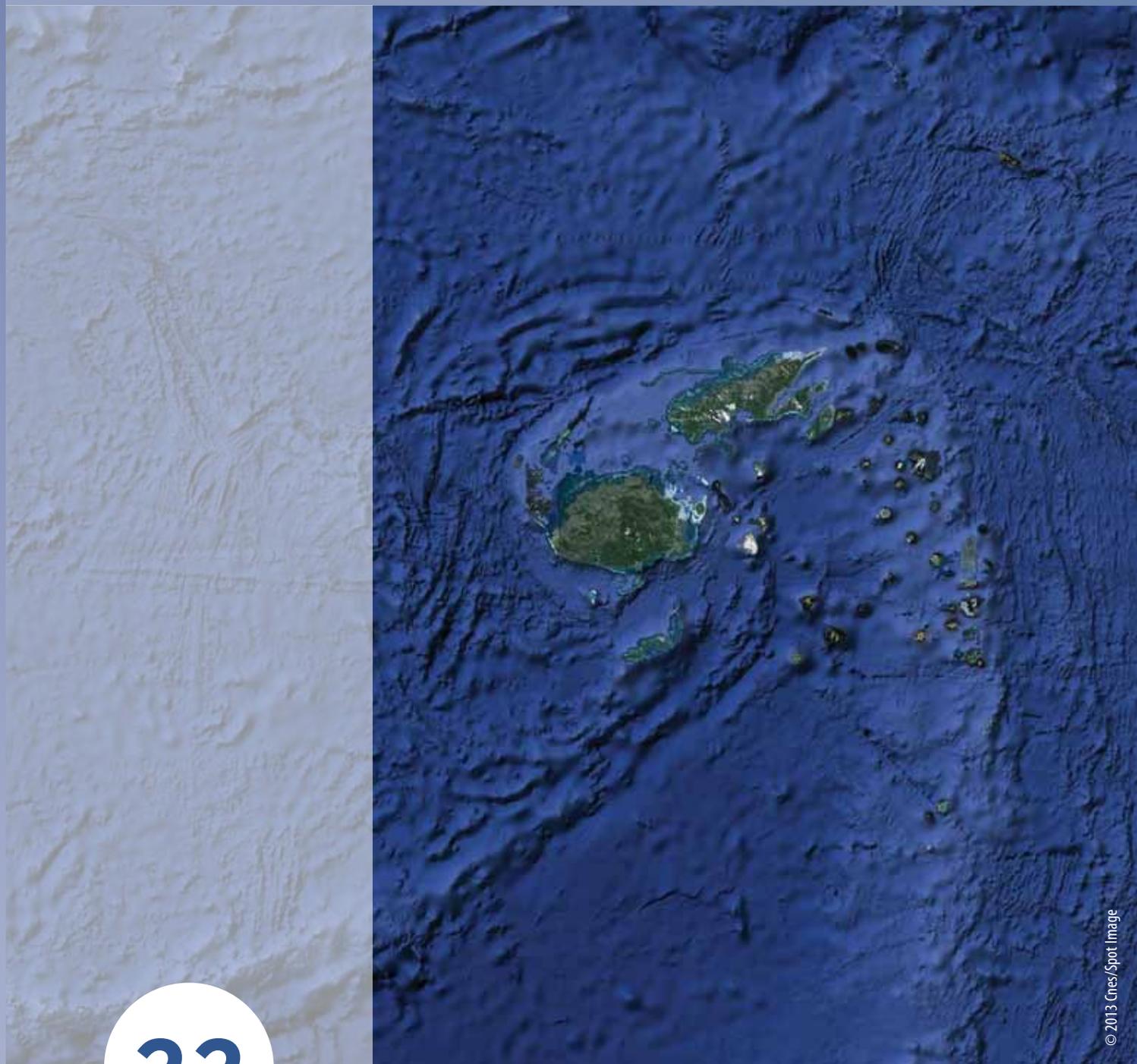


RAPID BIOLOGICAL ASSESSMENT SURVEY OF **SOUTHERN LAU, FIJI**



22

**CONSERVATION
INTERNATIONAL**

Pacific Islands



BIODIVERSITY CONSERVATION LESSONS LEARNED TECHNICAL SERIES

22

Rapid Biological Assessment Survey of Southern Lau, Fiji

Biodiversity Conservation Lessons Learned Technical Series is published by:

Critical Ecosystem Partnership Fund (CEPF) and Conservation International Pacific Islands Program (CI-Pacific)

PO Box 2035, Apia, Samoa

T: + 685 21593

E: cipacific@conservation.org

W: www.conservation.org

The Critical Ecosystem Partnership Fund is a joint initiative of l'Agence Française de Développement, Conservation International, the Global Environment Facility, the Government of Japan, the MacArthur Foundation and the World Bank. A fundamental goal is to ensure civil society is engaged in biodiversity conservation.

Conservation International Pacific Islands Program. 2013. Biodiversity Conservation Lessons Learned Technical Series 22: Rapid Biological Assessment Survey of Southern Lau, Fiji.

Conservation International, Apia, Samoa

Authors: Marika Tuiwawa & Prof. William Aalbersberg, Institute of Applied Sciences, University of the South Pacific, Private Mail Bag, Suva, Fiji.

Design/Production: Joanne Aitken, The Little Design Company, www.thelittledesigncompany.com

Cover Photograph: Fiji and the Lau Island group. Source: Google Earth.

Series Editor: Leilani Duffy, Conservation International Pacific Islands Program

Conservation International is a private, non-profit organization exempt from federal income tax under section 501c(3) of the Internal Revenue Code.

OUR MISSION

Building upon a strong foundation of science, partnership and field demonstration, Conservation International empowers societies to responsibly and sustainably care for nature for the well-being of humanity.

ISBN 978-982-9130-22-8

© 2013 Conservation International

All rights reserved.

This publication is available electronically from Conservation International's website:

www.conservation.org or www.cepf.net



The Critical Ecosystem Partnership Fund is a joint initiative of l'Agence Française de Développement, Conservation International, the European Union, the Global Environment Facility, the Government of Japan, the MacArthur Foundation and the World Bank. A fundamental goal is to ensure civil society is engaged in biodiversity conservation.

ABOUT THE BIODIVERSITY CONSERVATION LESSONS LEARNED TECHNICAL SERIES

This document is part of a technical report series on conservation projects funded by the Critical Ecosystem Partnership Fund (CEPF) and the Conservation International Pacific Islands Program (CI-Pacific). The main purpose of this series is to disseminate project findings and successes to a broader audience of conservation professionals in the Pacific, along with interested members of the public and students. The reports are being prepared on an ad-hoc basis as projects are completed and written up.

In most cases the reports are composed of two parts, the first part is a detailed technical report on the project which gives details on the methodology used, the results and any recommendations. The second part is a brief project completion report written for the donor and focused on conservation impacts and lessons learned.

The CEPF fund in the Polynesia-Micronesia region was launched in September 2008 and will be active until 2013. It is being managed as a partnership between CI Pacific and CEPF. The purpose of the fund is to engage and build the capacity of non-governmental organizations to achieve terrestrial biodiversity conservation. The total grant envelope is approximately US\$6 million, and focuses on three main elements: the prevention, control and eradication of invasive species in key biodiversity areas (KBAs); strengthening the conservation status and management of a prioritized set of 60 KBAs and building the awareness and participation of local leaders and community members in the implementation of threatened species recovery plans.

Since the launch of the fund, a number of calls for proposals have been completed for 14 eligible Pacific Island Countries and Territories (Samoa, Tonga, Kiribati, Fiji, Niue, Cook Islands, Palau, FSM, Marshall Islands, Tokelau Islands, French Polynesia, Wallis and Futuna, Eastern Island, Pitcairn and Tokelau). By late 2012 more than 90 projects in 13 countries and territories were being funded.

The Polynesia-Micronesia Biodiversity Hotspot is one of the most threatened of Earth's 34 biodiversity hotspots, with only 21 percent of the region's original vegetation remaining in pristine condition. The Hotspot faces a large number of severe threats including invasive species, alteration or destruction of native habitat and over exploitation of natural resources. The limited land area exacerbates these threats and to date there have been more recorded bird extinctions in this Hotspot than any other. In the future climate change is likely to become a major threat especially for low lying islands and atolls which could disappear completely.

For more information on the funding criteria and how to apply for a CEPF grant please visit:

- www.cepf.net/where_we_work/regions/asia_pacific/polynesia_micronesia/Pages/default.aspx
- www.cepf.net

For more information on Conservation International's work in the Pacific please visit:

- www.conservation.org/explore/asia-pacific/pacific_islands/pages/overview.aspx

or e-mail us at cipacific@conservation.org

Location of the project in the Polynesia-Micronesia Biodiversity Hotspot





Contents

	About the Biodiversity Conservation Lessons Learned Technical Series	3
	Lessons Learned	7
PART 1	Rapid Biological Assessment Survey of Southern Lau, Fiji	
	SUMMARY REPORT	9
	Archeological Surveys	9
	Reptile Surveys	15
	Entomological Surveys	19
	Marine Vertebrates Resource Inventory	22
	Marine invertebrates and algae of Southern Lau	24
	Botanical and Vegetation Surveys	28
	Mammal Survey of Southern Lau	29
	Southern Lau Natural Resource Awareness and Management Planning	31
PART 2	CEPF Large Grant Final Project Completion Report	55
	Map	
	Location of the project in the Polynesia-Micronesia Biodiversity Hotspot	4



Ono-i-Lau, a volcanic and coral island in Fiji's Lau archipelago.

Photo © NASA. Source: Wikipedia.

<http://eol.jsc.nasa.gov/scripts/sseop/photo.pl?>

RAPID BIOLOGICAL ASSESSMENT SURVEY OF SOUTHERN LAU, FIJI

Lessons Learned

Manage a smaller team on such an expedition so that more effort is spent on actual surveys rather than planning logistics; More background research of the sites before actual work e.g. water availability, accessibility to islands etc.; Involvement and the participation of relevant stakeholders i.e. govt. reps, scientific community, provincial council, local community.

Project Design Process

Aspects of the project design that contributed to its success/shortcomings.

The RAP survey was a success; it enabled the compilation of baseline data and checklist for different taxa within the short timeframe.

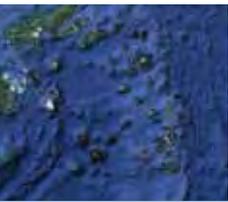
Project Implementation

Aspects of the project execution that contributed to its success/shortcomings.

