WCS

EBM FIJI ISLANDS

WILDLIFE CONSERVATION SOCIETY
FIJI COUNTRY PROGRAM 2015

FROM THE DIRECTOR

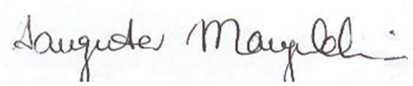
2015 has been a busy but fulfilling year for the Wildlife Conservation Society (WCS) Fiji Country Program, as we launched a number of fisheries initiatives including a Women in Fisheries Programme to support the economic empowerment of rural fisherwomen in Fiji.

Our management team has assisted the remaining districts in Bua Province come to the near completion of their ecosystem-based management plans, and the communities of Koro and Ovalau commence their island-based plans. WCS is now working closely with the Provincial office and district representatives to synthesize district plans into a single integrated coastal management plan for Bua Province building on the three pillars of environment, people and development.

In partnership with the Department of Fisheries, our science team developed new survey and analytical skills to understand the value chains of key invertebrate fisheries in Fiji. We also applied a new analytical framework called the Social-Ecological Systems Meta-Analysis Database to assess the ecological and socioeconomic impacts of locally managed marine areas and *tabu* areas in Fiji. Dr. Stacy Jupiter continued to lead complementary work to look at the impacts of periodic harvests from *tabu* areas which will be developed into guidance for best practice management that can be shared all across Fiji.

WCS continued to play a strong role on the Protected Areas Committee in 2015, and has been invited to join the BIOFIN Committee under the Department of Environment, and Fisheries Offshore Marine Reserve Committee under the Department of Fisheries. In the upcoming months, we will evaluate our conservation work to date and will formulate a new 5 year strategy for WCS-Fiji for launch in 2016, that feeds into a larger Melanesia Strategy. We will continue our commitments to integrated coastal management, ecosystem-based management at district and islands-scale, providing high-quality, scientifically-sound guidance on protected area management and policy, and fostering the enabling conditions for sustainable coastal fisheries management in 2016, while expanding our work on payments for ecosystem services.

On behalf of the WCS Fiji team, we look forward to continuing and strengthening our partnerships in country and the region, while exploring new opportunities for collaboration. We thank everyone for their support and look forward to a productive and inspiring 2016.



Sangeeta Mangubhai
WCS Fiji Director

THE WCS TEAM

Sangeeta Mangubhai, Director – Fiji Program

Dr. Sangeeta Mangubhai joined WCS-Fiji in 2014 as the Deputy Director, and was promoted in December to the Director's position. She has worked on marine science and conservation in Australia, East Africa, Indonesia and the South Pacific. She completed her Ph.D. in 2007 through Southern Cross University in Lismore, Australia, looking at reproduction and recruitment of corals in Kenya. Since then she has been working on designing marine protected areas, marine spatial planning, coral reef and invertebrate fisheries, environmental policy, and climate change. She is a specialist in designing monitoring programs to understand impacts of disturbances on coral reef communities, and the return of investment of conservation strategies. She is currently the Co-Chair for the Executive Committee for the Women in Fisheries Network-Fiji, a member of the Scientific Advisory Committee for the Phoenix Islands Protected Area, editor for the journal Pacific Conservation Biology, and an adjunct scientist with the New England Aquarium.

Stacy Jupiter, Director – Melanesia Program

Dr. Stacy Jupiter has been working with WCS since 2008, first as the Fiji Country Director and more recently as the Melanesia Director. After completing a Bachelor degree in biology at Harvard University, she worked as a U.S. Peace Corps volunteer in Gabon. Her Ph.D. research through the University of California, Santa Cruz focused on linkages between land use and downstream impacts to water quality and nearshore coral reefs, topics which she continued to develop as a postdoctoral fellow with the ARC Centre of Excellence for Coral Reef Studies in Australia. With the WCS Fiji team, Stacy has been working on assessing the effectiveness of marine protected areas to increase the abundance and size of food fish of importance to local communities. In addition, she is trying to integrate connectivity science into development of a national system of protected areas for Fiji to preserve ecosystem services, livelihoods and human health. She will continue to integrate these topics across the Melanesia, while initiating new WCS programs in Solomon Islands and Vanuatu.

Nischal Narain, Finance Manager

Nischal Narain joined WCS-Fiji in 2008 as Finance Manager. He holds a Masters degree in Business Administration (MBA) with University of the South Pacific. He previously worked with Pacific Theological College as Director of Finance and Administration and WWF South Pacific as Finance Manager. Nischal specializes in budget preparation, financial monitoring and reporting, cash flow, and cash forecasting. He looks after the after information technology and also involved in local corporate funding. He also helps to oversee the operations of the WCS-Fiji office.

Ruci Lumelume, Policy Advisor

Ruci Lumelume joined WCS-Fiji in 2015 as our Policy Advisor. Ruci is WCS' government liaison for WCS-Fiji, supporting the Fiji government in its international commitments and the development of new legislation and policies that address conservation and fisheries issues. Ruci has a Bachelor of Arts in geography, population studies and demography, and postgraduate degree in development studies from the University of the South Pacific. She worked previously for IUCN focusing on wetlands, and the Fiji Islands Trade and Investment Bureau.

Akanisi Caginitoba, Community Engagement Officer

Akanisi Caginitoba (Cagi) joined WCS-Fiji in 2002 working as an administration officer. Cagi led a livelihood project that built the capacity of women in Vanua Levu to run small businesses to produce *kuta* weaving, honey and virgin coconut oil. She is a specialist in community ecosystem based management planning, community leadership and assists communities identify and develop community projects. Previously, she was been part of the entomology team for Fiji arthropod survey initiated by the Schlinger Foundation. Cagi has also worked as a finance assistant for 3 years.

Waisea Naisilsisili, Field Officer

Waisea Naisilisili joined WCS-Fiji in 2003 as a field collector and now works as a project officer and is part of the biological survey team. Waisea has previously worked at the Fiji Mineral Resources as a research assistant collecting mineral samples. Waisea specializes in coral reef fish surveys and community catch monitoring. He is also a specialist in community engagement and is currently leading WCS' island planning process and community engagement in the Lomaiviti Province.

Kini Koto, Field Officer

Kini Koto previously worked for Wildlife Conservation Society from 2003 to 2006 before moving to Wetlands International-Oceania from 2007 to 2011. He completed a Diploma in Ocean Resource Management and Policies in June 2009, and is currently undertaking a Bachelor of Arts, majoring in Marine Affairs and Management. Kini has participated in terrestrial and freshwater water projects to designate areas for protection around the country, and liaised with communities on the establishment of the traditionally protected Waimanu Forest Reserve. He specialises in identifying freshwater fish, and has co-authored a description of a new fish species in Fiji (*Hippicthy's albumaculousus)*. Kini is also a specialist in community engagement and consultation.

Sirilo Dulunaqio, Community Liaison Officer

Sirilo Dulunaqio (Didi) joined WCS as a Community Liaison Officer in 2005. Previously Didi trained and work as a dive instructor. Originally from Kubulau, Didi provides a critical link between WCS activities and management implementation with the communities of Kubulau and adjacent districts, and provides technical and logistical support on biological surveys. Didi is now working with communities and dive operators in Ra Province to establish a marine protected area and a voluntary contribution to conservation scheme.

Margaret Fox, Conservation Officer

Margaret Fox joined the WCS-Fiji marine team in March 2010 as a conservation officer. She completed her Bachelor of Science degree in Marine Biology and Chemistry at the University of the South Pacific in 2002. She first joined WCS-Fiji in 2003 as a research assistant studying the distribution pattern of invasive vine, *Merremia peltata*. Since then she has worked as a Marine Biologist with Turtle Island Resort where she helped set up marine protected areas. Margaret's expertise includes coral identification, invertebrate identification, socioeconomic surveys, and community engagement and consultation. Margaret is overseeing WCS' women in fisheries programme.

Yashika Nand, Marine Scientist

Yashika Nand joined WCS-Fiji in 2010 as a Marine Scientist. She has graduated with her Post-graduate Diploma in Marine Science specializing in coral reef ecology and biology with emphasis in climate change from the University of the South Pacific in 2008. Previously she worked for the Department of Fisheries in Fiji as the lead coral researcher. Yashika manages all data from WCS' biological monitoring program, and helps integrate this into conservation planning in Fiji. Her expertise includes coral identification, coral health assessments, aquarium trade fishery and more recently value chain analysis of fisheries. She is currently doing a Masters in coral reef ecology, focusing on coral disease at the University of the South Pacific.

Dwain Qalovaki, Communication Officer

Dwain Qalovaki joined WCS-Fiji in 2013 with 9 years of experience as a marketing communications, project management, media and research professional across the private, public and non-government sectors. He has received specialist training in the area of development journalism, marketing, project management and digital communications both locally and abroad. Dwain is currently running a campaign to promote the Vatu-i-Ra Seascape and marine managed areas, and running WCS social media sites.

Ingrid Qauqau, GIS Officer

Ingrid Qauqau has been working with WCS-Fiji as a GIS officer since 2003. She graduated with a Bachelor's Degree in environmental science in 2002 from the University of the South Pacific. She specializes in general mapping, image analysis, remote sensing, spatial analysis, and habitat mapping. Ingrid is also a member of the GIS user forum of Fiji.

Gandercillar Vosaki, GIS/IT Support Officer

Gandercillar Vosaki joined WCS in 2012 as the Geographical Information Systems (GIS) and Information Technology (IT) support Officer. As part of the Fiji Program's Eco-health partnership with Edith Cowan University in Western Australia, Gander provides GIS support to investigate links between environmental change and water borne bacterial disease transmission and to build predictive models. She provides mapping support to the Vatu-i-Ra Seascape campaign and efforts to establish offshore marine managed areas.

COLLABORATING STUDENTS WITH WCS-FIJI

Rachel Dacks

Rachel is in the final year of her PhD at University of Hawaii. Her thesis is titled "Investigating the complexities of coral reef social-ecological resilience in Fiji". She has conducted household and fisher interviews across Fiji to better understand how marine resource use varies across a gradient of social, economic, and ecological conditions. She is supervised by Dr. Cynthia Hunter and advised by Dr. Stacy Jupiter.

