talk to the communities about their experiences.

JEFFREY:

Born and raised here and his ancestors have come from this part of north-west Efate.

He knows the bush very well and knows how this area can be disturbed and how vulnerable it is.

He didn't understand what was in the forest prior to this and felt like this was a great opportunity to partake in this study.

The area that now is used to run livestock (that currently occupies the area from the coast to the end of the leaseholders' land, approximately 2km inland), used to have very good native forest cover..

He didn't understand what was up there and how many different kinds of animals there are. He felt very moved to have the opportunity to see this forest on his customary land.

SPECIALIST TEAM:

We need to survey different parts of ELMA.

Cattle need to be kept out of the proposed conservation area as they spread invasive species.

A transect needs to be set up to monitor change in vegetation types. The forest is currently in a state of recovery so we need to monitor the forest.

We are here today because of the partnerships at community, national and regional levels, even as far as the community and landowners. We need to build on these partnerships.

Traditional knowledge is very important in these assessments. They need to balance the scientific information with traditional knowledge. There's no traditional information about what is actually inside the forest. Changes in the forest, the settlements. We are lacking all this traditional knowledge. What about the history and foundations that we need to build on? Sharing of information would help to establish a baseline.

Going out into the field, we need the local people to be with us. We need local guides. Otherwise we are biased in what we are collecting.

Need a traditional knowledge conservation program. Roger seconded the need for this.

There's old tracks on the island that link Tanoliu to Epau – so all these places on Efate are connected.

There are old settlements up in the mountains. Lots of people up there throughout history have perished because of mosquitoes and tribal wars.

Lots of people in the bush were using the sea for food.

Talked about custom areas and old villages.

Capacity building: Presley wondering about capacity building in communities and schools for environmental education.

APPENDIX H
LIST OF BIOBLITZ TEAM MEMBERS

Appendix H: List of Bioblitz team members

Local specialists

Presley Dovo – Entomology – Department of Forestry

Andrew Toara Morris – Birds – Birdlife International

Frazer Alo – Botany - Department of Forestry

Elisha Tekak – Botany - Department of Forestry

Stephanie Sali – Botany - Department of Forestry

Jenny Donlan – GIS – ELMA: Shefa Provincial Government (Jenny Donlan: Spatial Analysis Services)

Priscilla Amkori - Bats - Vanuatu Environmental Science Society

Thomas Junior Doro – Botany - Department of Forestry

International specialists

Roger MacGibbon – Ecologist – WSP Opus

Simon Chapman – Lizard and bat ecologist – Ecology NZ

Mark O'Brien – Bird expert – BirdLife International

Environmental network representatives

Joyline Johnny – Tasivanua Network - Emua representative

Topen Lore – ELMA Network - Mangaliliu representative

George Tavanearu – ELMA Network - Veden Lengi representative/Secretary

Philip Johnathan - Tasivanua Network - Pang Pang representative

Toara Kaloris – Tasivanua Network / ELMA Network - Ekipe representative

Marjorie Lulu – Tasivanua Network - Saama representative

Chief Nemal Thomas – ELMA Network - Epau representative

Jeffrey Pakoa - ELMA Network - Tanoliu representative

Coordination

Vanessa Organo – ELMA: Shefa Provincial Government

Emil Samuel – RESCCUE/Live and Learn

Karie Korah - Shefa Provincial Government (driver)

Rowan Dixon – WSP Opus

Jean-Pierre Popovi - Tanoliu community representative (track cutter and guide coordinator)


RESCCUE