The majority of team members of the survey were quite familiar with the RAP survey approach. Those that did not especially (individuals from other organizations) caused delays in the completion of their report.



Source: Google.



Southern Lau Biodiversity Survey 2011

SUMMARY REPORT

Archeological Surveys

ELIA NAKORO - FIJI MUSEUM

Introduction and Background

The Lau group consists of very remote islands that lie scattered towards the east of Viti Levu mainland. Culturally and as well as biogeographically, the Lau Islands are the meeting points between Polynesia and Melanesia. Although the precise timing and the origins of the cultural relationship between Tonga and Lau remains unknown, their people have been interacting since the seventeenth century and probably well before 1000 BP. During the seventeenth century, Lauan people were intermediaries between chiefly lineages of Tonga and Fiji.

During European contact the Lauans were engaged in exchanged networks that spanned much or all of Fiji, Tonga and Samoa. Many anthropologists have suggested that Lau, and the islands of Lakeba in particular, was a central political node between Polynesia and the main Fiji Islands (Hocart 1929; Roth 1953; Best 1984, 2002; Hunt 1988). Archaeological research can address this issue by providing chronological evidence that characterizes social change in terms of settlement, subsistence, and other forms of material culture.

Results

A list of sites surveyed during the expeditions is tabulated below and it includes information on name of the island, site name, site type and general location.

Island	Site Name	Site Type	General location
Ono-i-lau	<i>Vatu vola</i>	Petroglyph	Located about 900m SW of Nukuni and Lovoni villages
Ono-i-lau	<i>Muana-i-ra</i>	Old village site	Located about 110m SW from Nukuni and Lovoni.
Ono-i-lau	<i>Vugalei</i>	Old village site	Located between Muana-i-ra and the current villages of Nukuni and Lovoni
Ono-i-lau	<i>Bulubulu nei Tui Nayau</i>	Burial	Located about 260m NW of Matokana village.
Ono-i-lau	<i>Ligau</i>	Old village site	Located about 640m west of Lovoni village.
Ono-i-lau	<i>Nautu-utu</i>	Old village site	Located about 160m north of Ligau
Ono-i-lau	<i>Lomanikoro</i>	Defensive site (hill fortification).	Situated in the hills behind Doi village
Ono-i-lau	<i>Vakase</i>	Old village site	Located near Motukana village.
Ono-i-lau	<i>Motokana</i>	Old village site	Located towards the foreshore of the current village.
Vatoa	<i>Koromatua</i>	Old village site	Located about 1000m east-northeast of Vatoa village
Vatoa	<i>Unknown</i>	Cave burial	Located about 1km from Vatoa village.
Vatoa	<i>Unknown Number 2</i>	Defensive site (hill fortification)	Located 286m north-northeast from cave burial above.
Vatoa	<i>Unknown Number 4</i>	Rock shelter	Located about 57 m northeast of the above.
Vatoa	<i>Nai rikarika ni yalo</i>	Sacred site	Located NE coast about 1.2 k m from Koromatua site.
Vatoa	<i>Pulepule</i>	Defensive site (hill fortification)	Located about 2km NE from Vatoa village.
Vatoa	<i>Unknown</i>	Historical water source	Located about 113m west-southwest of Pulepule hill fort.
Ogea	<i>Naicegecegu</i>	Historical site	Located along the mid-eastern coast north of Ogea village.
Ogea	<i>Unknown</i>	Rockshelter	Located about 2.2km NE of Ogea village
Ogea	<i>Vanua ni yadra</i>	Historical site	Located about 78 m south-southeast from the above site.
Ogea	<i>Bulubulu ni kai Tonga</i>	Burial site	Located 305m NE of the village
Ogea	<i>Vakaruru ni cagi</i>	Historical site	Located about 146m east-northeast from the edge of the village.
Ogea	<i>Unknown</i>	Skeletal remains	Located 258m east of the village
Ogea	<i>Unknown</i>	House mound	Locate 55m SE from the previous site

Island	Site Name	Site Type	General location
Ogea	<i>Koromatua</i>	Old village site	Located close to the NE end of the village.
Ogea	<i>Sautabu</i>	Sacred burial ground	Located in the Matuatabu Primary School compound.
Namuka	<i>Bulubulu ni kai Tonga</i>	Burial site	Located SW outskirts of Nawatia village in the middle of the school playing field
Namuka	<i>Korowaiwai</i>	Fortified village	Located about 434m west of the previous burial site.
Namuka	<i>Koroqara</i>	Fortified village and cave	Located on the other side of the island about 1.3km north-northwest from Korowaiwai
Namuka	<i>Korovuso</i>	Old village site	Located 201m away from Koroqara fort.
Namuka	<i>Qaravatu (Nabalebale)</i>	Cave	Located along the mid northern coast of the island, northeast from Nawatia village.
Namuka	<i>Koroilagi</i>	Fortified village	Located 689m east of the above site.
Namuka	<i>Kacivitinana</i>	Historical site	Located 580m SW from the site mentioned above.
Namuka	<i>Naqalitoka</i>	Rock shelter	Located 620m SW from the above site.
Namuka	<i>Mona calidi</i>	Historical site	located about 63m SW from Naqalitoka along the coast
Namuka	<i>Qaravatu</i>	Cave	Located about 168m away from above site.
Fulaga	<i>Toka</i>	Old village site	Located 365m south of Naividamu village.
Fulaga	<i>Sautabu I</i>	Sacred burial ground	Located about 346m north NE of Muanaira village.
Fulaga	<i>Qilo</i>	Fortified old village site	Located about 43m south of the above site.
Fulaga	<i>Sautabu II</i>	Sacred burial ground	Located 37m SE of Qilo.
Fulaga	<i>Yavu ni vale</i>	House mound	Located 92m SW of the Sautabu sites.
Fulaga	<i>Qara vatu ni sui I</i>	Cave burial	Located about 143m north of Mua-i-ra village.
Fulaga	<i>Qara vatu ni sui II</i>	Cave burial	Located in a crevice of an outcrop within Qilo site.
Fulaga	<i>Nakorowaiwai</i>	Fortified old village site	Located about 242m north of Muana-i-cake village.
Fulaga	<i>Qara vatu ni sui III</i>	Cave burial	Located along the track midway between the coastal flat and Nakorowaiwai.
Fulaga	<i>Narocake</i>	Fortified old village site	Located about 2.4km SE from Muana-i-cake village.
Kabara	<i>Cabe ni lotu</i>	Historical site where Christianity first arrived	Located about 1.5km NE Udu village.
Kabara	<i>Tobu ni wai</i>	Historical site	Located midway between Naikeleaga and Udu village on the eastern coast.
Kabara	<i>Sautabu</i>	Sacred chiefly burial ground	Located 39m NW of the historical spring.
Kabara	<i>Taqu</i>	Old village site	Located in the same area above.
Kabara	<i>Nasevou</i>	Defensive site	Located meters away south of Tokalau village
Kabara	<i>Delaioloi</i>	Defensive site	Located 483m SW of Nasevou site
Totoya	<i>Davura</i>	Defensive site	Located 3.7km north-northeast from Udu village.

Island	Site Name	Site Type	General location
Totoya	<i>Korowaiwai</i>	Defensive site	Located about 20ms north-northeast of Dravuwalu village.
Totoya	<i>Koromatua</i>	Old village site	Located 55m NE of Dravuwalu village.
Totoya	<i>Makapapa</i>	Burial ground	Located 25m NE of Dravuwalu village.
Matuku	<i>Nakabati</i>	Old village site	Located about 641m south-southeast of Nakabati village.
Matuku	<i>Ududra</i>	Historical site	Located about 1 km south of Yaroi village.
Matuku	<i>Unknown</i>	Defensive site	Located less than 1 km NE of the Matuku jetty.
Matuku	<i>Delai</i>	Defensive site	Located few meters SW of Lomai village.
Matuku	<i>Vanua cabe kina na lotu</i>	Historical site	Located 30 m along the coast north of Qalikarua Village.
Matuku	<i>Vuni Duibana</i>	Historical tree	Located on the northwestern coastal end of a small island south of Qalikarua village.
Matuku	<i>Bulubulu ni kai Ra</i>	Burial ground	Located on the SE end of the same island where the Duibana grows.
Matuku	<i>Vatu ni loka (Raviravi)</i>	Historical stone	Located 40m east-northeast of Levukaidaku village.
Vanuavatu	<i>Batukeivasu</i>	Defensive site	Located 48m SE of the village
Vanuavatu	<i>Nauluvatu</i>	Defensive site	Located 1.2km east-southeast from the village.
Vanuavatu	<i>Koroilagi</i>	Defensive site	Located directly below Nauluvatu (above-mentioned) look-out point.
Vanuavatu	<i>Qaravatu</i>	Cave	Located 803m south from Koroilagi site along the eastern coast.
Vanuavatu	<i>Qaranikawakawa</i>	Historical site	Located 822m from Koroilagi defensive site on the southern end of the island.
Vanuavatu	<i>Koroilagi II</i>	Defensive site	Located 715m south-southwest from the qara vatu
Moala	<i>Delaimoala</i>	Historical site	Located 3.2km east of Nuku village.
Moala	<i>Lovo ni tamata</i>	Historical site	Located 78m SE at the foot of Delaimoala.
Moala	<i>Lovo ni vonu (2x)</i>	Historical site	Located 17m NE from the lovo ni tamata
Moala	<i>Waitadravula</i>	Historical site	Located 331m east-southeast of the lovo pits.
Moala	<i>Komete vatu (stone tanoa)</i>	Historical site	Located 527m east-southeast from Waitadravula
Moala	<i>Koro ni yavusa tinitini</i>	Old village site	Located 213m SE of the Komete vatu
Moala	<i>Navucanimasi</i>	Defensive site	Located 1.6km north-northwest of Keteira village
Moala	<i>Muaimatuku</i>	Old village site	Located 221m SW of Navucanimasi defensive site

Conclusion and Recommendations

The islands of southern Lau possess a rich and intact cultural heritage. However, the people lack understanding and awareness on the importance of preserving the well being and the very essence that molded a community's identity. Most of which are pristine and beautifully structured.

The survey of the said ancestral village sites, historical sites and sacred sites revealed that there is much history contained in the remote islands of southern Lau. History pertaining to traditional and cultural development is linked strongly to the identity of its people.

Such History should and must be preserved irrespective of whether they are tangible or intangible cultural assets. In this sense, the history of the movement and settlement of the people of Lau must be preserved.

Therefore, the department recommends that the villagers should play a crucial role in this act to preserve its identity and must do so in transferring its history to the young generations, and demarcate sites of cultural heritage.