Jordan Goetze

Jordan is in the final year of his PhD in Marine Ecology at the University of Western Australia in Perth. He is a specialist in the use of stereo-video methods to assess the benefits of periodically harvested closures to small scale fisheries across Fiji. His thesis is titled "The effectiveness of periodically harvested closures as a fisheries management strategy". He is supervised by Drs. Timoth Langlois, Shaun Wilson, Euan Harvey, Jane Prince and Stacy Jupiter.

Aaron Jenkins

Aaron is in the final year of his PhD at Edith Cowan University in Western Australia. His thesis is titled "Environmental determinants of Typhoid fever in Central Division, Fiji: refocusing the transdisciplinary lens." He is supervised by Prof. Pierre Horwitz, Prof. Adam Jenney and Dr. Stacy Jupiter.

Steven Lee

Steven is a Fijian in the second year of his Master of Science at University of Bremen in Germany. His thesis is titled "The ecosystem role of *Holothuria scabra*: impacts of farming and wild harvest on a Fijian reef flat." He is supervised by Dr. Sebastian Ferse, Prof. Christian Wild, Dr. Sangeeta Mangubhai, and Amanda Ford.

OUR 2015 INTERNS

Namrata Chand

Namrata has a Bachelor of Applied Science in Aquaculture and Fisheries from University of Otago in New Zealand. She completed a four month internship with WCS-Fiji assisting with the entry of fisheries data, and supporting a public campaign on the Vatu-i-Ra Seascape.

Harriet Davies

Harriet has a Bachelor of Science (Hons) in marine science from Murdoch University in Australia. She is currently doing an internship with WCS-Fiji to support marine spatial planning to identify potential offshore marine managed areas in the Vatu-i-Ra Seascape.

Camari Divuniwaqa

Camari completed a three month internship with WCS-Fiji assisting with the entry of socioeconomic data, translating district management plans and supporting a public campaign on the Vatu-i-Ra Seascape.

Emma Gernez

Emma has a Master of Arts in sustainable development and social science from the University of Pay and Pays de l'Adour in France. Emma completed a three month internship with WCS-Fiji, assisting with the entry and analysis of socioeconomic data from the Vatu-i-Ra Seascape.

Albert Manual

Albert is a graduate from University of the South Pacific. Albert completed a two month internship with WCS-Fiji, assisting with the entry of fisheries data, and supporting a public campaign on the Vatu-i-Ra Seascape.

Katie Miller

Katie Miller has a Master of Environmental Law from the University of Sydney. Katy completed a two month internship with WCS-Fiji, assisting with the entry of fisheries and socioeconomic data, the establishment of a photo database, and supporting a public campaign on the Vatu-i-Ra Seascape.

Sereima Rokoqiqi

Sereima has a Bachelor of Science in environmental science from University of the South Pacific. She is currently doing an internship with WCS-Fiji assisting with the entry of fisheries and socioeconomic data, supporting staff with community-based work, and helping with a public campaign on the Vatu-i-Ra Seascape.

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EXECUTIVE SUMMARY

The Vatu-i-Ra Seascape is an area of unique ecological value located between Fiji's two main islands that incorporate the four provinces of Bua, Ra, Lomaiviti, and Tailevu, their associated traditional fishing grounds and offshore channels. Wildlife Conservation Society (WCS) is working with a diversity of partners to preserve the functional integrity of Fiji's Vatu-i-Ra Seascape to sustain biodiversity, fisheries, and intact linkages between adjacent systems from land to sea, thereby enhancing social-ecological resilience to disturbance, and improving quality and abundance of marine resources for Fiji's people and economy.

This report highlights WCS Fiji Country Program's achievements from January to December 2015, under our three main themes of Science, Management and Communication. We also highlight our engagement with national and regional policy and planning, and the links to Fiji's national priority strategies under the NBSAP Implementation Framework 2010-2014, the National Climate Change Policy and Green Growth Framework, to enable governments and partners to assess progress towards national targets.

In 2015, WCS Fiji's scientific studies focused on:

- assessing the impact of periodic harvests of *tabu* areas on reef fish populations;
- investigating the links between environmental change and waterborne bacterial disease;
- understanding the links between local ecological knowledge, ecosystem services and resilience to climate change;
- monitoring the impact of the MacArthur Foundation's 10 year coastal and marine strategy;
- testing the effectiveness of Locally-Managed Marine Areas (LMMAs) in Fiji with the Social-Ecological Systems Meta-Analysis Database (SESMAD) framework; and
- conducting a value chain analysis of the sea cucumber fishery.

In our efforts to help strengthen community-based natural resource management in the Vatu-i-Ra Seascape WCS:

- continued to work with each of the nine districts in Bua Province on the development or implementation (for those completed) of district ecosystem-based management (EBM) plans;
- commenced an integrated coastal management plan for Bua Province, that builds on each of the nine district EBM plans;
- completed a number of management planning workshops with communities of Koro and Ovalau to support them design their island-scale EBM plans;
- strengthened the skills and capacity of local women in Bua Province to develop eco-friendly livelihoods around *kuta* weaving, honey and virgin coconut oil;

- supported local communities and tourism operators to explore opportunities to establish a voluntary contribution to conservation scheme around dive tourism, including the drafting of a management plan for the Vatu-i-Ra Conservation Area;
- launched a women in fisheries programme focused initially on mud crab fisheries in Bua Province; and
- commenced marine spatial planning with stakeholders in the Vatu-i-Ra Seascape to identify potential marine managed areas, that complement and support inshore areas, while reducing conflict between competing uses.

Our communication work focused on:

- building the foundation for a Vatu-i-Ra Seascape campaign, to support both inshore and offshore marine managed areas;
- hosting an art and photographic expedition at the Fiji Museum to showcase the Vatu-i-Ra Seascape;
- signing a Pacific broadcast deal with Fiji Television Limited (Fiji TV) to broadcast nature documentaries to 14 Pacific island countries free of charge;
- extensive screening of our 26-minute documentary 'Roots to Happiness' to a wide range of audiences; and
- eight new scientific publications, on a range of topics including shark movement patterns, methods to detect impacts of fishing within periodically harvested closures (*tabus*), marine spatial planning for protected areas, the recovery potential of the world's coral reef fisheries, and securing sustainable seafood from developing countries.

Lastly, WCS Fiji continued to maintain a strong presence on national committees and steering groups like the Protected Area Committee (PAC) and the Fiji Locally Management Marine Area (FLMMA) network to help achieve national objectives in biodiversity protection, protected areas, conservation planning, and sustainable fisheries. We end the year formally accepting membership on the newly formed BIOFIN Committee under the Department of Environment, and Fisheries Offshore Marine Reserve Committee under the Department of Fisheries.

SCIENCE

The following sections present a synthesis of completed and ongoing scientific activities by WCS and partners for 2015.

Assessing Impacts of Periodic Harvests on Reef Fish Populations

STATUS: In progress

FUNDING: David and Lucile Packard Foundation (2012-38137, 2014-39332)

PARTNER ORGANISATIONS: University of Western Australia (UWA), Fiji Locally Managed Marine Area Network (FLMMA), California Polytechnic State University San Luis Obispo (CalPoly SLO), The Nature Conservancy (TNC), ARC Centre of Excellence for Coral Reef Studies, James Cook University (ARC CoE), National Center for Scientific Research (CNRS)

OUTPUTS:

- *Journal article:* Goetze JS, Jupiter SD, Langlois TJ, Wilson SK, Harvey ES, Bond T, Naisilisili W (2015) Diver operated video most accurately detects the impacts of fishing within periodically harvested closures. Journal of Experimental Marine Biology and Ecology 462:74-82
- *Journal article:* Goetze J, Januchowski-Hartley F, Claudet J, Langlois T, Wilson S, Jupiter S (in review) Periodic closures are more effective at reducing fish wariness than increasing abundance or biomass. Proceedings of the National Academy of Sciences
- *Journal article:* Goetze J, Claudet J, Januchowski-Hartly F, Langlois T, Wilson S, White C, Weeks R, Jupiter S (in review) Demonstrating benefits from periodically harvested fisheries closures. Ecology Letters
- *Conference presentation:* Jupiter S, Goetze J, Carvalho P, Claudet J, Hamilton R, Januchowski-Hartley F, Langlois T, Weeks R, White C, Wilson S (2015) Can you have your fish and eat them too? Effectiveness of periodically harvested closures for achieving multiple objectives. 27th International Congress for Conservation Biology, Montpellier, France, August 2-6.
- *Conference presentation:* Carvalho P, Jupiter S, Januchowski-Hartley F, Goetze J, Claudet J, Langlois T, White C (2015) Periodically harvested closures: potentially optimal fisheries management strategies. 27th International Congress for Conservation Biology, Montpellier, France, August 2-6.

RESEARCH HIGHLIGHTS:

In recognition that periodically harvested closures (PHCs) have emerged as the most common management strategy within locally-managed marine areas (LMMAs) in much of the western Pacific, there is an urgent need to address the following questions:

- Under what harvesting regimes (frequency, intensity, duration) can PHCs be sustainably fished and what size do they need to be relative to the size of the LMMA to achieve both socioeconomic and ecological objectives?

- What are the appropriate indicators of when PHCs can be opened and when they should be closed?

From October 2012 to the present, Wildlife Conservation Society (WCS) has been leading research in Fiji to build credible, legitimate knowledge in order to provide guidelines to communities in the LMMA Network regarding optimum harvesting schemes for achieving ecological and socioeconomic objectives.

In 2015, WCS and our partners at UWA, CalPoly, TNC, ARC CoE and CNRS and have:

- Held a workshop in Albany, Western Australia to undertake a meta-analysis to evaluate under what conditions PHCs provide protection and harvest benefits;
- Developed bioeconomic models to investigate what harvesting regimes best optimize for multiple benefits from PHCs simultaneously; and
- Held a workshop in Big Sur, California, USA, to refine the meta-analysis, discuss parameterizing the bioeconomic model to empirical harvest data from Fiji, further develop publications, and draft an outline for a Phase III proposal to the Packard Foundation to translate the scientific findings into communications products that will ultimately improve the sustainability of fisher practice.