Finally, the Department of Archaeology of the Fiji Museum has conducted its survey and has confirmed that all the sites visited warrants proper preservation and thus this is covered in the legislation (Cap 264: Preservation of Objects of Archaeological and Palaeontological Interest) that governs the work of the department.

From the field survey, the department of Archaeology was able to ascertain that the sites visited were previously occupied at one point of time.

The old village sites that were assessed contained comprehensible evidence of human habitation. Evidence for the koro makawa (old village) for all the sites was depicted in the form of house mounds of raised earthen materials and those aligned with stones at the edge. Also apparent are the amazing work and foot prints of fortification trenches and fortification walls.

Possible threats to Cultural Features

(I) HUMAN-RELATED DISTURBANCE

For the sites surveyed, there was evidence of human-induced disturbances observed. The most extensive disturbance was the use of these sites for agricultural purposes and this was evident for most of the sites.

(II) NON-HUMAN THREATS

These threats occur naturally and cause irreversible damage. Natural elements such as heavy rain, flooding and strong winds contribute to changing and shaping the natural and cultural landscape of the earth from time to time.

Wild animals such as pigs also destroy cultural remains by trampling or digging around in search of sources of food for its survival therefore villages should ensure proper domestication of farm animals.

References/Bibliography

1. Fankhauser B, Clark G, Anderson A, 2009, *The Early Prehistory of Fiji: Characterization and Sourcing of Archaeological Adzes and Flakes from Fiji*, Terra Australis 31, Australian National University.
2. Gatty R, 2009, *Fijian-English Dictionary with notes on Fijian culture and natural history*, Oceania Printers, Suva, Fiji.
3. Hocart A. M, *Lau Islands, Fiji*, Bernice P Bishop Museum, Bulletin 62, Honolulu, Hawaii.
4. Jones S, 2007, *Human Impacts on Ancient Marine Environments of Fiji's Lau Group: Current Ethnoarchaeological and Archaeological Research*, Journal of Island and Coastal Archaeology, Volume 2.
5. 1995, *Mai Kea ki Vei? Stories of Methodism in Fiji and Rotuma*, Star Printery, Suva
6. O'Day S. J, O'Day P, Steadman W. D, 2004, *Defining the Lau Context: Recent Findings on Nayau, Lau Islands, Fiji*, New Zealand Journal of Archaeology, Volume 25 (2003).
7. Orser E. C, 2004, *Historical Archaeology-Second Edition*, Pearson Education, Inc., Upper Saddle River, New Jersey.
8. Smart D. C, 1965, *Preliminary Report on Archaeological Field-work in Kabara, Southern Lau Islands, Fiji, October to December 1964*, Fiji Museum, Suva, Fiji.
9. Reed A. C, 1990, *Tovata I & II*, Fiji Museum, Suva
10. Reverend Epeli Rokowaqa, 1973, *Ai Tukutuku kei Viti "The History of Fiji,"* Methodist Magazine, Ai Tukutuku Vakalotu. In Wood A. H, 1978, *Overseas Missions of the Australian Methodist Church*, Vol. 2, Melbourne, Australia

Reptile Surveys

NUNIA THOMAS (NATUREFIJI-MAREKETIVITI); ROBERT FISCHER (UNITED STATES GEOLOGICAL SOCIETY); JESSY GREISMER (KANSAS UNIVERSITY).

Twenty seven islands across twelve island groups were surveyed for reptiles and amphibians between July 6 and August 2, 2011. An additional island (Lakeba) in central Lau was briefly visited and is included in the discussion. A total of 14 reptile species (Table 2) were found including one invasive species (*Hemidactylus frenatus*). No amphibian species were found. Five of these species are endemic to Fiji and one (*Leiopisma alazon*) is endemic to only the Ono-I-Lau group. The highest number (Table 4) of species (10) was detected on Moala, Vanuavatu, and Yanuya (Ono-I-Lau group).

This survey reports the first reptile records for 10 islands in the Southern Lau Group (Table 3), and added 22 new island records for reptiles across all of the islands. Many of the records are consistent with the Whitney South Seas Expedition (Burt and Burt 1932) and Zug's 1980's surveys (Zug 1991). The range expansion of the Fijian iguanas (*Brachylophus fasciatus*) and Lauan ground skink (*L. alazon*) are very significant. Also several possible new species were discovered within the *Emoia* skinks classified as *concolor* and possibly within the Pacific boa (*Candoia bibroni*).

Recommendations and Conclusion

The Southern Lau Islands has exceptional herpetofauna diversity and needs further, detailed field work and research to ascertain the following:

1. Status (Ecological, conservation, genetic) of the herpetofauna on each island (particularly for the endemic and unknown species); and their subsequent threats and how these threats will be addressed.
2. Appropriate conservation actions: The main islands surveyed appeared to have ideal habitats for herpetofauna – but the presence of pigs, feral cats and bad agricultural practices may have a slow, long term negative impact on these populations. Uninhabited fishing camp islets yielded good herpetofauna diversity, but could lose their herpetofauna to invasive species brought in during the island visits. Further work needs to:
 - a. Identify inhabited inaccessible islets and ensure that invasive species (rats, cats, yellow crazy ants, pigs and goats) do not establish on them. These islets can also be priorities for invasive species eradication;
 - b. Identify uninhabited accessible islets frequently used as fishing camps and develop biosecurity protocol for these islets. These islets can also be priorities for invasive species eradication and control;
 - c. Identify inhabited islands with manageable invasive species.
 - d. Identify islands and islets free of invasive species and develop biosecurity protocol to ensure that they remain free of invasive species.
3. The Southern Lau islands are good sites for herpetofauna ecological studies. This needs to be explored further by future local students interested in ecological studies, which can range from basic ecological data of the species to assessing the threats to their survival.

A number of conservation recommendations based on the results of the survey are discussed including, identification of potential sites warranting National Significance and issues associated with the spread of invasive species.

Table 2 Species occurrence results by island from the Southern Lau RAP surveys.

Species	Island										Yagasa										Total						
	Moala	Matuku	Totoya	Vanua Vatu	Kabara	Vuagava	Marabo	Fulaga	FU Islet 1	FU Islet 2	FU Islet 3	Navutu-l-Loma	Navutu-l-Ra	Yagasa levu	Namuka Levu	Namuka Driki	Ogea Levu	Ogea Driki	OG Islet 1	Vatoa		Ono-l-lau Island	Mana	Yanuya	Dogovua	Tuvana-l-Ra	
<i>Brachylophus fasaatus</i>	N	S	N	N	N	N	N	N	N	D		S	S	D	N	S	N	S		S			N	N	N		6
<i>Gehyra oceanica</i>																											20
<i>Hemidactylus frenatus</i>										S		N	D		N	S	S	S	S		S	D	S	N	N		17
<i>Lepidodactylus lugubris</i>	N	N	N	N	N	N	N	N				D	D		N	N		N		N		D	N			14	
<i>Nactus pelagicus</i>	N	S	N	N	N	N	N	N				E	D	E	D	D		S	S	D	S	D	N			15	
<i>Cryptoblepharus eximius</i>	D				S?	E						E	D	E	D	D		S	S		S		E	D		8	
<i>Emoia cf concolor</i>	S	N	S	N	N		N								N	S	S	S	S	S		S				20	
<i>Emoia cyanura</i>	S	S	S	S	S?	S	D	S	S	S	S	D			S	S	N	S	S	S	S	S	S			21	
<i>Emoia impar</i>	S	S	S	S	S?	S	S	S	S	S	S	S	D		S	D		S	S	S	S	S	S	S	S	5	
<i>Emoia trossula</i>	D										E	E									D		S			3	
<i>Leiopismis alazon</i>																						D	D	D		10	
<i>Lipinia noctua</i>	S	S	S	S									S							S	S	D	S	D		9	
<i>Candoia bibroni</i>	N			N	N	N					N		N		N		N					N	N	D		9	
<i>Laticauda colubrina</i>	10	7	8	10	9	5	4	7	2	4	1	6	6	4	9	5	5	5	4	7	7	5	10	2	5	6	
<i>Bufo marinus</i>																										1	
<i>Sus scrofa</i>																						S					11
<i>Rattus exulans</i>		S	S	S	S	S	S	S	S	S		S	S			S	S	S					S			9	
Yellow Crazy Ants	S	S	S	S	S	S	S	S	S	S	S	S											S	S	S	9	

Key: S - sticky traps; N - night surveys; D - day surveys; E - identified but escaped

Table 3. Comparison of how many reptile and amphibian records were known for each island and how many new island records were documented during the Lau RAP surveys.

Island	Historic	Lau Trip	New Records by Island
Moala	8	10	2
Matuku	8	7	0
Totoya	8	8	0
Vanuavatu	3	10	7
Kabara	1	9	8
Vuaqava	2	5	3
Marabo	0	4	4
Fulaga	5	7	2
FU-Islet 1	0	2	2
FU-Islet 2	0	4	4
FU-Islet 3	0	1	1
Navutu-I-Loma	2	6	4
Navutu-I-Ra	1	6	5
Yagasa Levu	0	4	4
Namuka Levu	5	9	4
Namuka Driki	0	5	5
Ogea Levu	3	5	2
Ogea Driki	2	5	3
OG-Islet 1	0	4	4
Vatoa	3	7	4
Ono-I-Lau Island	1	7	6
Mana	0	5	5
Yanuya	6	10	4
Dogovua	0	2	2
Tuvana-I-Ra	0	5	5

Table 4. Comparison of historic and our records for the distribution by islands for each species detected during the surveys.

Number of Islands species was detected from in the Southern Lau Group

	Historic	Lau Trip	New Island Records
<i>Brachylophus fasciatus</i>	4	6	2
<i>Gehyra oceanica</i>	9	20	11
<i>Hemidactylus frenatus</i>	0	0	0
<i>Lepidodactylus lugubris</i>	8	17	9
<i>Nactus pelagicus</i>	4	14	10
<i>Cryptoblepharus eximius</i>	6	15	9
<i>Emoia cf concolor</i>	4	8	4
<i>Emoia cyanura</i>	6	20	14
<i>Emoia impar</i>	8	21	13
<i>Emoia trossula</i>	2	5	3
<i>Leiopisma alazon</i>	1	3	2
<i>Lipinia noctua</i>	5	10	5
<i>Candoia bibroni</i>	2	9	7
Total Island Records:	59	148	89

Entomological Surveys

HIDA SAKIKI – WAQA (IAS, USP)

An entomological survey of the Southern Lau Group was conducted in June 2011. The team involved personnel from the Ministry of Agriculture, Fiji; Flinders University, Australia and South Pacific Regional Herbarium (SPRH, IAS, USP). The prime objective of the survey was to conduct a baseline survey of insects, report on its current ecological status and propose better management measures for their conservation.