The findings to date from our research our highlighted below:

- The meta-analysis indicates that PHCs with high compliance can be effective at carrying more targeted fish biomass prior to a harvest than fished areas, and that they can be used as a fish reservoir for local communities during harvest events. The effectiveness of PHCs for providing a fisheries benefit to communities is greatest for large, old closures, where fishing pressure outside the PHC and harvest intensity inside is high. Meanwhile, short-term pulse harvest benefits are best achieved from larger PHCs protected for multiple years and then harvested intensively, with high fishing pressure outside during closure periods.
- Theoretical bioeconomic modeling, using a scenario where half of the LMMA is under PHC, indicates that optimization of multiple objectives is achieved from well-managed systems (fishing at maximum sustainable yield) when PHCs are closed for 1-2 years and then pulse harvested. However, in systems with overfishing (greater than maximum sustainable yield), the closure period needs to be longer than 2 years to allow for adequate build-up of targeted fish populations. In both of these scenarios, the pulse harvests should only occur during one year and then the PHC should be closed again.

NEXT STEPS:

- Submit publications on PHC work covering fish population recovery post-harvest and theoretical modeling.
- Calibrate theoretical bioeconomic models to on the ground conditions from 2 harvests from Nakodu Village PHC, Koro Island, separated by 1 year.

- Submit Phase III proposal to the Packard Foundation for focused work on communicating lessons to communities to improve the sustainability of PHC practice.

LINKS TO NATIONAL PRIORITIES:
NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Action 8.2a: Perform stock assessments of inshore fisheries. **Fiji Climate Change Policy Objective 5 (Adaptation), Strategy 5:** Support the ecosystem-based approach throughout Fiji, recognising that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience; and **Strategy 13:** Implement best practice adaptation measures, based on sound scientific research, and lessons learnt from local, regional and international experiences. **Green Growth Framework Thematic Area 3 (Sustainable Island and Ocean Resources)**: (i) develop a natural resource management system which is inclusive and integrated, and continue capacity building and awareness programmes with all communities, emphasizing supporting resource owners on the importance of proper environmental stewardship, (ii) government to continue to work with community and civil society on initiatives such as the establishment of marine protected areas and community based fish wardens.

Researchers collaborating on investigating periodically harvested closures gather in Albany, Australia, for the meta-analysis workshop.

Investigating links between environmental change and waterborne bacterial disease in Fiji

STATUS: In progress

FUNDING: Edith Cowan University Industry Linkage Grant

PARTNER ORGANISATIONS: Edith Cowan University (ECU), Ministry of Health, Massachusetts Institute of Technology (MIT)


Nerere a periurban area that has records of typhoid. ©Aaron Jenkins (left). Aaron Jenkins sampling water. ©Alanieta Naucukidi (right)

OUTPUTS:

- *Book chapter:* Jenkins AP, Jupiter SD (2015) Natural disasters, health and wetlands: A Pacific small island developing state perspective. In: Finlayson CM, Horwitz P, Weinstein P (eds), Wetlands and Human Health, Springer, pp 169-192
- *Journal article:* Brito IL, Yilmaz S, Huang K, Tamminen M, Smillie CS, Jupiter SD, Naisilisili W, Jenkins AP, Wortman JR, Birren BW, Singh A, Gevers D, Alm EJ (in review) Mobile genes in the human microbiome are structured at global, regional, and individual scales. Nature
- *Conference presentation:* Jenkins AP, Prasad N, Naucukidi L, Rosa V, Pravin S, Vosaki G, Kumar R, Cambemaiwai T, Kama M, Jenkins KM, Jupiter S, Crump JA, Mulholland EK, Horwitz P, Strugnell R (2015) An interdisciplinary study of typhoid fever in Central Division, Republic of Fiji. 9th International Conference on Typhoid and Invasive NTS disease, Bali, Indonesia, May 1.

RESEARCH HIGHLIGHTS:

WCS and our partners have taken two primary approaches to investigate how transmission of benign and pathogenic bacteria in humans may be related to environmental condition. In

January 2011, a pilot study (the Fiji Community Microbiome Study (FijiCOMP) was launched by Dr. Ilana Brito of MIT to identify the major routes by which bacteria are transferred in order to better understand how typhoid is spread across districts in Fiji. FijiCOMP was a pilot field study conducted in Bua and Macuata provinces to try to determine whether the microbiome, or the natural microbial flora inhabiting individuals' guts, skin and mouths, can be used to as sentinels, to map routes of bacterial transmission. The pilot study's two main goals were: a) to validate a technique used to investigate bacterial transmission; and b) to use this technique to evaluate the transfer of bacteria based on individuals' behaviors, demographics and locations.

Although it has taken several years, all of the data have now been analyzed and reveal that:

- ***The Fijian microbiome contains many uncharacterized species and genes.*** The microbiomes of Fijians are similar in composition to other developing world microbiomes, with a predominance of *Prevotella copri*, an organism associated with inflammation, and members of the Succinivibrionaceae family, a family of bacteria that produces the metabolite succinate. Succinate is considered an inflammatory metabolic signal whose accumulation in the gut has been shown to benefit the growth of *Clostridium difficile*, a life-threatening gram-positive pathogen associated with diarrhea.
- ***Transmission can be seen within households, rather than families.*** We hypothesize that bacteria showing social transmission (rather than familial) represents more recent associations between individuals, rather than past or inherited associations, although longitudinal studies may be necessary to confirm this observation.
- ***There was a surprising absence of endemic pathogens***. Despite our expectation to observe *Salmonella typhi* within individuals' gut microbiomes, only one person carried any *Salmonella* strain. Only one individual surveyed had *Shigella*. *Clostridium difficile* was observed in four individuals.
- ***Genes transferred amongst bacteria represent local pools of functional and antibiotic resistance genes.*** One of the major findings from FijiCOMP thus far has been the observation of distinct pools of mobile genes in the Fijian population as compared with the American population that is reflective of different selective pressures imposed by differences in diet and antibiotic use. One of the major questions that remains is how quickly these genes fluctuate within individuals, which could modify our expectations concerning the spread of antibiotic resistance.

A summary report of findings has been delivered to Ministry of Health and the Ministry of Education, in support of the requirements of Dr. Brito's research permit. The findings have also been submitted in a paper in review in the journal Nature. Potential follow-up activities include:

- Longitudinal microbial transmission study to determine the rates of transfer and the direct consequences of exposure;
- Environmental surveillance of microbes to examine the environmental routes for microbial transmission by surveying various environmental sources during different weather and environmental degradation conditions; and

- Assessment of typhoid susceptibility during a typhoid epidemic to surveil the local population for carriage, and microbiome composition to determine whether there are any patterns of susceptibility or determining whether individuals are symptomatic or not.

In the second study, WCS and Aaron Jenkins of ECU are taking a two-phased approach to investigate in particular factors associated with the emergence of past and present typhoid cases in Fiji. Under Phase I, a retrospective geospatial assessment of recent typhoid cases was completed to look for environmental correlates of typhoid incidence. All 168 typhoid cases from Central Division in 2013 were located to the place of residence where onset of fever occurred, and high proportions of cases from 2008 to 2012 have been spatially registered.

Under Phase II, Mr. Jenkins worked with the Ministry of Health and various collaborating researchers to undertake a comprehensive case-control study of typhoid cases presenting from 2014. Epidemiological surveys covering health histories and behavior were taken from presenting cases and two matched controls. Environmental samples (sediment, water) were taken from sources within and adjacent to case and control households and analyzed for concentrations of nutrients and *Escherichia coli* (an indicator of fecal contamination). Environmental samples were also collected and prepared for PCR extraction to attempt to isolate *S. typhi* from the environment, using a new method to detect *S. typhi* presence at low concentrations.

NEXT STEPS:

- Geospatial and case control data analysis presently being finalized and prepared for publication.
- PCR analysis of environmental samples to be done for environmental surveillance of typhoid from case and control sites.

LINKS TO NATIONAL PRIORITIES:

Fiji Climate Change Policy Objective 5 (Adaptation), Strategy 9: Build the capacity of the health and agriculture sectors to respond effectively to climate sensitive diseases, including the strengthening of disease surveillance and control systems, and early warning mechanisms for climate sensitive human and livestock diseases. **Fiji Ministry of Health Strategic Plan (2011 - 2015): Objective 2.3:** Reduce confirmed cases of typhoid by 75% by 2015; **Objective 2.7:** Reduce incidence rates of leptospirosis by 50% by 2015; and **Objective 7.1:** Increase the proportion of people with access to safe water.

Understanding the links between local ecological knowledge, ecosystem services, and resilience to climate change in Pacific Islands

STATUS: In progress

FUNDING: U.S. National Science Foundation (Coastal SEES # 1325874)

PARTNER ORGANISATIONS: University of Hawaii, Natural Capital Project - Stanford University, University of the South Pacific (USP)

OUTPUTS:

- *Conference presentation:* Ticktin T, Dacks R, Quazi S, Jupiter S (2015). Assessing resilience in ridge-to-reef landscapes in Fiji. 52nd Annual Meeting, Association for Tropical Biology and Conservation (ATBC), Honolulu, HI, July 12-16.
- *Conference presentation:* Dacks R, Ticktin T, Jupiter S (2015). Social drivers of ecological resilience in Fijian coral reef systems. Social drivers of ecological resilience in Fijian coral reef systems. 52nd Annual Meeting, Association for Tropical Biology and Conservation (ATBC), Honolulu, HI, July 12-16.
- *Conference presentation:* Dacks R, Ticktin T, Jupiter S (2015). Investigating drivers of ecological resilience in Fijian coastal communities. 23rd Hawaii Conservation Conference, HI, August 3-6.

RESEARCH HIGHLIGHTS:

This collaborative project with University of Hawaii focuses on social-ecological systems and resilience theory, and ethnobiology theory and methods related to local ecological knowledge (LEK), to model and test the relationships among LEK systems and indicators of adaptive capacity and social-ecological resilience to climate change in coastal Fijian communities. The project will also develop spatially explicit ecosystem service models that significantly advance the integration of cultural values as well as linked terrestrial and marine components to explore the effects of different land/ocean use and climate change scenarios on ecosystem services and indicators of resilience in selected Hawaiian and Fijian watersheds.

Rachel with her research team in Natokalau Village.

WCS and University of Hawaii researchers, along with USP students, conducted over 4 months of fieldwork (August to December 2014) in 20 villages across five regions on four islands of Fiji. The team completed: botanical/ecological surveys in 100 agroforests involving transects and plots to record species, cultivars and indices of ecological resilience; 100 interviews with agroforesters on forest and agroforest management and preparation for, and response to, natural disasters; 325 household interviews on livelihoods, traditional ecological knowledge (TEK), social networks, and socioeconomics; 100 interviews with fishers on

fishing effort, species and patterns of fishing; and focus group discussions, participatory mapping and interviews with village leaders in each of the 20 villages on management of villages resources, land-use history, connection to place, TEK, response to disasters, etc. The team also compiled the ecological data from coral reef surveys across the 20 villages collected by co-PI Jupiter and others.