A preliminary checklist of insects collected from each island is tabulated in Table 5. A total of 11 coleopteran (beetle) families including the rare Cerambycidae (long-horn beetles) were recorded across 10 islands. The uninhabited island and forested areas of Vuaqava is significant owing to good number of cerambycids sampled from this island.

A total of 18 species of butterflies were sampled across 13 islands from the Southern Lau Group of islands. Of these, two species i.e *Papilio schmeltzi* and *Polyura caphontis* are endemic to Fiji. *P. schmeltzi* listed new records for Fiji from the current surveys i.e. Totoya and Matuku whilst *P. caphontis* was confirmed to be still on Moala. In 1874, *P. caphontis* was only recorded on Viti Levu, Moala and Totoya. The island of Fulaga yielded greatest butterfly diversity.

An interesting find was the stick insect *Nisyrys spinulosus*, a new record for Moala which has only been previously recorded on Viti Levu and more recently in Nakorotubu and Nakauvadra mountain ranges, Ra Province.

Bees of the families Halictidae and Megachilidae comprised the entirety of collections throughout the survey, and covered three subgenera. Of the family Halictidae, *Lasioglossum* subgenus *Homalictus* is abundant throughout the Pacific, and was prevalent on the majority of islands in the Southern Lau Group. It appears likely that this prevalence was entirely due to one species, *Homalictus fijiensis* however, this species may in fact be more complex with segregation of island groups. Analysis of sequence data from the islands of Southern Lau may therefore reveal in-process speciation. Of the family Megachilidae, there are two prevalent sub genera in the Southern Lau Group and indeed the southwestern Pacific: Callomegachile and Eutricharea. Bees of these subgenera are most important as honeybee-substitute pollinators due to their similar size and pollinating abilities. Their populations are also perhaps the easiest to promote locally as they are wood boring. Understanding their true extent in not just the Southern Lau Group but the entirety of Fiji will be important for the future of food security in the region.

Pest surveys for rhinoceros beetles and fruitflies were also carried out. Results reveal that all islands surveyed in Southern Lau with the exception of Matuku and Totoya showed signs of rhinoceros beetle damage on coconut palms. An interesting result was the occurrence of the fruitfly, *Bactrocera distincta* from the fruit of the tree *Manilkara vitiensis* locally known as *tarai* which was collected on Ogea Driki, an uninhabited island. Previous fruit fly work in Vatoa had yielded *B. distincta* in qalaka (*Planchonella costoto*) and fruit collections during this survey also reconfirmed this result.

The survey suggests that the islands of Vuaqava (long-horn beetles) and Moala (*Nisyrys spinulosus* and *Polyura caphontis*) are significant islands/sites for the conservation of insects and perhaps terrestrial biodiversity in general.

Table 5. Preliminary checklist of Insects collected from each island visited.

Keys: Ono = Ono-i-lau; Yan = Yanuya; Man = Mana; Vat = Vatoa; Oge dri = Ogea driki; Oge lev = Ogea levu; Nam = Manuka-i-lau; Ful = Fulaga; Kab = Kabara; Tot = Totoya; Mat = Matuku; Van = Vanuavatu; Moa = Moala; Lak = Lakeba; Yag = Yagasa

Taxa	Ono	Yan	Man	Vat	Oge dri	Oge lev	Nam	Ful	Kab	Mat	Van
BUTTERFLY SURVEYS											
<i>ORDER LEPIDOPTERA</i>											
<i>Family Hesperidae</i>								√	√		
<i>Oriens augustula</i>											
<i>Family Lycaenidae</i>											
<i>Jamides bochus</i>								√	√		
<i>Family Nymphalidae</i>											
<i>Danaus chrysippus petilia</i>							√				
<i>Tirumala hamata</i>											
<i>Danaus plexippus</i>				√						√	√
<i>Doleschallia bisaltide</i>		√						√			
<i>Euploea boisduvalii boisduvalii</i>				√	√		√		√		√
<i>Euploea core</i>		√					√	√			
<i>Euploea nemertes macleayi</i>				√					√		√
<i>Euploea tulliolus</i>				√	√	√	√			√	√
<i>Hypolimnas antilope</i>											
<i>Hypolimnas bolina</i>	√	√		√		√		√	√	√	
<i>Hypolimnas octocula</i>				√							
<i>Junonia villida</i>				√		√	√	√			
<i>Melanitis leda</i>											
<i>Polyura caphontis</i>											
<i>Family Papilionidae</i>											
<i>Papilio schmeltzi</i>										√	
<i>Family Pieridae</i>											
<i>Belanois java</i>	√		√	√	√	√	√	√	√		√
<i>Appias albina</i>			√	√				√			√
<i>Appias paulina</i>											
<i>Catosilia pomona</i>			√								
<i>Eurema hecabe</i>						√	√	√	√	√	

Taxa	Ono	Yan	Man	Vat	Oge dri	Oge lev	Nam	Ful	Kab	Mat	Van
LIGHT TRAP											
ORDER COLEOPTERA	Oge dri	Vua	Nam	Ful	Kab	Yag	Mat	Van	Moa		
Family Cerambycidae		√				√		√	√		
Family Chrysomelidae	√					√					
Family Coccinellidae			√								
Family Curculionidae	√							√			
Family Dytiscidae							√				
Family Elateridae		√									
Family Eucnemidae			√	√	√		√				
Family Oodemeridae				√	√						
Family Scarabaeidae				√			√				
Family Tenebrionidae	√		√	√				√			
ORDER ORTHOPTERA											
Family Gryllacrididae	√				√						
Family Tettigoniidae	√				√				√		
ORDER HEMIPTERA						√					
NATIVE BEE SURVEYS											
	Ono	Vat	Oge lev	Lak	Nam	Ful	Kab	Tot	Nan	Van	Moa
L. (Homalictus) sp.	√		√	√	√	√	√	√	√	√	√
M. (Callomegachile)	√	√		√	√	√	√	√		√	√
M. (Eutricharaea) sp.	√	√	√	√	√	√		√	√	√	√
M. (Eutricharaea) sp.				√		√					
Taxa	Vato	Oge lev	Oge dri	Ful	Kab	Mat	Van	Moa	Kab		
ORDER ORTHOPTERA	√			√	√	√	√				
ORDER LEPIDOPTERA	√										
Danaus plexipus	√										
ORDER COLEOPTERA					√				√		
Family Coccinellidae		√									
Family Cerambycidae					√			√			
ORDER PHASMID			√	√	√		√				
Nisyrus spinulosus							√				
ORDER HEMIPTERA							√				

Marine Vertebrates Resource Inventory

BY SEMISI MEO, AISAKE BATIBASAGA, RON VAVE AND RUSIATE (IAS, USP).

Coral reefs belonging to 14 islands in the Southern Lau region were surveyed between 5th July and 4th August, 2011. Around one to two days were spent surveying the reefs of each island.

With a team of four people, the surveys were undertaken in areas mostly confined to outer reef slopes. A total of 36 dive site locations covering 14 islands were selected and of these 35 were surveyed using SCUBA and one was snorkeled in the shallow waters of a small, rocky island in Fulaga. Depths surveyed ranged from 1 to 42 meters.

Sites surveyed for the benthic substratum in Southern Lau islands predominantly comprised of hard coral followed by rock and sand. Average hard coral cover per island showed that Marabo island had the highest and the lowest were found on the reefs of Vatoa, Ogea and Yagasa cluster of islands.

On species richness, overall, an average of 14 to 21 species of fish per transect (40m X 2m) were noted on each island, with Fulaga Island having the lowest and Yagasa cluster of islands having the highest. Fish species richness tends to decrease northward where islands are closer to each other and where fishing pressure is greater. Yagasa cluster of islands are uninhabited. Possibly, Naevo Island would have had the highest species richness if more dives and transects were used.

Fish census on the biomass (Table 6) which has average fish biomass by island and is also ranked from highest to lowest. The submerged reef Vuata Ono and Ono-i-Lau Island registered the highest average fish biomass of 31,041Kg and 30,278Kg respectively, followed by Namuka, Moala, Naevo and Tuvana with biomass between 25000kg to 19000kg respectively. Totoya and Kabara islands registered the lowest biomass – around 3000kg to 4000kg respectively. A majority of inhabited islands in the Southern Lau Group (ranked 7th to 14th), with average fish biomass at, almost a third to that of very distant reef system such as Vuata Ono. The major contributing factor here could be the fishing pressure from this inhabited islands which this report assumes to be mostly for household consumption. This is despite the fact that there are wharfs in some of the Southern Lau islands which means that the access to market is there. The other major limiting factor is the fact that there is no ice plants on these islands.

Fish abundance and diversity is relatively high around the Southern Lau island in comparison to other parts of Lau and around Fiji. This is especially true for the uninhabited islands towards the south – Tuvana, Yagasa, Ono-i-lau and Vuata ono and Naevo. Notable abundance of the giant clams *Tridacna spp.* was observed on Tuvana-i-Ra and the endemic giant clam *Tridacna balavuana* was spotted in Matuku. On Vatoa notable abundance of *Chlorurus microrhinos* undergoing spawning activities was observed towards the outer reef area and so was the parrot fish in reefs near Vuaqava, and near Ogea Levu waters a lone humpback whale was observed.

Fulaga recorded the highest number of fish taxa (206) followed by Moala (190 taxa) but this could have been because a greater area was assessed when compared to other sites.

Distribution patterns of fish across the reef ecosystem are standard largely in inhabitant islands regions. There is abundance of herbivorous fish species in these reef systems which perhaps are attributed to fishing pressure by humans.

To conclude Naevo Reef is a potential island of species significance and could be proposed as a national marine sanctuary site. This island is owned by the people of Ogea Island, however is remotely situated from the inhabitant islands, for a frequent visitation. With an appreciated fish biomass and diversity recorded, Naevo Island and reef is potentially an island for seeding of larval stocks.

Tuvana-i-Ra Island and neighbouring Tuvana-i-Colo Island, are the most distant islands of all, and are bound to be biological significant and with special values because of its location. The reefs being well flushed and clean with intertidal reef pools in the inner reef area, which harbors fish even at low tides. The outer reef area is completely covered with the local delicacy *Caulerpa sp* (seagrapes algae) extending from the crest sloping down to about 12m depths. The island is quite unique and with observed invertebrate and fish abundance. Human impact and pressure is also a precedent from Tuvana island groups and significantly impacting on the diversity and abundance of marine life in the island. An urgent intervention on marine biodiversity and awareness is needed with these communities and to assess the sources of livelihood for the communities. The livelihood options needs to be diversified so the communities have a range of options to choose from rather than marine-based alternatives.

Table 6. A Rank of average fish biomass by island

RANK	ISLAND	AVERAGE BIOMASS (KG)
1	Vuata Ono	31,041.09
2	Ono-i-Lau	30,278.30
3	Namuka-i-Lau	25,389.96
4	Moala	22,948.79
5	Naevo	20,407.56
6	Tuvana-i-Ra	19,422.07
7	Vatoa	11,743.40
8	Matuku	10,515.20
9	Ogea	10,149.00
10	Fulaga	9,687.81
11	Vanuavatu	8,262.12
12	Yagasa	5,799.73
13	Kabara	4,795.84
14	Totoya	3,484.37

Marine invertebrates and algae of Southern Lau

BY KLAUS FEUSSNER (IAS, USP), MARK HAYES (ATLANTA GEORGIA TECH UNIVERSITY) AND KATIE SOAPI (IAS, USP).

A marine invertebrates and algae survey of the Southern Lau Group was conducted in June 2011. The team involved personnel from the SCRIPPS Institute for Oceanography (San Diego) in collecting sediment samples for isolating actinomycetes and with Georgia Institute Technology (GIT) to collect algae and marine invertebrates. The purpose of the survey is not only to document the diversity of these groups of organisms in the area but to also screen some of these organisms for bioactive compounds against some diseases.

Collections from two tidal-flats and from a total of 33 dives (depths between 1 and 25m) were done to collect marine invertebrates, algae and sediment samples.

A total of 158 individual samples of marine invertebrates, algae and cyanophytes were collected. In addition another 640 marine sediment samples were collected for actinomycetes analysis. Of these samples 117 specimens (see Table 7) have been identified and it included the following taxa: 42 alga, 26 sponges, 22 cnidarians, one hydrodeans, one bryozoa and two ascidians. Based on the identified taxa listed on Table, the more common taxa collected from more than one island is the cnidarians taxa *Sinularia* sp. followed by *Sarcophyton* sp. and the sponge *Japis* sp. The most diverse invertebrate and flora was collected on a single dive site on the island of Ogea (8 taxa) followed by Vanuavatu (8 taxa) and then Moala. Matuku, Vatoa and Ono-i-lau with 6 taxa each. A highlight of the survey is the discovery of a possibly undescribed "new" symbiotic sponge living underneath *Lithophyllum* (algae) at a dive site in Vanuavatu.

Overall the marine invertebrates, algae and cyanophytes at the dive spots were very biodiverse compared to other similar areas in Fiji however Moala had the richest, and the most impressive drop-off was encountered off Fulaga.

Table 7. Preliminary checklist of invertebrates and algae collected from Southern Lau in June 2011

Phyllum	Genu/species	Ono ilau	Vatoa	Ogea	Namuka	Fulaga	Kabara	Totoya	Matuku	Vanua vat	Moala
Algae	<i>Codium mamillosum</i>	x									
Algae	<i>Lobophytum,</i>	x									
Algae	<i>Sarcophyton</i>	x									
Algae	<i>Porolithon onkodes,</i>	x									
Algae	<i>Amphiroa tribilis,</i>	x		x							
Algae	<i>Amphiroa mamillosum</i>	x									
Algae	<i>Dictyosphaeria versluysii</i>	x									
Algae	<i>Halophila ovalous desitiens</i>	x									
Algae	<i>Peysonnelia,</i>		x								
Algae	<i>Rhipilia penicilloides?</i>		x								
Algae	<i>Valonia aegagropila?</i>		x								
Algae	<i>Peysonnelia bornetii</i>			x							
Algae	<i>Microdictyon hamurai</i>			x							
Algae	<i>Codium geppiorum</i>				x						
Algae	<i>Galaxaura</i>				x						
Algae	<i>Caulerpa recemosa</i>				x						
Algae	<i>Caulerpa taxifolia</i>				x						
Algae	<i>Udotea</i>				x						
Algae	<i>Boodlea composita,</i>				x						
Algae	<i>Laurentia</i>				x						
Algae	<i>Champia compressa</i>				x						
Algae	<i>Rhizoclonium africanum</i>	x			x						
Algae	<i>Kappaphycus alvavezii</i>				x						
Algae	<i>Dasyphila plumaroides</i>					x					
Algae	<i>Portieria hornemanni</i>					x					
Algae	<i>Galaxaura spp.</i>						x	x			

Phyllum	Genu/species	Ono ilau	Vatoa	Ogea	Namuka	Fulaga	Kabara	Totoya	Matuku	Vanua vat	Moala
Algae	<i>Laurentia</i>					x					
Algae	<i>Gibsmithia dotyi</i>					x					
Algae	<i>Actinotrichia fragilis</i>					x					
Algae	<i>Amansia rhodenta</i>						x				
Algae	<i>Caulerpa racemosa var. turbinata</i>						x				
Algae	<i>Asperagopsis taxiformis</i>							x			
Algae	<i>Plocamium</i>								x		
Algae	<i>Amphiroa fragilis</i>								x		
Algae	<i>Asteromenia peltata?</i>								x		
Algae	<i>Lithophyllum</i>									x	
Algae	<i>Chaetomorpha</i>									x	
Algae	<i>aedoclathris,</i>									x	
Algae	<i>Tydemanina expeditionis</i>									x	
Algae	<i>Soliera</i>									x	
Algae	<i>Peysonnelia namoena</i>										X
Algae	<i>Condrophycus succisa</i>										X
Sponge	<i>Acanthella cavernosa</i>	x									
Sponge	<i>Pseudoceratina clavata?</i>	x									
Sponge	<i>Hippospongia</i>	x									
Sponges	<i>Axymissa</i>	x									X
Sponge	<i>Psammaplysilla</i>	x									
Sponge	<i>Jaspis</i>	x			x			x		x	
Sponge	<i>Diacarnus spinipoculum</i>		x								
Sponge	<i>Lamello-dysidea,</i>		x	x							
Sponge	<i>Spongionella</i>		x								
Sponge	<i>Astrosclera willeyana</i>		x								
Sponge	<i>Leucetta solida?</i>			x							
Sponge	<i>Dysidea</i>			x							
Sponge	<i>Pseudoceratina</i>			x					x		
Sponge	<i>Haliclona</i>			x							x

Phyllum	Genu/species	Ono ilau	Vatoa	Ogea	Namuka	Fulaga	Kabara	Totoya	Matuku	Vanua vat	Moala
Sponge	<i>Agelas</i>				x					x	
Sponge	<i>Axinellida</i>				x						
Sponge	<i>Aplysinella</i>				x						
Sponge	<i>Aka</i>				x						
Sponge	<i>Pseudoceratina verrucosa</i>					x					
Sponge	<i>Cribrochalina</i>						x				x
Sponge	<i>Coscinoderma matthewsii</i>						x				
Sponge	<i>Phyllospongia</i>						x				
Sponge	<i>Acanthella cavernosa</i>							x			
Sponge	<i>Ircinia</i>								x		
Sponge	<i>Dysidea arenaria</i>										x
Cnidaria	<i>Ellisella</i>	x									
Cnidaria	<i>Xenia</i>	x									
Cnidaria	<i>Sinularia</i>	x					x		x	x	
Cnidaria	<i>Sarcophyton</i>	x							x		
Cnidaria	<i>Rumphella</i>	x									
Cnidaria	<i>Briareum,</i>		x								
Cnidaria	<i>Cladiella</i>		x				x				
Cnidaria	<i>Melitheia,</i>			x							
Cnidaria	<i>Dendronephthya</i>			x							x
Cnidaria	<i>Scleronephthya</i>			x							
Cnidaria	<i>Rumphella suffruticosa</i>						x		x		
Cnidaria	<i>Acanthogorgia</i>						x				
Cnidaria	<i>Plumigorgia,</i>						x				
Cnidaria	<i>Nephtea</i>							x			
Cnidaria	<i>Paralemnalia digitiformis?</i>							x			
Cnidaria	<i>Sinularia flexibilis</i>							x	x		
Cnidaria	<i>Lobophytum</i>								x		x
Cnidaria	<i>Discosoma</i>								x		
Cnidaria	<i>Stephanogorgia</i>										x
Cnidaria	<i>Annella mollis?</i>										x
Cnidaria	<i>Menella</i>										x
Cnidaria	<i>Paraminabea</i>										x
Hydroidea	<i>Distichopora</i>		x								
Ascidian	<i>Polyandrocarpa polypora</i>			x							
Ascidian	<i>Distaplia</i>				x						
Bryozoan	<i>Triphyllozoon</i>			x							

Botanical and Vegetation Surveys

BY MARIKA TUIWAWA (IAS, USP) AND ARTHUR WHISTLER (UNIVERSITY OF HAWAII)

A botanical and vegetation survey of the Southern Lau Group was conducted from the 3rd July to 3rd August 2011. The survey team comprised Art Whistler (University of Hawaii) and Marika Tuiwawa (South Pacific Regional Herbarium (SPRH), University of the South Pacific (USP)); and assisted by Manoa Maiwaqa (SPRH, USP) and sometimes by researchers in other disciplines, such as Alivereti Naikatini (SPRH, USP) and Elia Naikoro (Fiji Museum), Binesh Dayal and Paula kamikamica (Fiji Department of Forestry). The purpose of the survey was to conduct a baseline survey of plants found in the islands visited and where feasible include the density and diversity of economically important plant species, the conservation status of known rare and threatened plant species and report on its current ecological status, and propose management measures for their conservation.

A total of 548 vascular plant species were recorded from 14 islands (including three island groups – Ono (visited all three islands), Namuka (two islands - visited both), Yagasa (visited all three islands) and Fulaga (visited only three islands)). The plant species is made up of 126 families comprising 405 genera. There were 22 undetermined species and eight families with indet genera (taxonomic work to determine the identity of these taxa is ongoing at the South Pacific Regional Herbarium). Poaceae was the largest family recording 49 species, followed by *Rubiaceae* (33 spp.), Fabaceae (32 spp.) and Euphorbiaceae (30 spp.). There were 85 single records from the islands surveyed with the volcanic island of Moala recording the highest with 48 species, followed by Matuku with ten species and the islands of Fulaga and Kabara recording eight species each. Out of the 85 single species recorded (native species) for some of the islands surveyed 26 species were new records for Lau Province and of these two species (*Asplenium multifidum* – a fern and *Stephania forsteri* – a creeper) were new records for Fiji.