Dr. Stacy Jupiter (co-PI) and local staff from WCS trained community members to carry out CPUE (catch-per-unit-effort) surveys, which were carried out over a period of 6 months in four of the five study regions. All the data were entered and coded by members of the team and are presently being analysed using structural equation models to investigation relationships between factors that may influence social-ecological resilience. Preliminary analyses have been presented at two major conferences (see Outputs above). Preliminary results were also presented back to each of the communities in September and October 2015 and each village was given a poster showing important characteristics of social-ecological resilience. A local artist has been commissioned to develop colouring books that feature local knowledge associated with natural resources that have particular cultural relevance during each calendar month of the year. WCS has been providing consistent advice and data to modelers from the Natural Capital Project and University of Hawaii to undertake working modeling how future land and climate scenarios will affect the provision of terrestrial and marine ecosystem services in Kubulau District, Fiji. The terrestrial and marine scenarios have been defined, data have been collated, and work is presently underway to carry out the modeling.

NEXT STEPS:

- Finalize colouring book and distribute to each of the 20 Fijian study villages along with summaries of the final data analyses
- Complete ecosystem service mapping for Kubulau District
- Develop publications to share the results from this project

LINKS TO NATIONAL PRIORITIES:

National Climate Change Policy, Objective 5 (Adaptation) Strategy 2: Include vulnerability assessment and climate change impact projections into resource management planning, such as integrated coastal and watershed management plans; **Strategy 4:** Develop adaptation technologies that take traditional knowledge into account and are culturally acceptable; and **Strategy 5:** Support the ecosystem-based approach throughout Fiji, recognising that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience. **NBSAP Implementation Plan Thematic Area 1 (Forest Conversion), Action 3.1b:** Integrate appropriate traditional knowledge and skills into training courses, **Action 3.2m:** Encourage and assist landowning and TFRO communities to document their traditional knowledge of biodiversity and its uses and develop their own local strategies. **NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Action 6.1a:** Collate marine traditional and local knowledge and make available upon request to traditional owners for management and educators to aid in curriculum development.

Testing the Effectiveness of Locally-Managed Marine Areas in Fiji with the Social-Ecological Systems Meta-Analysis Database Framework (SESMAD)

STATUS: Completed

FUNDING: David and Lucille Packard Foundation (#2014-40462)

PARTNER ORGANISATIONS: University of Victoria, Dartmouth College

OUTPUTS:

- *Journal article:* Jupiter S, Epstein G, Ban N, Mangubhai S, Fox M, Cox M (in review) A social-ecological systems approach to assessing conservation and fisheries outcomes in Fijian locally-managed marine areas. Conservation Biology.


Fishermen of Nakodu Village, Koro Island, hauling in a gill net (left) ©Emily Darling/WCS. Margaret Fox interviewing communities in Ovalau to test the SESMAD questionnaire (right) ©Stacy Jupiter/WCS

RESEARCH HIGHLIGHTS:

The overall goal of the one year project was to assess the social and ecological characteristics that influence social and ecological success of LMMAs where periodically harvested closures (*tabus*) are being used, to provide fisheries and conservation benefits to local Fijian communities. *Tabus* are one of the most commonly employed management tools by Pacific island communities, particularly in Fiji. While most LMMA communities express an interest in the long-term sustainability of fisheries, in practice, many communities use *tabus* within LMMAs as "banks in the water" to ensure a ready supply of fish and invertebrates for village events or fundraisers. There are, however, potential trade-offs between long-term sustainability and short-term cultural benefits, which depend on the magnitude of the catch of fish and invertebrates extracted for short-term interests. Although pulse harvests benefit fishers in the short term, they could increase the likelihood of resource depletion and sensitivity to social and ecological disturbances, thus compromising long-term ecological and socioeconomic objectives.

We applied a new analytical framework called the Social-Ecological Systems Meta-Analysis Database (SESMAD) to the study sites in Fiji. SESMAD was developed by 14 scientists from diverse backgrounds. The SESMAD project (http://sesmad.dartmouth.edu/) is intended to address questions about the ecological and social performance of alternative resource management and conservation approaches. Fiji data gathered from eight *tabus* from seven LMMAs provided an ideal opportunity to test whether the SESMAD framework yields critical new information about LMMA effectiveness, and whether involvement in real-time decision support has academic value to the SESMAD project. Key accomplishments achieved during this grant include:

- Identification of Fijian communities' main motivations for managing LMMAs, which enabled us to select appropriate outcomes variables (e.g., provisioning service potential, biodiversity conservation) against which we could evaluate management effectiveness;
- Identification of context-appropriate potential explanatory variables derived from SESMAD, and expert opinion;
- Quantitative and qualitative analysis of cases that revealed several key variables that we predict influenced *tabu* and LMMA outcomes, including: the presence/absence of clear physical and social boundaries; the presence/absence of monitors; congruence between decision making affecting *tabus* and their broader LMMAs; and whether rules (e.g., harvest frequency) were linked to the state of the resource base;
- An assessment of the utility of applying the SESMAD framework to LMMAs and its applicability for other small-scale fisheries systems.

NEXT STEPS:

- Scorecards on the status of the seven LMMAs and eight *tabu* areas with recommendations to improve their local management measures to be shared back to communities who participated in the study.
- Presentation to government and FLMMA practitioners to share the main findings of the project, and distribute report to partners.

LINKS TO NATIONAL PRIORITIES:

NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Action 8.2a: Perform stock assessments of inshore fisheries. **Fiji Climate Change Policy Objective 5 (Adaptation), Strategy 5:** Support the ecosystem-based approach throughout Fiji, recognising that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience; and **Strategy 13:** Implement best practice adaptation measures, based on sound scientific research, and lessons learnt from local, regional and international experiences. **Green Growth Framework Thematic Area 3 (Sustainable Island and Ocean Resources)**: (i) develop a natural resource management system which is inclusive and integrated, and continue capacity building and awareness programmes with all communities, emphasizing supporting resource owners on the importance of proper environmental stewardship, (ii) government to continue to work with community and civil society on initiatives such as the establishment of marine protected areas and community based fish wardens.

Value chain analysis of the wild caught sea cucumber fishery

STATUS: In progress

FUNDING: David and Lucille Packard Foundation (#2014-40154)

PARTNER ORGANISATIONS: Department of Fisheries

RESEARCH HIGHLIGHTS:

Fisher from Kubulau searching for sandfish (*dairo*) at low tide. ©Sangeeta Mangubhai/WCS

WCS and Department of Fisheries led Fiji's first comprehensive value chain analysis of the wild caught sea cucumber fishery (February to April 2015). Value chain analysis is a useful tool to understand the relationships and linkages between buyers, processors, sellers, and other service providers, to identify opportunities and constraints to industry growth and competitiveness in Fiji. This work was timely, given the Department has drafted a national management plan for sea cucumbers. Understanding the commercial aspects of the fishery is critical to implementing sound management at the community level. Sites were chosen across Bua, Caukadrove and Macuata provinces, as well as select villages across Viti Levu based on recommendations from the Department of Fisheries, NGOs and academics with experience working with the sea cucumber industry. Interviews were conducted with fishers, processors, middlemen, boat owners, restaurant owners, local market sellers and seven exporters. Results of the study were presented at the Northern Division Fisheries Forum in August 2015 in Labasa.

NEXT STEPS:

- A report has being drafted for review by the Department of Fisheries.
- Results of the value chain analysis will be formally presented to the Director of Fisheries, in partnership with a complementary ACIAR project led by Dr Steve Purcell from Southern Cross University on sea cucumber value-adding.
- Share results back with communities, middlemen and exporters.

LINKS TO NATIONAL PRIORITIES:

NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Action 8.2a: Perform stock assessments of inshore fisheries. **Fiji Climate Change Policy Objective 5 (Adaptation), Strategy 5:** Support the ecosystem-based approach throughout Fiji, recognising that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience. **Green Growth Framework Thematic Area 3 (Sustainable Island and Ocean Resources)**: (i) develop a natural resource management system which is inclusive and integrated, and (ii) implement a framework for inshore fisheries valuation.

Monitoring the impact of the MacArthur Foundation's 10 year coastal and marine strategy

STATUS: In progress

FUNDING: John D. and Catherine T. MacArthur Foundation (13-104090-000-INP)

PARTNER ORGANISATIONS: WCS offices in Melanesia, Indonesia, East Africa, Caribbean

OUTPUTS:

- *Report:* Mangubhai S, Nand Y, Fox M (2015) Fiji: A Baseline Assessment of Coral Reef Fisheries. Wildlife Conservation Society, Bronx NY USA.

RESEARCH HIGHLIGHTS:

Monitoring the effectiveness of conservation interventions is critical for adaptive management and provides the opportunity to evaluate components of successful fisheries management around the world (Fig. 1). WCS and our partners in key geographies are working to: (1) refine a global framework to monitor the impact of investments in coral reef fisheries management by standardizing methodologies and developing a coordinated database of monitoring indicators; (2) provide baseline "Year 0" assessments for priority geographies in the Western Indian Ocean, Melanesia, Indonesia, and the Caribbean; and (3) build capacity for coordinated monitoring and evaluation frameworks across each of the priority geographies. By bringing together global partners towards collaborative fisheries monitoring, we can provide information to assess the impact of investments made by the MacArthur Foundation's 10 Year Coastal and Marine Grant Making Strategy and identify successful fisheries management in a global context.

Baseline ecological and socioeconomic data was collected for 41 specific indicators at eight sites across four districts in three provinces in Fiji. The most recent biological monitoring was conducted between 2010 and 2014, using standard underwater visual census techniques, and represents 'Year 0' baseline data. Monitoring data were aggregated at the district (*tikina*) because *tabu* areas were established and agreed upon by districts, or because monitoring data were only available at the district level. Catch per unit effort surveys commenced in September 2014 to examine changes in fish catch over time, using trained community representatives. Three types of socioeconomic surveys were conducted between 2014 and 2015 at each of the eight villages – household surveys, community leader surveys, and compliance interviews. A fishers' focus group discussion was also held at each village to get a clearer understanding of the management at each site, including the size and location of *tabu* areas and the formal and informal rules developed by the communities for fisheries management.

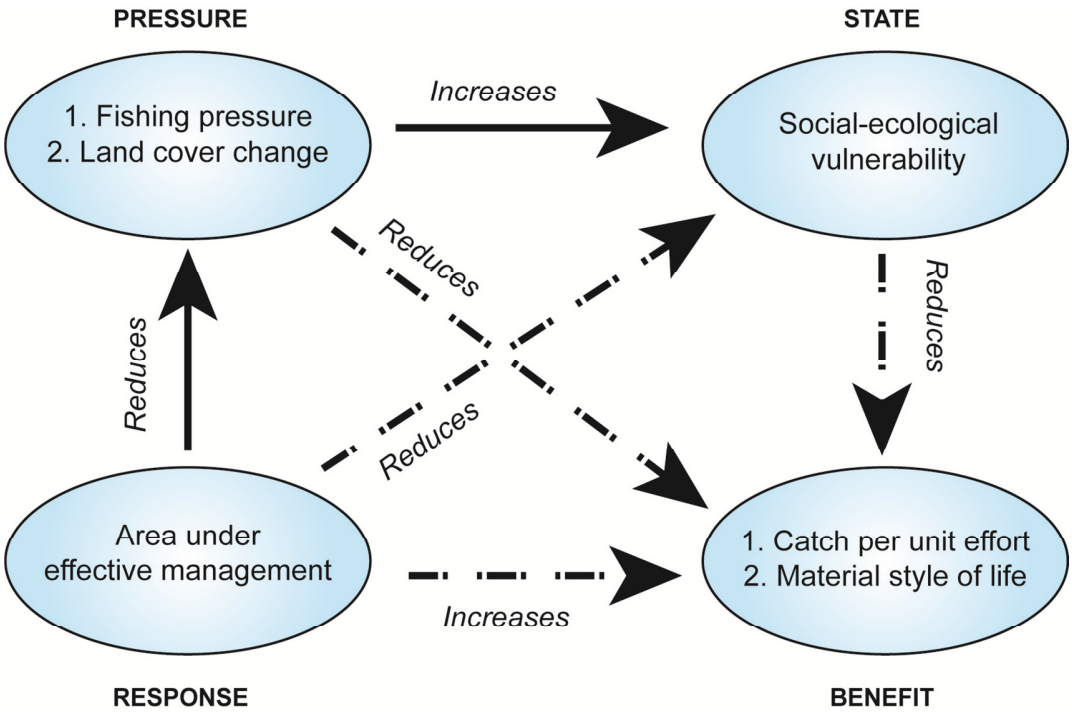


Figure 1. Core indicators proposed for measuring changes in pressure, state, response and benefits to assess progress against the MacArthur Foundation's long-term objectives for slowed decline of coastal fisheries productivity, reduced pressures on coastal systems, and improved social-ecological resilience to climate change impacts. Solid arrows indicate direct pathways; dotted arrows indicate indirect pathways.

NEXT STEPS:

- Review and fine-tune biological and socioeconomic indicators for monitoring
- Continue to share results back to local communities
- Analyse socioeconomic indicators, particularly relating to adaptive capacity of local communities, and finalise report

LINKS TO NATIONAL PRIORITIES:

NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Action 3.2b: Monitor core set of existing MPAs for biodiversity and fisheries resources compared with unmanaged sites; **Action 8.2a**: Perform stock assessment of inshore marine resources. **Green Growth Framework Thematic Area 3 (Sustainable Island and Ocean Resources)**: (i) develop a natural resource management system which is inclusive and integrated, and continue capacity building and awareness programmes with all communities, emphasizing supporting resource owners on the importance of proper environmental stewardship, (ii) government to continue to work with community and civil society on initiatives such as the establishment of marine protected areas and community based fish wardens.

Sixth Expedition to the Phoenix Islands Protected Area – Republic of Kiribati

STATUS: Completed

FUNDING: New England Aquarium, Woods Hole Oceanographic Institution (WHOI), Robertson Foundation, Prince Albert II of Monaco Foundation

PARTNER ORGANISATIONS: Government of Kiribati, SCRIPPS, WHOI


Sangeeta Mangubhai and Yashika Nand monitoring coral reefs in the Phoenix Islands. ©Craig Cook

OUTPUTS:

- *Report:* Mangubhai S, Rotjan R (2015) Phoenix Islands Protected Area Expedition 2015. New England Aquarium, Boston, USA.

RESEARCH HIGHLIGHTS:

The sixth multi-disciplinary scientific research expedition to the Phoenix Islands Protected Area (PIPA) took place from 1-30 September 2015. The purpose of this expedition was: (1) to continue long-term monitoring of the resilience of PIPA to coral bleaching; and (2) implement research that contributes to the 10-year PIPA research vision. Research projects focused on invertebrate diversity, health and connectivity of organisms within and between islands, and assessing current and historical reef resistance, resilience, and recovery to high thermal events. Reef health data were collected at fifty sites for corals, and sixty-one sites for fish. Photomosaic images were collected at fifty-one sites. Following bleaching in 2002-03 and again 2010, coral recovery was mixed throughout the islands, but overall, the coral community composition did not appear to have changed much from 2009 and 2012. Sites with low/ no recovery were instead dominated by filamentous algae and cyanobacteria, which is increasingly thought to correlate with iron pollution. Bleaching at all sites was assessed via transects, and early signs of coral bleaching were documented at all of the atolls and islands in PIPA. Surveys of coral disease revealed little/no signs of pathogenic infection. Overall the reef systems in PIPA were observed to be healthy, without the levels of disease typically documented on inhabited reefs.

NEXT STEPS:

- Preparation of three manuscripts for submission to scientific journal.
- Presentation of the results of the 2015 expedition to the Kiribati Government.

MANAGEMENT

The following sections present a synthesis of completed and ongoing activities that have strengthened and supported community-based natural resource management in Fiji.

Spreading Ecosystem-Based Management

Engaging districts of Bua Province

STATUS: Ongoing

FUNDING: John D. and Catherine T. MacArthur Foundation (13-104090-000-INP)

PARTNER ORGANISATIONS: Bua Provincial Council Office, Cakaudrove Provincial Council Office, iTaukei Affairs Board, iTaukei Lands and Fisheries Commission, SeaWeb Asia-Pacific, Bua Yaubula Management Support Team (BYMST), Fiji Locally-Managed Marine Area Network (FLMMA), University of the South Pacific - Institute of Applied Science (USP-IAS)

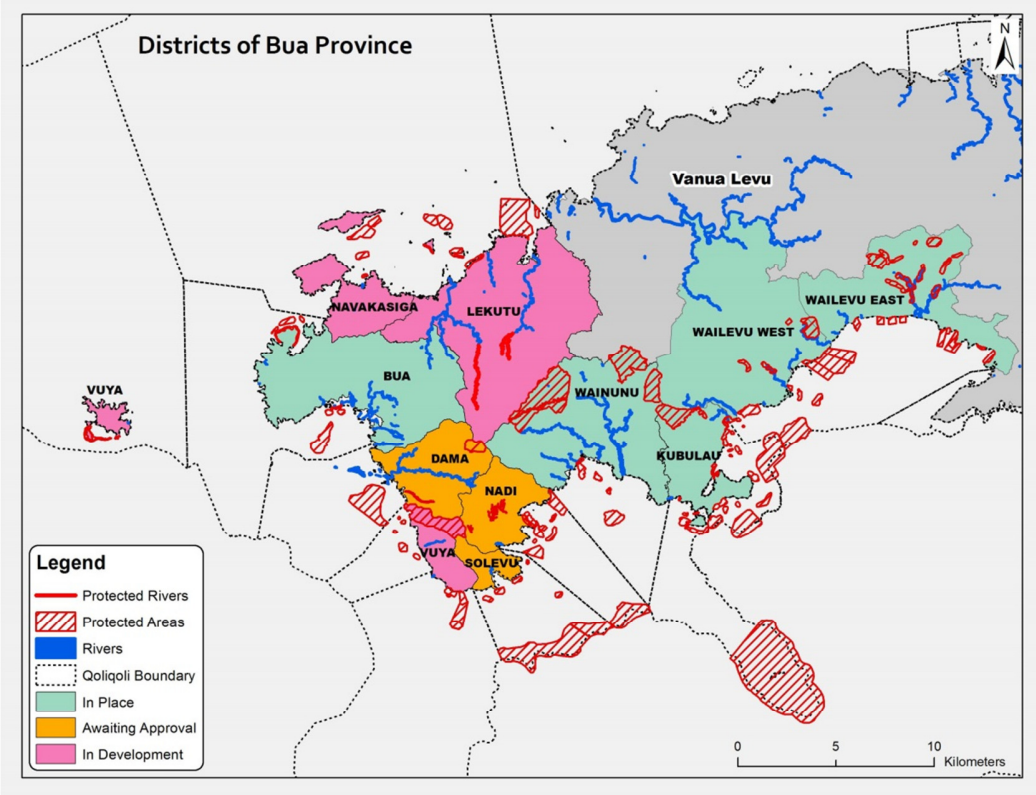


Figure 2. Current management status of districts in Bua Province.

HIGHLIGHTS:
Three districts have completed and are implementing Ecosystem-Based Management (EBM) management plans (Kubulau, Wainunu, Bua), three districts have drafted their plans and are awaiting approval (Dama, Solevu, Nadi), and the remaining three have finalised the content and are compiling a first draft (Lekutu, Navakasiga, Vuya) (Fig.2). Lekutu and Navakasiga share traditional fishing grounds, and have opted for a single shared EBM management plan. Management support workshops have been undertaken in all districts in Bua Province, to build and strengthen the capacity of Resource Management Committees (RMC) in district-level EBM planning and implementation. WCS has also been mentoring and supporting the Bua *Yaubula* Management Support Team (BYMST), which received its first small grant from the Global Environmental Facility (GEF) through the United Nations Development Programme (UNDP) to raise awareness on natural resource management, strengthen the capacity of BYMST and district representatives, and integrate districts plans into the Bua Provincial Integrated Coastal Management (ICM) Plan. This grant is a positive step towards the BYMST becoming more independent and therefore, less reliant on WCS for support.