A total of six vegetation types were observed during the survey. This included the Coastal Vegetation, Limestone Vegetation, Lowland Vegetation, Mangrove Vegetation, Swamp or Marshland Vegetation and, Secondary or Disturbed Vegetation. The three most commonly observed vegetation types were Coastal, Limestone and Disturbed or Secondary vegetation types where for most islands visited it covers more than 75% the entire island and this include almost all arable lands on the islands. These areas are either currently used for farming and/or human habitation or are left as fallows.

Some recommendations for further activities based on the results of the survey includes: reiteration of sites and potential sites warranting National Significance for conservation and these include Fulaga and Ogea Bay of Islands; Yanuya Island (Ono-I-Lau), Yagasa Cluster of Islands (all currently listed on the Preliminary List of Sites of National Significance for Fiji (Fiji's National Biodiversity Strategy and Action Plan (2007); Vuaqava, Ogea Levu, Ogea Driki, and Moala Islands Olsen et al. (2010); Fulaga, Namuka, and Tuvana-i-colo and Tuvana-i-Ra. Additional surveys to complement this preliminary work and management plans developed as soon as for these islands.

A comprehensive ethno-botanical survey be carried out as soon as with the traditional wood carvers and weavers of Southern Lau, in particular on Kabara, Ogea and Fulaga islands.

Mammal Survey of Southern Lau

BY NAIKATINI ALIVERETI (IAS, USP) AND TUVAREA TUAMOTO (BIRD LIFE INTERNATIONAL)

Nine of the twelve species of mammals present in southern Lau are of great significance as two are threatened with extinction and seven are significant invasive species.

The Pacific Sheath-tail Bat (*Emballonura semicaudata*) which is endangered is restricted to isolated locations with little human disturbance and relatively intact forest vegetation cover (Palmerim 2006; Esselstyn 2004). Only three caves were visited during these trip and *E. semicaudata* was detected in only one (Vanuavatu Island). On Vuaqava and Kabara islands the bat was observed and detected (bat detector) whilst carrying out night surveys. This species seems to be surviving well only on these two islands compared to the rest of the islands that were visited. Overall the Pacific Sheath-tail bat population in Southern Lau is threatened of becoming extinct.

The Samoan Flying Fox (*Pteropus samoensis*) which is listed as vulnerable was only recorded from the island of Ogea Driki. This island is an uninhabited island and most of the vegetation is still very much intact. Island groups like the Yagasa group, Kabara group and Fulaga also have similar systems with intact forests which are suitable for this species however it was not recorded.

The Pacific/Tongan Flying Fox (*Pteropus tonganus*) was the most common bat species observed in the Southern Lau. Ten roosting colonies were recorded in 10 of the 19 islands that were surveyed. This is a positive sign of how well this species is surviving in the Southern Lau Group. The largest roost was recorded in Ogea Driki with over a thousand bats. The forest systems remaining in the Southern Lau Group must provide suitable habitat with enough food for this species. Also since most of the roosts are located in intact forest systems on limestone islands there is less disturbance from humans due to the accessibility. The estimated population of this species in the Southern Lau is about 5000. The Yasayasa Moala group was under surveyed for this species considering the islands sizes, so there should be more roosts of this species in this group.

The two *Pteropus spp.* act as important dispersers of seed and ensure the survival of the native forest trees in Southern Lau. It is imperative that swift action be taken to conserve this bat species, in addition to conserving the native forest systems found on these islands. More work needs to be carried out in the future to confirm their presence or absence on the other islands of Southern Lau.

Of the 14 non-native mammals found in Fiji, 9 were recorded during the current survey of Southern Lau. Seven of these (domestic cattle, goat, pig, house cat, dog, Pacific Rat and Black Rat) are listed as 'significant invasive species on the islands of the South Pacific' (Sherley 2000). Their presence should be of great concern because these particular species can cause serious damage to native vegetation and ecosystems in both terrestrial and marine environments (Sherley 2000).

It is important to note that nine of the eleven species of mammals present in the Central Lau Group are of great significance as two are threatened with extinction and seven are significant invasive species. There is a great need to conduct more surveys in the region for the two threatened species of bats, set up management plans and conservation measures, and also carry out awareness programme with the local people in order to help conserve the remaining populations of these three bat species. Non-native mammals present in the Southern Lau Group need to be closely monitored and controlled if possible. Their introduction to other small islands needs to be restricted or prevented. It is recommended that all domestic animals are fenced and populations regulated.

BIBLIOGRAPHY

Esselstyn, J. A.; Wiles, G. J. and Amar, A. 2004. Habitat use of the Pacific Sheath-tail bat (*Emballonura semicaudata*) of the Aguiguan, Mariana Islands. *Acta Chiropterologica*, 6(2): 303-308, 2004.

IUCN. 2007. *2007 IUCN Red List of Threatened Species*. <www.iucnredlist.org>. Downloaded on 10 November 2007.

Palmerim, J. M., Champion, A., Naikatini, A., Niukula, J., Tuiwawa, M., Fisher, M., Yabaki-Gounder, M., Thorsteinsdottir, S., Qalovaki, S., and Dunn, T. 2006. *Distribution, Status and Conservation of Bats in the Fiji Islands*. Unpublished report.

Palmerim, J. M., Champion, A., Naikatini, A., Niukula, J., Tuiwawa, M., Fisher, M., Yabaki-Gounder, M., Thorsteinsdottir, S., Qalovaki, S., and Dunn, T. 2007. Distribution, status and conservation of the bats of the Fiji Islands. *Oryx*, 41(4): 509-519.

Pernetta, J. C. and Watling, D. 1978. The introduced vertebrates and native vertebrates of Fiji. *Pacific Science*, 32(3): 223-244.

Sherley, G. (Ed.) 2000. *Invasive species in the Pacific: A technical review and draft regional strategy*. South Pacific Regional Environment Programme (SPREP), Apia, Samoa.

Tarburton, M. K. 2002. Demise of the Polynesian Sheath-tail Bat *Emballonura semicaudata* in Samoa. *Micronesica*, 34: 105-108.

Williams, J. M. 1974. The ecology and behaviour of *Rattus* species in relation to the yield of coconuts and cocoa in Fiji. Unpublished PhD Thesis, University of Bath. In Sherley, G. (Ed.) 2000. *Invasive species in the Pacific: A technical review and draft regional strategy*. South Pacific Regional Environment Programme (SPREP), Apia, Samoa.

Southern Lau Natural Resource Awareness and Management Planning

BY AMELIA PEI (FIJI DEPARTMENT FISHERIES) AND SUNIA WAQAINABETE (FIJI DEPARTMENT OF FISHERIES)

Introduction

The Fiji Locally Managed Marine Area (FLMMA) network was part of the team that conducted natural resource awareness and management planning for ten islands within Southern Lau. The current status of natural resource management planning for the various islands is such that:

- *Tikina Ono* consisting of four villages and neighbouring island Vatoa had an existing development plan done in partnership with WWF with funding by Global Environment Facility small grant programme for Fiji under UNDP.
- *Tikina Totoya* consisting of four villages and neighbouring island Vanuavatu also had existing management plan done in partnership with the Department of Fisheries and Wildlife Conservation Society (WCS),
- *Tikina Moala* which consisted of a total of eight villages had existing management plan done in partnership with the Department of Fisheries and WCS.

As for the rest of the islands, they have never had any consultation with regards to natural resource management, but are adopting traditional methods to do conservation.

The overall goal of the awareness and planning workshop was to:

- Enhance the knowledge and skills of community members in marine conservation and practices by combining traditional and scientific knowledge.
- Improve and maintain a healthy marine environment for Southern Lau by developing natural resources management plans that will ensure protection and sustainable use of these resources.

The expected outcome of the workshop is the development of island based management plans and awareness and review of existing management plans through participatory exercises and engagement of all groups within the island (men's, women's, youth, school children) during the duration of the workshop in different islands.

Results

The workshop was planned for two days in all the Islands and for some exceptional cases evening sessions had to take place due to time constraints. The team consisted of a few partner organizations both from Fiji government and non-governmental organizations with a common goal of inspiring the community towards natural resources management for their future generations. The first day of the workshop focused on building capacity in terms of raising awareness within communities, thus encompassing the "ridge to reef concept", whereas the second day was mainly focused on development of management plans.

During the workshop participants were to also map out the distribution their natural resources according the following:

- **Coral Reefs:-** covering all habitats with fish and invertebrates, spawning sites, turtle nesting sites, existing *tabu* areas, whale and shark sites.
- **On land:-** overview of the island, different trees fruiting and non-fruiting trees, birds, animals, water sources, rivers and streams and different crops.
- **Village:-** village settings, rubbish dumps (if any), livestock area, plantation, school, existing village projects
- And also a look back by the elders of the status of the village now compared to past years (30-60 years back).

Overall the workshops saw the participation of approximately 400 participants across the ten islands. They provided a platform for sharing amongst community member, implementing partners and also relevant stakeholders who are involved in natural resource management covering the 'ridge to reef concept'.

Interestingly a few of the islands within Southern Lau have already set up Marine Protected Area without any consultation. For example in the island of Fulaga the community have decide on the harvesting of edible sea cucumber dairo (bech de mer) and kaikoso (bivalve) for subsistence use only.

From the management plan that were put together by the communities, threats identified that were common across all the ten islands included:

- Destructive fishing methods such as fish poisoning, undersize nets, night diving and use of rotenone from *duva* (derris roots),
- Over-exploitation of sea cucumber,
- Burning
- Harvesting of turtles and fish during breeding and spawning seasons
- Unnecessary cutting of trees including mangrove (logging)
- Damage done by livestock
- Insufficiency of clean water
- Lack of knowledge on marine resources.
- Soil erosion, the effects of waves and tides on shorelines, and flooding in villages.
- Pest and diseases like whiteflies and fruit flies on crops
- Drying up of water catchment/sources.

Communities then discussed possible solution to implement to help lessen the effects of threats to their community. Below is a summary of the list of solution common to ALL ten islands:

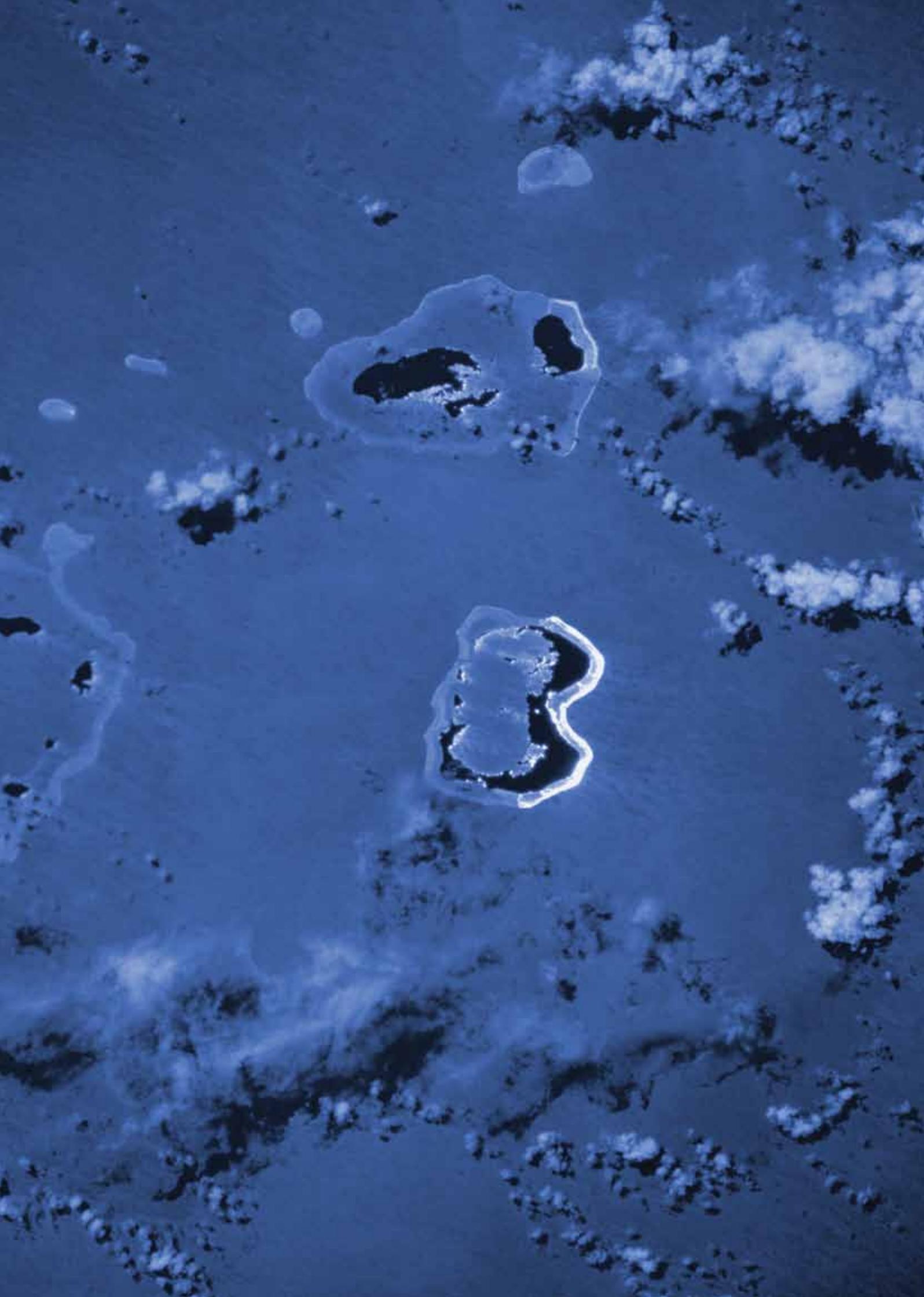
- Consolidating existing laws (Fisheries Act, Environment Act) and be made available to relevant stakeholders especially the communities.
- Replanting of trees especially fruiting trees. Communities to ask nearby villages for seedlings (if any) or request Agriculture Department.

- Enforcement on the use of appropriate fishing gear. Decision needs to be made by village councils and fish wardens who are responsible for enforcement.
- Fish Warden training by the Department of Fisheries and renewal of Fish Warden Licenses.
- Proper fencing of livestock within each village. This should be done as a village initiative.
- Empowering community through capacity building on the respective regulations/acts/decrees that associated with natural resources and communities to be responsible for enforcement.
- Replanting of littoral forests.
- Communities to opt for alternative livelihood sources to minimize pressure on beach de mer.
- Provision of village directive on the wise/proper usage of water.
- Sustainable harvesting of beach de mer.
- BAN the use of undersize nets, derris and night diving.
- More awareness on natural resource management.

Conclusion

To conclude community based adaptive management has been proven as a useful tool in terms of resource management. On most of islands the sooner the implementation process takes place the better. If actions are taken sooner rather than later more options and more time will be available to phase in changes if needed to adequately prepare these communities in addressing these issues.

Governance and/or **decision making** at ALL levels within the community are crucial and likewise FULL support for implementation process.



BIODIVERSITY CONSERVATION LESSONS LEARNED TECHNICAL SERIES

CEPF Large Grant Final Project Completion Report Rapid Biological Assessment Survey of Southern Lau, Fiji

Organization Legal Name

University of the South Pacific

Project Title

Rapid Biological Assessment Survey of Southern Lau, Fiji

Date of Report

MAY 2012

Report Author and Contact Information

Marika Tuiwawa and Prof. William Aalbersberg,
Institute of Applied Sciences,
University of the South Pacific,
Private Mail Bag,
Suva,
Fiji.

CEPF Region

Polynesia-Micronesia Hotspot

Strategic Direction 2

Improve management of key biodiversity areas

Grant Amount

\$58,000

Project Dates

1 February 2011 – 31 December 2011



Implementation Partners for this Project

Please explain the level of involvement for each partner

Ministry of Fisheries and Forests – contributed 22 personnel for the survey. They were involved in the fish stock assessment within the inshore fisheries, outer reef surveys, socioeconomic survey, timber tree survey and the locally managed marine area awareness and management process. The Ministry also provided a support vessel (MV Tuiniwasabula) and two skiffs and its crew (at no cost from the project except for fuels) during the entire survey.

NatureFiji-MareqetiViti – Provided personnel to lead the reptile survey with collaborators from USGS (1 person) and University of Kansas (1 person). The collaborators provided own funds for the survey.

Bird Life international – Provided and financially supported 3 personnel to carry out bird (terrestrial and marine/ocean birds) surveys. The partner provided own funds to do the surveys.

Fiji Museum – Provided personnel to carry out archeological surveys (cultural significant sites like burial caves, old village sites, fortress, gardens) on the islands visited.

Fiji Locally Managed Marine Area (FLMMA) network – Contributed and provided financial support for food allowance for own personnel (4 people) plus an officer from the provincial office to be the protocol officer for the Expedition. The team conducted a series of workshops on all the islands visited where a community based framework for the sustainable use of their natural resources was developed. This framework is the basis for the establishment of a community driven Marine Protected Area.

Ministry of Agriculture - Land-use and Biosecurity Fiji – The Ministry provided 3 personnel at their own cost to carry-out awareness training on the entire island visited. When not conducting awareness they would carry-out invasive species assessment and visit farmers in nearby villages from where the ships were anchored.

Conservation International (Fiji) - Provided a personnel (at own cost) to assist with the FLMMA work and off shore reef surveys.

World wild Fund for Nature Conservation (Fiji) – provided and financially supported personnel (one person) to carry out a turtle survey especially to create awareness and document nesting sites and a survey on the use of the animals as food.

Ministry of Health – Provided a nurse (at own cost) to assist with medical needs of the team.

Institute of Applied Science, University of the South Pacific (USP) – Drug Discovery Unit – provided financial support and 8 personnel to collect marine invertebrates and algae. With their collaborators from Georgia Tech University the group also assisted with some marine ecology assessment.

Institute of Applied Science, USP, – South Pacific Regional Herbarium – provided financial support and 4 personnel to do terrestrial work on mammals, Plants and vegetation ecology, and entomological work. A collaborator (botanist) from the University of Hawaii assisted the group with their work.

Conservation Impacts

Please explain/describe how your project has contributed to the implementation of the CEPF ecosystem profile

The survey will definitely strengthen the resolve to formally declare areas in Southern Lau already earmarked for protection of its biodiversity, and better management of its natural resources. This will also include other areas identified during this survey that would require protection.

In term of awareness (threatened species, unique landscapes and traditional/customary sites of national significance) this has been greatly elevated during the survey. Besides the formal workshops (FLMMA) and training (e.g. parataxonomy) that various members of the island communities were engaged in there were a lot more informal discussions that took place between community leaders and senior members of the expeditions. During these discussions the importance of the islands' biodiversity and more importantly the need to sustainably use them and also to protect them is discussed at length. This together with the presentation of the research findings at the next annual Lau Provincial Council Meeting, allows or provides the opportunity to maximize information sharing to the whole of southern Lau community. This latter meeting is where both the traditional and current (government appointed) leaders meet to discuss development plans for the entire province.

Please summarize the overall results/impact of your project against the expected results detailed in the approved proposal

See attached report summary (Part 1).

Planned Long-term Impacts - 3+ years (as stated in the approved proposal):

Natural resources, habitats and threatened species in the Southern Lau Group will be appropriately managed.

Actual Progress Toward Long-term Impacts at Completion:

Plans are in place for islands in the Southern Lau Group for future conservation and management of their natural resources. These include habitat mapping of terrestrial and marine resources (i.e. fish spawning areas, intact forest systems, IBAs, invasive species etc.).

FLMMA has indicated that they would have established an MPA on all habited Islands in the next 5 years.

Planned Short-term Impacts - 1 to 3 years (as stated in the approved proposal):

A most recent biological diversity and ecological report for Southern Lau is available that can be used to better manage current and future development in the various areas surveyed.

Actual Progress Toward Short-term Impacts at Completion:

- A full biodiversity report of the Southern Lau will be available to stakeholders in June 2012, coinciding with the Lau Provincial Council meeting.
- FLMMA: workshops carried out in the islands have drafted better management of the "qoliqoli" areas. This ties in with the work of the Department of Fisheries, Fiji in efforts for better management of the inshore fisheries resources.