WCS finalised a practical hands-on facilitator's guide to community EBM planning that can be applied at different scale scales in Fiji, including village, district and island. The process complies with Fijian traditional protocols, and highlights ways to empower local ownership of management plans, create open and transparent bottom-up planning processes, and promote effective co-management. The guide outlines each step in the planning process and provides facilitator notes for government officers, *Yaubula* Management Support Teams, *i-Taukei* Affairs Board appointed Conservation Officers, conservation practitioners, and communities. It incorporates good practices learned from FLMMA and WCS over the last 10-15 years.

LINKS TO NATIONAL PRIORITIES:
Implementation Plan Thematic Area 6 (Protected Areas), Strategy 2: Expand protected area network in priority sites at the national level and provincial level to achieve national targets, **Objective 2.2**: By 2014, develop management structures and implement paths to gazettal at highest priority sites, **Actions 2.2b-c**; and **NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Strategy 4**: Design new ecologically relevant inshore MPAs, **Objective 4.6:** By mid-2014, 25% of the communities will have established new management structures for new MPAs, **Action 4.6a:** Consult with communities at priority regions outside of existing MMAs to establish new MPA management structures. **Climate Change Policy Adaptation Strategy 5:** Support the ecosystem based management approach throughout Fiji, recognizing that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience. **Green Growth Framework Thematic Area 3 (Sustainable Island and Ocean Resources)**: (i) develop a natural resource management system which is inclusive and integrated, and continue capacity building and awareness programmes with all communities, emphasizing supporting resource owners on the importance of proper environmental stewardship, (ii) government to continue to work with community and civil society on initiatives such as the establishment of marine protected areas and community based fish wardens.

Island-scale planning in Lomaiviti Province

STATUS: Ongoing

FUNDING: John D. and Catherine T. MacArthur Foundation (13-104090-000-INP)

PARTNER ORGANISATIONS: Lomaiviti Provincial Council Office, YMST-Koro, YMST-Ovalau and Moturiki, I-Taukei Affairs Board (Conservation Officer)

Participants of the workshops at Koro Island. ©Waisea Nasilisili/WCS

HIGHLIGHTS AND NEXT STEPS:

Two management workshops were conducted on Ovalau Island and three on Koro Island in the Lomaiviti group in 2015. The workshops were attended by Government representatives from the Departments of Fisheries, Forestry, Environment and Agriculture, high chiefs for Koro, Ovalau and Moturiki Islands, the Lomaiviti Conservation Officer, Lomaiviti Youth Coordinator, and village spokesmen. Communities from the two islands each created visions for the most important ecosystems on their islands, such as forests, rivers, mangroves and coral reefs. These ecosystem visions were then combined into a single inspiring vision for each of the two islands. Both the communities on Koro and Ovalau have a solid understanding of EBM and the principles of management planning, have identified issues and threats to their natural resources, and started outlining potential management strategies for their respective islands.

The communities on Koro have reviewed their existing *tabu* area within their LMMAs, and identified sites for inclusion in the EBM plan for their island. *Tabu* areas were selected based (i) historical use, (ii) traditional ecological knowledge, and (iii) ease of enforcement. Through a transparent and participatory process, community representatives attending the second workshop have started to identify the rules for these areas. Over the next 2-3 months, these rules will be discussed further at the village level to get wider consensus, to ensuring long-term compliance by communities. The communities of Koro and Ovalau will complete their island EBM plans in 2016.

LINKS TO NATIONAL PRIORITIES:

NBSAP Implementation Plan Thematic Area 6 (Protected Areas), Strategy 2: Expand protected area network in priority sites at the national level and provincial level to achieve national targets, **Objective 2.2**: By 2014, develop management structures and implement paths to gazettal at highest priority sites, **Actions 2.2b-c**; and **NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Strategy 4**: Design new ecologically relevant inshore MPAs, **Objective 4.6:** By mid-2014, 25% of the communities will have established new management structures for new MPAs, **Action 4.6a:** Consult with communities at priority regions outside of existing MMAs to establish new MPA management structures. **Climate Change Policy Adaptation Strategy 5:** Support the ecosystem based management approach throughout Fiji, recognizing that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience. **Green Growth Framework Thematic Area 3 (Sustainable Island and Ocean Resources)**: (i) develop a natural resource management system which is inclusive and integrated, and continue capacity building and awareness programmes with all communities, emphasizing supporting resource owners on the importance of proper environmental stewardship, (ii) government to continue to work with community and civil society on initiatives such as the establishment of marine protected areas and community based fish wardens.

Participants of the community planning workshops at Koro Island. ©Waisea Nasilisili/WCS

Provincial-scale engagement

STATUS: Ongoing

FUNDING: John D. and Catherine T. MacArthur Foundation (13-104090-000-INP)

PARTNER ORGANISATIONS: Bua Provincial Council Office, iTaukei Affairs Board, Departments of Fisheries, Forestry and Agriculture, Bua *Yaubula* Management Support Team, SeaWeb

District representatives at the first ICM workshop in Savusavu. ©Kini Koto/WCS

HIGHLIGHTS AND NEXT STEPS:
The first ICM workshop for the Bua Province was held in July, 2015 in Savusavu. The workshop aimed to: (i) gain an understanding of ICM, and its relevance to Bua Province; (ii) review the progress of district EBM plans, and their contribution to the Bua Provincial ICM Plan; (iii) identify vision, goals, objectives, issues and strategies; and (iv) develop a governance body to oversee the implementing of the Provincial ICM Plan. A large focus of the workshop was identifying threats and issues that could not be addressed at village or district level that required provincial or national-level interventions. All available datasets and data layers were presented and shared. The most eye-opening part of the workshop for stakeholders was to see the scale of resource extraction that was earmarked for the province across the forestry and mining sectors, mostly without the knowledge of district heads. Participants discussed how an ICM for the province could help them achieve a better balance better protecting and maintaining key habitats and ecosystems, while still allowing for economic development. WCS will continue to work with the Bua Provincial Council to complete the Bua Provincial ICM Plan in 2016.

LINKS TO NATIONAL PRIORITIES:
NBSAP Implementation Plan Thematic Area 4 (Coastal Development) Strategy 1: Strengthen national guidelines for inter-sectoral coastal development, **Objective 1.3:** By 2014, a national coastal development plan to be developed to regulate/monitor coastal development activities; **Adaptation Strategy 5:** Support the ecosystem based management approach throughout Fiji, recognizing that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience. **Green Growth Framework Thematic Area 3 (Sustainable Island and Ocean Resources)**: (i) develop a natural resource management system which is inclusive and integrated.

Improving Effectiveness of Inshore Fisheries Management Systems in Fiji to Achieve Sustainable Ecological, Social and Economic Outcomes

STATUS: Ongoing

FUNDING: David and Lucille Packard Foundation (#2015-41007)

PARTNER ORGANISATIONS: Department of Fisheries, Fiji Environmental Law Association, Biospherics

Sea cucumber monitoring inside and outside *tabu* areas in Bua Province (left). Value chain analysis training ©Sangeeta Mangubhai/WCS

HIGHLIGHTS AND NEXT STEPS:
Our fisheries work focuses around three key objectives: (1) improving fisheries management systems by strengthening regulation of two commercially important species groups (sea cucumbers, mud crabs) and refining local size limits for key reef fish species; (2) supporting development of effective government legislative, policy, and management frameworks that provide the enabling conditions for sustainable inshore fisheries management; and (3) strengthening the governance of inshore fisheries through increased skills and institutional capacity for co-management. Key accomplishments achieved in 2015 are highlighted below:

Sea cucumber surveys: In-water sea cucumber surveys were conducted by WCS and Department of Fisheries at nine sites across four districts in Bua Province, using standardized protocols developed by the Secretariat of the Pacific Community (SPC). Sea cucumber diversity and densities were calculated for *tabu* and adjacent open fishing areas. There was no significant difference in sea cucumber densities between *tabu* and adjacent open fishing areas. Sea cucumber densities in community fishing grounds are too low to result in successful reproduction and recruitment. Diversity was also low, with less than 5 species recorded at most sites. The results of the stock assessment and the value chain analysis (see Science section) were shared with eight local communities during a "Sea Cucumber Roadshow" in August 2015.

Priority list of reef fish: In February, 2015, Department of Fisheries, WCS, WWF and USP-IAS staff met to identify 15-20 key vulnerable coral reef fish species important for subsistence and/or artisanal fisheries in Fiji that should be prioritised for targeted research for management. Five criteria were used to identify and prioritize reef fish species: (i) important both for consumptions and commercial purpose; (ii) culturally and socioeconomically important to local communities; (iii) priority species for Department of Fisheries; (iv) species with a critical ecological role on reefs; and (v) life-history patterns make them vulnerability to fishing patterns. Criteria (i)-(iv) were based on expert opinion, and information gathered through catch per unit effort surveys across Fiji. Vulnerability to fishing pressure was based on published "Vulnerability Indices".[1] For species where the vulnerability index was not available, the data were extracted from FishBase (http://www.fishbase.org/). A preliminary list of species was refined to 20 priority species that have vulnerability scores ≥ 30 and are caught in sufficient numbers in Fiji to potentially conduct assessments such as length at maturity.

Regional size limits: A review was conducted by Melanesia Director, Dr Stacy Jupiter to compare the size limits of reef fish in Fiji, with Australia, Samoa, Palau and Papua New Guinea. The review found some species, such as groupers had a lower size limit in Fiji (25cm) compared to for example, Australia (38cm). The size limit of lethrinids (or emperors) in Fiji, were consistent with other places (25cm). The size limits of parrotfish were 5cm lower in Fiji and other parts of the Pacific, compared to Australia. Interestingly, many of the surgeonfish and unicornfish had a higher size limit in Fiji (30cm) compared to Australia (25cm) and Samoa (20cm). Fish rulers were also produced based on the current legal size limit for fish in Fiji. These rulers will be distributed to each of the fisheries divisions in Fiji shortly, and provided to fish wardens that attend the 2016 training led by the Fiji Environmental Law Association (FELA).

Size at maturity assessments: Dr. Jeremy Prince delivered a 'training of trainers' workshop for in-country partners to assess maturation status of priority reef fish species. The main objective of the workshop is to build in-country expertise, so that Department of Fisheries, NGOs and university partners do not need to rely on external experts to do this work. Thirty-five participants were trained over a course of 3 days. In early 2016, WCS will start working with a select number of local communities, the Department of Fisheries and WWF to collect size at maturity data on 3-5 priority reef fish (identified abovementioned workshop).