- Department of Forestry, Fiji: Mapped forests systems of Southern Lau in efforts to set up forest reserves, management of exotic species (e.g. pine and mahogany wood lots on Ono-i-Lau, Namuka-i-Lau, Totoya, Moala), reforestation and aforestation projects on some islands and high value plant species (yasi - sandalwood) projects in Southern Lau.
- Department of Agriculture and Biosecurity, Fiji: Pest and disease surveillance for food security. Awareness on effects of pests/ introduced species. Land-use planning.
- Biodiversity: Conduct baseline, inventory of terrestrial and marine resources and identify islands of biological importance for future detailed biological investigations and conservation.
- Ministry of Fisheries, Fiji: Mapping of resource areas and rehabilitation. Raise awareness regarding fisheries plan and socio-economic surveys and conduct surveys to assess fish stock, especially spawning grounds for some important fish species.
- Important sites of cultural significance were assessed, mapped and documented for all islands visited. Most of these will be included in the directory of Cultural Sites of National Significance.
- Some of the only known primary coastal and limestone vegetation were visited during the survey and together with its landlocked seawater lakes (with little known aquatic fauna and flora) would be recommended to be part of Fiji's network of Protected Areas.
- All baseline data collected for future long-term management plans for Southern Lau group to conserve and sustainably manage natural resources.

Please provide the following information where relevant

- *Hectares Protected:* N/A
- *Species Conserved:* N/A
- *Corridors Created:* None as yet- assessment still at preliminary stages.

Describe the success or challenges of the project toward achieving its short-term and long-term impact objectives

Success: the baseline survey of Southern Lau group for terrestrial and marine resources completed within the planned timeframe of 1 month

Challenges: Logistics and management of the entire team (80 members) to cover 14 islands within 1 month; travel throughout 14 isolated islands where 40% of time was spent on inter-island travel; Captain of the main vessel passed away 1 week into the expedition; fuel was underestimated for the entire trip which required a re-order half way into the survey- fuel was mainly consumed by the outboard motors that transported people from the larger vessel to the island; keeping a balanced meal was not easy esp. vegetable supplies so supplements were taken via multivitamin C tablets and tinned stuff; water supply for the entire team on board was insufficient- water had to be rationed and because the Southern Lau group also has problems with their supply of fresh water, water had to be collected from rain; accessibility to some islands weren't easy, there weren't any boat passage and access depended on the tide thus not all islands were surveyed with an equal effort which was also affected by the adverse weather conditions.

Were there any unexpected impacts (positive or negative)?

The Captain of the vessel accidentally passed away which almost cancelled the expedition.

Project Components

Please report on results by project component. Reporting should reference specific products/deliverables from the approved project design and other relevant information.

Component 1 Planned: Organize and secure inter and intra-island transportation

Component 1 Actual at Completion: Completed

Component 2 Planned: Updated biodiversity information for Southern Lau

Component 2 Actual at Completion: In progress

Component 3 Planned: Reports

Component 3 Actual at Completion: In progress - June 2012

Were any components unrealized? If so, how has this affected the overall impact of the project?

No

Please describe and submit (electronically if possible) any tools, products, or methodologies that resulted from this project or contributed to the results.

Final report in progress and to be completed end of June 2012.

Lessons Learned

Describe any lessons learned during the design and implementation of the project, as well as any related to organizational development and capacity building. Consider lessons that would inform projects designed or implemented by your organization or others, as well as lessons that might be considered by the global conservation community.

Manage a smaller team on such an expedition so that more effort is spent on actual surveys rather than planning logistics; More background research of the sites before actual work e.g. water availability, accessibility to islands etc.; Involvement and the participation of relevant stakeholders i.e. govt. reps, scientific community, provincial council, local community.

Project Design Process: (aspects of the project design that contributed to its success/shortcomings)

The RAP survey was a success; it enabled the compilation of baseline data and checklist for different taxa within the short timeframe.

Project Implementation: (aspects of the project execution that contributed to its success/shortcomings)

The majority of team members of the survey were quite familiar with the RAP survey approach. Those that did not especially (individuals from other organizations) caused delays in the completion of their report.

Other lessons learned relevant to conservation community:

- RAP surveys on islands to cover both terrestrial and marine taxa in order to identify hotspot areas i.e. all taxa covered.
- Awareness to the community.
- Assist land owners set up their own management plans for sustainable development and use of natural resources.

Additional Funding

Provide details of any additional donors who supported this project and any funding secured for the project as a result of the CEPF grant or success of the project.

Donor	Type of funding*	Amount	Notes
Conservation International (Fiji)	Cash	900	Provided a person to assist with inshore fisheries assessment
	In-kind	1200	
Fiji Locally Managed Marine Areas	Cash	5000	5 personnel including a provincial rep. rations for trip
	In-kind	8000	
Institute of Applied Science, University of the South Pacific	In-kind	15000	Salaries and wages for 10 Scientific and technical personnel.
MacArthur Foundation	Cash	10000	For payments of equipment and consumables for the survey.
Natural Product Research-Bioprospecting, IAS, USP	Cash	24000	Equipment and supplies for the trip.
	In-kind	6000	
Georgia Tech University, USA	Cash	4000	Ration and per diems for 4 Scientific personnel
	In-kind	5000	
Ministry of Forest and Fisheries	Cash	10000	24 personnel and per diems for trip, and salaries and wages
	In-kind	8000	
Ministry of Agriculture	Cash	3600	4 Scientific personnel and ration for trip, and salaries and wages
	In-kind	2500	
Birdlife international	Cash	2700	3 Scientific personnel and ration for trip, and salaries and wages.
	In-kind	3000	
World wild Fund for Nature		900	A Scientific personnel and per diem for trip.
		1000	
USGS	Cash	900	A Scientific personnel and ration for the trip.
	In Kind	1500	
University Kansas	Cash	1800	2 Scientific personnel and cost of rations.
	In Kind	2000	
University of South Australia	Cash	900	Rations and per diem for Scientific personnel.
		1000	

*Additional funding should be reported using the following categories:

- A Project co-financing (Other donors contribute to the direct costs of this CEPF project)
- B Grantee and Partner leveraging (Other donors contribute to your organization or a partner organization as a direct result of successes with this CEPF project.)
- C Regional/Portfolio leveraging (Other donors make large investments in a region because of CEPF investment or successes related to this project.)

Sustainability/Replicability

Summarize the success or challenge in achieving planned sustainability or replicability of project components or results.

The documented (reports) outcome of the data collated and analyzed during the survey will provide the most recent and updated status of plants and animals found in the islands visited. It will also provide information on the status of the environment (both marine and terrestrial) for these rarely visited groups of islands. This is very useful information for development plans for this group of Islands.

Local personnel involved in the survey have now continued to carry-out other surveys of such nature in various parts of Fiji. This is especially true for personnel that work in various government departments.

Summarize any unplanned sustainability or replicability achieved.

The training workshop on sustainable use of natural resources continues to be followed in other sites provinces in Fiji since the Southern Lau expedition. The same applies for the biodiversity rapid survey where at least three RAPs have been planned for three provinces in 2012.

Safeguard Policy Assessment

Provide a summary of the implementation of any required action toward the environmental and social safeguard policies within the project.

N/A

Additional Comments/Recommendations

None.

Information Sharing and CEPF Policy

CEPF is committed to transparent operations and to helping civil society groups share experiences, lessons learned, and results. Final project completion reports are made available on our website, www.cepf.net, and publicized in our newsletter and other communications.

Full contact details:

Name: Marika Tuiwawa

Organization name: Institute of Applied Sciences, USP, Fiji

Mailing address: University of the South Pacific, Private Mail Bag, Suva, Fiji.

Tel: 679- 3232970

Fax: 679-3231534

E-mail: tuiwawa_m@usp.ac.fj

Performance Tracking Report Addendum

CEPF GLOBAL TARGETS

Provide a numerical amount and brief description of the results achieved by your grant. Please respond to only those questions that are relevant to your project.

PROJECT RESULTS	If relevant, provide your numerical response for results achieved during the annual period.	Provide your numerical response for project from inception of CEPF support to date.	Describe the principal results achieved from 1 February 2009–31 January 2010. (Attach annexes if necessary)
1. <i>Did your project strengthen management of a protected area guided by a sustainable management plan? Please indicate number of hectares improved.</i>	<i>Not relevant - aim of this RAP survey was to identify potential protected areas.</i>		
2. <i>How many hectares of new and/or expanded protected areas did your project help establish through a legal declaration or community agreement?</i>	N/A		
3. <i>Did your project strengthen biodiversity conservation and/or natural resources management inside a key biodiversity area identified in the CEPF ecosystem profile? If so, please indicate how many hectares.</i>		Ogea Is (site 78) 1350ha & Vuaqava (site 88) 990 ha	RAP for all terrestrial taxa and vegetation mapping in these two islands identify them as still being intact – will be proposed as protected areas.
4. <i>Did your project effectively introduce or strengthen biodiversity conservation in management practices outside protected areas? If so, please indicate how many hectares.</i>	<i>Not relevant- Initial stages of establishing marine protected areas.</i>		
5. <i>If your project promotes the sustainable use of natural resources, how many local communities accrued tangible socioeconomic benefits?</i>	<i>Awareness in progress in each island and the setting up/ development of management plans for sustainable use of resources.</i>		

TABLE 1 Socioeconomic Benefits to Target Communities

If your project provided concrete socioeconomic benefits to local communities, list the name of each community and place an X in all relevant boxes under Community Characteristics and Nature of Socioeconomic Benefit.

Name of Community/ Island (NB: only inhabited islands comprising 1-8 villages/ island)		Ono-I-Lau	Vatooa	Ogea	Namuka	Fulaga	Kabara	Moala	Matuku	Totoya	Total
		Community Characteristics									
Other											0
Communities falling below the poverty rate											0
Urban communities											0
Recent migrants											0
Pastoralists/nomadic peoples											0
Indigenous/ ethnic peoples		X	X	X	X	X	X	X	X	X	9
Subsistence economy		X	X	X	X	X	X	X	X	X	9
Small landowners		X	X	X	X	X	X	X	X	X	9
Nature of Socioeconomic Benefit											
Other											0
More participatory decision-making due to strengthened civil society and governance.			X	X	X	X	X	X	X	X	9
Improved use of traditional knowledge for environmental management			X	X	X	X	X	X	X	X	9
Increased access to public services, such as education, health, or credit								X			1
More secure sources of energy											0
Reduced risk of natural disasters (fires, landslides, flooding, etc)											0
Improved tenure in land or other natural resource due to titling, reduction of colonization, etc.											0
More secure access to water resources								X	X	X	3
Increased food security due to the adoption of sustainable fishing, hunting, or agricultural practices											0
Increased Income due to:	Payment for environmental services										0
	Park management activities										0
	Ecotourism revenues										0
	Adoption of sustainable natural resources management practices	X	X		X			X	X	X	6

**CONSERVATION
INTERNATIONAL**

Pacific Islands



BIODIVERSITY
CONSERVATION
LESSONS LEARNED
TECHNICAL SERIES

22