Fish Wardens' Workshop: The enforcement of fisheries laws and regulations is challenging given the limited human and financial resources to support fisheries management, and the size of Fiji's inshore waters. A workshop was held with 50 fish wardens from the provinces of Bua, Macuata and Cakaudrove in August, 2015 in Labasa. The workshop provided the opportunity for dialogue and to strengthen working relationships between fish warden, Department of Fisheries and other enforcement agencies like the police. There were four main objectives: (i) increase understanding of the laws in Fiji in relation to fisheries management; (ii) identify what are the main challenges to enforcement within community fishing (*iqoliqoli*) grounds faced by

[1] Cheung WWL, Pitcher TJ, Pauly D (2005) A fuzzy logic expert system to estimate intrinsic extinction vulnerabilities of marine fishes to fishing. Biological Conservation 124:97-111.

fish wardens; (iii) discuss enforcement and management gaps and how they could be better addressed; and (iv) provide feedback on enforcement toolkit for Fiji. Issues and challenges were identified during breakout group discussions, and potential solutions were identified by participants. These included: provision of resources for fish wardens, improved training, developing clearer systems or lines of communication between fish wardens and enforcement agencies, and updating Fiji's fisheries laws, especially relating to the penalties.

Fisheries Forum: The Department of Fisheries in collaboration with WCS, WWF and Partners in Community Development (PCDF) hosted a fisheries forum for the Northern Fisheries Division in August, 2015. The forum was the first of its kind for Fiji, and brought together over 50 participants from government organizations, provincial office representatives, commercial fishers, exporters and middlemen, NGOs, and community members (including fish wardens). The goal of this forum was to share information, identify challenges and finding solutions collectively for the sustainable management and development of Fiji's coastal fisheries. It provided the opportunity to share results of fisheries assessments, inventories and new research, and the opportunity for focused dialogue on sustainable fisheries development. Information and discussions focused on 5 key topics relevant to the Northern Division: (i) sea cucumbers; (ii) aquaculture; (iii) endangered and threatened species; (iv) coral reef fisheries; and (v) enforcement. Gaps, issues and challenges were identified during breakout group discussions, and potential solutions were identified. These included: need for improved enforcement, better education and awareness on fisheries laws, updating legislation, and improving the fisheries licensing system for greater transparency.

LINKS TO NATIONAL PRIORITIES:
NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Action 8.2a: Perform stock assessments of inshore fisheries. **Green Growth Framework Thematic Area 3 (Sustainable Island and Ocean Resources)**: (i) develop a natural resource management system which is inclusive and integrated, and continue capacity building and awareness programmes with all communities, emphasizing supporting resource owners on the importance of proper environmental stewardship.



Workshop to assess size at maturity of reef fish. ©Dwain Qalovaki/WCS (left) ©Sangeeta Mangubhai/WCS (right)

Supporting women in fisheries as a strategy to strengthen and expand marine conservation in Fiji

STATUS: Ongoing

FUNDING: Flora Family Foundation (#2015-2694), David and Lucille Packard Foundation (#2015-41007)

PARTNER ORGANISATIONS: Department of Fisheries, Women in Fisheries Network-Fiji, FLMMA, Ministry of Women, Children and Poverty Alleviation

HIGHLIGHTS AND NEXT STEPS:

Fisherwoman from Daria Village catching mud crabs (left). ©Rebecca Weeks/WCS.

WCS launched its Women in Fisheries Programme, focused initially on the mud crab fishery in Bua Province. Mud crabs were selected because: (i) of growing concern about the number of undersize crabs being sold in markets; (ii) they are a high value commodity largely targeted by women in coastal areas; (iii) they provide an opportunity to highlight the importance of mangrove habitats for fisheries; and (iv) almost no work has been done on the mud crab fishery in Fiji. In October protocols were developed and tested for the value chain analysis survey, catch per unit effort logbook for women crab fishers, and for market surveys. Department of Fisheries and WCS staff conducted value chain analysis surveys in 18 villages across all 9 districts in Bua Province in November/December 2015. A preliminary assessment of mangrove habitats was also done at most of the sites to explore which methods will be used in early 2016 to assess the mud crab population density in a select number of mangrove forests.

LINKS TO NATIONAL PRIORITIES:

NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Action 3.2b: Monitor core set of existing MPAs for biodiversity and fisheries resources compared with unmanaged sites; **Action 8.2a**: Perform stock assessment of inshore marine resources. **Green Growth Framework Thematic Area 3 (Sustainable Island and Ocean Resources)**: (i) develop a natural resource management system which is inclusive and integrated, and continue capacity building and awareness programmes with all communities, emphasizing supporting resource owners on the importance of proper environmental stewardship. **Thematic Area 4 (Inclusive Social Development)**: increase women's capacity to participate in decision making and leadership at all levels to development (from village to national government) by 2018. **Fiji National Gender Policy**: 5.7 Gender Statistics and Research, 5.19 Leadership, Training and Development.

Supporting livelihoods and income generation

Livelihood development

STATUS: Ongoing

FUNDING: Flora Family Foundation

PARTNER ORGANISATIONS: Fiji Council of Social Services (FCOSS)


Participants during the beekeeping training in Kavula village. *Kuta* weaving by women in Dama district. ©Akanisi Caginitoba/WCS

HIGHLIGHTS:
Over the past three years, WCS has supported income generation projects for 76 women from 23 villages across seven districts in the Vatu-i-Ra Seascape, focusing on ecosystem-friendly income sources that benefit both people and conservation. In 2015, the women from Kavula had the opportunity to sell their honey at the European Union Expo in Suva, while the women from Dama district joined 600 other women artisans from rural communities across Fiji for the second National Women's Expo in Suva in October 2015. The theme of the expo was *Connecting Women to Markets: Make It Happen*. Over the three days the women made sold *kuta* products and had the opportunity to engage with community business women from across Fiji. WCS and the Fiji Council of Social Services (FCOSS) Microfinance Department also conducted financial literacy and basic business skills training for community representatives, including 25 women were engaged in beekeeping, *kuta* mat weaving, and virgin coconut oil production. During the financial literacy training the women discussed how to establish a culturally-appropriate profit-sharing mechanism in their village.

LINKS TO NATIONAL PRIORITIES:
By providing means to alternate revenue streams, this activity in principle supports **NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Strategy 2:** Promote biodiversity tourism. **Strategy 9**: Reduce demand for marine natural resources and biodiversity products. However, monitoring will be required to evaluate whether revenue is additive or alternative.

Sustainable financing for local community protected areas

STATUS: Ongoing

FUNDING: John D. and Catherine T. MacArthur Foundation (13-104090-000-INP), Secretariat for the Pacific Community (through USP-IAS)

PARTNER ORGANISATIONS: Ra Provincial Council, USP-IAS, Volivoli Resort, Wananavu Resort, Nai'a Cruises, SPC

HIGHLIGHTS:

Coral popular with divers in the Vatu-i-Ra Conservation Area. ©Lill Haugen

A series of meetings and workshops were held with local communities to draft a management plan for the Vatu-i-Ra Conservation Area. The most significant of these was a 2 day workshop for the district of Nakorotubu in Ra Province, which was attended by 40 participants from the district. The workshop had two aims. Firstly, to share information on the Namena Marine Reserve and reflect on process and key lessons learned in establishing and managing the reserve that would be useful to apply to the Vatu-i-Ra Conservation Area. Secondly, the participants provided inputs into the management plan for Vatu-i-Ra Island and surrounding reefs, including designating the boundaries of the proposed MPA. The representatives decided that island will be included in the management plan, as it has cultural and historical significance for the resource land owners, and is an important roosting site for nationally significant seabird colonies.

WCS facilitated a meeting on January 22, 2015, between the key dive operators, Volivoli Resort, Wananavu Resort, and Nai'a Cruises to discuss: (i) current threats to the coral reefs within the proposed MPA; (ii) the requirements of the dive industry to participate in a voluntary diver payment scheme, and their role and responsibilities; (iii) what an acceptable voluntary diver fee would be; (iv) what would be acceptable uses of any funds that are generated; (v) content of the management plan; and (vi) preliminary ideas on enforcement. Funding leveraged through the RESCCUE Fiji project will help support this work over the next 3 years.

LINKS TO NATIONAL PRIORITIES:
By providing means to alternate revenue streams, this activity in principle supports **NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), Strategy 9**: Reduce demand for marine natural resources and biodiversity products. However, monitoring will be required to evaluate whether revenue is additive or alternative. **Thematic Area 3 (Protected Areas), Strategy 3:** Develop sustainable finance mechanisms for new and existing protected areas. **Action 3.1d:** Ensure meaningful participation and provide equitable incentives and remuneration to resource owners for Protected Area establishment and management.

Offshore Marine Managed Areas: campaigning for the Vatu-i-Ra Seascape

STATUS: Ongoing

FUNDING: Waitt Foundation

PARTNER ORGANISATIONS: Department of Fisheries, Department of Environment, IUCN, WWF, Conservation International

Permanent Secretary for Fisheries and Forests, Mr. Inoke Wainiqolo opening the first spatial planning workshop. Eleni Tokaduadua, Principal Environment Officer for the Department of Environment (right), supporting the Vatu-i-Ra Seascape. ©Dwain Qalovaki/WCS

HIGHLIGHTS AND NEXT STEPS:

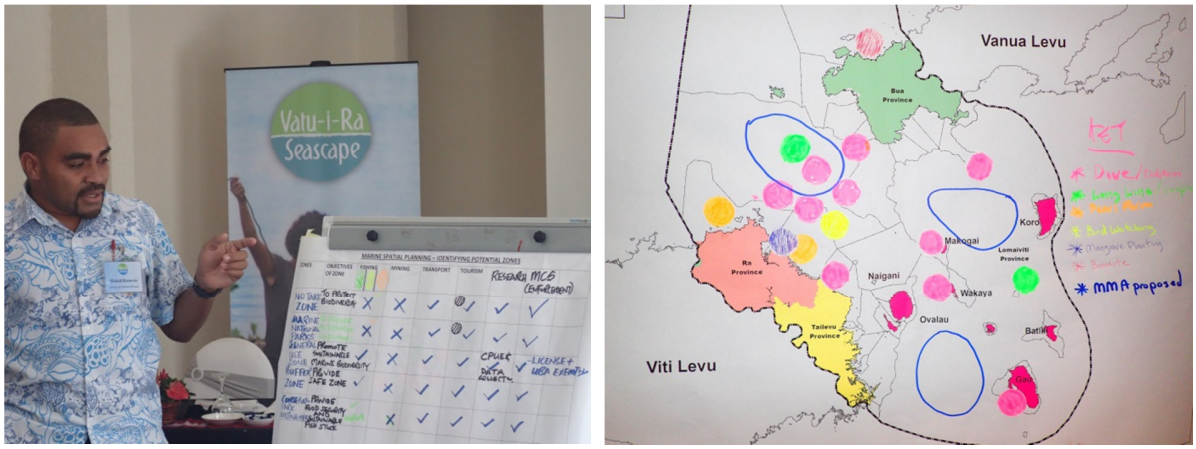
Two marine spatial planning workshops on the Vatu-i-Ra Seascape was held in July and December, 2015, at the Tanoa Plaza in Suva, with opening remarks by the Permanent Secretary for Fisheries and Forests. Both workshops were attended by over 30 representatives from government, senior officials from each of the four provinces, as well as those from the private sector and non-government organizations. The first workshop focused on developing a common understanding of Marine Managed Areas (MMAs) in the context of national policy and legislative frameworks, and mapping out important biological, ecological, social, and economic features in the Vatu-i-Ra Seascape. Participants also started to identify and map out possible areas in the Vatu-i-Ra Seascape that could be established as MMAs.

The second workshop focused on reviewing the proposed MMAs and their environmental, social and economic values, prioritizing the MMAs, and looking at potential zone configurations. The stakeholders at the workshop strongly requested that the ecological, social, and economic values of the Vatu-i-Ra Seascape should be protected, and that this should be a key recommendation to the Fiji Government. Next steps will be to prepare a document on the priority MMAs, their values and management, present the outcomes of the two workshops to the relevant technical and multi-sectoral committees under the respective ministries, undertake wider consultations with the private sector, and discuss with Department of Fisheries the process and opportunities for gazettal.

With the support of the Department of Fisheries, WCS contracted Dr. Veikila Vuki and regional fisheries expert, Mr. Robert Gillett, to conduct a review of offshore fisheries in the Vatu-i-Ra Seascape. Maps of key areas important to deeper water/offshore fisheries were developed for use in the spatial planning process to balance biodiversity conservation and sustainable fisheries use.

In partnership with the WWF and the National Protected Areas Committee, a consultancy has been issued to explore options for the sustainable financing of marine protected areas (MPAs) in Fiji. The key objectives of the study are to: (i) develop cost model for estimate the cost of implementing/managing MPAs in the Vatu-i-Ra Seascape, Great Sea Reef and Lau Seascape in Fiji; (ii) estimate what the cost of running a national network of MPAs would be; and (iii) identify existing and potential sources of long-term sustainable financing for a national network of marine and terrestrial protected areas, and their feasibility. The study was endorsed by the national Protected Areas Committee in May 2015, and was supported by other government, provincial and NGO stakeholders. This work will be completed in mid-2016.

LINKS TO NATIONAL PRIORITIES:
NBSAP Implementation Plan Thematic Area 6 (Protected Areas), Strategy 1: Identify gaps in biodiversity protection against national targets. **Strategy 2**: Expand protected area network in priority sites at the national level and provincial level to achieve national targets. **Green Growth Framework Thematic Area 3 (Sustainable Island and Ocean Resources)**: (i) develop a natural resource management system which is inclusive and integrated, and continue capacity building; (ii) establish deepwater MPAs targeting 30% of offshore areas by 2020.



First spatial planning workshop for the Vatu-i-Ra Seascape. ©Dwain Qalovaki/WCS

Kilaka Forest Conservation Area

STATUS: Ongoing

FUNDING: Harvey and Heidi Bookman

PARTNER ORGANISATIONS: Nadicake *mataqali*, iTaukei Land Trust Board (TLTB), Department of Forestry


Forest and freshwater streams in Kilaka. ©Ruci Lumelume/WCS (left), ©Kini Koto/WCS (right)

HIGHLIGHTS AND NEXT STEPS:

WCS has worked with the communities of Kubulau District, Bua Province, for over 10 years and has developed a strong working relationship with the Nadicake *mataqali* (clan) from Kilaka village that holds land tenure over the Kilaka forest. In 2006, the clan made a commitment to protect the forest on the land parcel over which they hold tenure for at least 10 years. Although not legally binding, this commitment included a promise not to lease the land for logging. In 2009 the management of this community-managed forest park was incorporated into the Kubulau District EBM plan. Although the forest area is a national priority for conservation, there is considerable and growing pressure to log the forest. WCS is working with I Taukei Land Trust Board and the Nadicake *mataqali* to explore options and opportunities to establish a forest conservation area over 402 ha of native forests. Protection of the forest would insure the intactness of the forest for future generations, maintenance of clean drinking water, protection of coastal reefs, and provision of a sustainable stream of revenue to landowners.

LINKS TO NATIONAL PRIORITIES:

NBSAP Implementation Plan Thematic Area 6 (Protected Areas), Strategy 1: Identify gaps in biodiversity protection against national targets. **Strategy 2**: Expand protected area network in priority sites at the national level and provincial level to achieve national targets. **Green Growth Framework Thematic Area 6 (Freshwater Resources and Sanitation Management):** Adoption of watershed management plans using integrated water resources management principles for major rivers, waterways and drainage systems.

COMMUNICATIONS: CAMPAIGNING FOR THE VATU-I-RA SEASCAPE

STATUS: Ongoing

FUNDING: Waitt Foundation


The President of Fiji, enjoying the art and photo exhibition on the Vatu-i-Ra Seascape (right). © Dwain Qalovaki/WCS. Kini Koto and intern Camari Kena, running in the Suva marathon in support of the Vatu-i-Ra Seascape. Photo ©Samuela Ulacake

HIGHLIGHTS:
The following sections present a synthesis of campaigns, completed and ongoing activities that WCS Fiji has undertaken to improve communication between our organization, community partners and external stakeholders.

Launch of website: In the first quarter, WCS formally launched the Vatu-i-Ra Seascape website http://fijiseascape.com/ which is the online hub for all content related to the campaign. The website hosted a range of stories on science (Seascape Science), community stories (Talanoa Seascape) and other conservation stories (Seascape Stories).

Photo competition: WCS also ran a nature photo competition which attracted over 300 images which will be used during the campaign to build support for the protection of the Vatu-i-Ra Seascape. Generous prize donations from industry partners included a five night's vacation at the renowned Volivoli Beach Resort and a day cruise for two to Tivia Island. The winning photos were exhibited at an art and photo exhibition in June, 2015. Over 30 Fijian artists showcased pieces that reflected the raw beauty of the seascape. The exhibition was opened by the patron of the arts, the President of Fiji in an effort to engage and inspire the general public, and begin a dialogue on the protection of the Vatu-i-Ra Seascape, as a national treasure.

Pacific broadcast deal: The region's largest broadcaster, Fiji Television Limited (Fiji TV) announced a first of its kind partnership with WCS to broadcast nature documentaries to 14 Pacific island countries free of charge. The documentaries will feature different types of

environmental issues that are relevant to the Pacific and two 15 second public service messages on the Vatu-i-Ra Seascape were produced to be broadcasted simultaneously.

Documentary screening: Throughout 2015, a 26 minute documentary 'Roots to Happiness' was distributed extensively to communities within the Vatu-i-Ra Seascape as well as played on inter-city and town transport company Sunset Buses (Fiji) Limited. It was also shown onboard Fiji's leading inter-island ferry service Patterson Brothers Shipping Company Limited and on visiting ocean cruise liners through Pacific Agencies (Fiji) Limited.

Suva marathon: In August, 2015 the South Pacific's biggest road race, the Suva Marathon selected the Vatu-i-Ra Seascape as one of its champion causes. For the event WCS engaged 60 prominent Fijians from the media, sports, and nature conservation sectors to show their support for the Vatu-i-Ra by running in seascape-branded gear.

In the media: Throughout 2015 Fiji Program engaged with the media to highlight conservation efforts through nine press releases which focused on the Vatu-i-Ra Seascape, marine spatial planning, fish size maturity, national marine priorities and typology for protected areas. This garnered coverage on print, radio, television and online media.

Communications partnerships: The Fiji Program has strengthened its partnership with SeaWeb's Asia Pacific Program, a communication specialist based in Suva, to get more stories from the seascape into print, radio, TV, and social media platforms in 2015. These included stories on spatial planning, offshore MMAs, integrated coastal management, community-based enforcement efforts, and fisheries.

Online presence: There are currently three websites which attracted 12,000 visits this year, 83% of which were unique visits predominantly from Fiji and 119 countries worldwide. This figure suggests that there is a growing number of Fijians outside the conservation sector that are accessing information on natural resource management.

Eco – adventures map: Following the production of a map that highlighted 33 sites that are generating revenue for communities, Tourism Fiji placed the online version of the map on its website as plans progress for an Android mobile application version which will be made available via Google Playstore.

New WCS logo: In November 2015, WCS launched its new logo as part of its 2020 plan to raise its visibility and increase its recognition as the leading wildlife conservation organization. Fiji rolled out the new brand identity and logo across all its communications platforms.

LINKS TO NATIONAL PRIORITIES:
This work supports **NBSAP Implementation Plan Thematic Area 5 (Species Conservation), Strategy 5:** Improved communication amongst stakeholders (including communities) on threatened and endangered species; **Strategy 4**: Share best practices and lessons learned to improve management effectiveness and governance.

ENGAGING WITH NATIONAL AND REGIONAL POLICY AND PLANNING

The following sections present a synthesis of ways that WCS Fiji has participated in development of national and regional conservation and resource management policies and planning in 2015.

Protected Area Committee

WCS participated in the four meetings of the Protected Areas Committee. Discussions in 2014 focused largely around the Fiji Government commitment to protect 30% of its seas by 2020, invasive species and the designation of new forest conservation areas. WCS-Fiji Director, Dr. Sangeeta Mangubhai was appointed the chair of the Marine Working Group for the Protected Areas Committee. The Marine Working group provided inputs and guided the development of a GEF PAS6 proposal on behalf of the Department of Environment, and guided the development of the agenda for the second typology workshop held in December 2015.

Fisheries Offshore Marine Reserve Committee

WCS has been invited by the Permanent Secretary for the Ministry of Fisheries and Forests to participate on a Fisheries Offshore Marine Reserve Committee. The Committee will be chaired by the Director of Fisheries.

BIOFIN Initiative Technical Advisory Committee

WCS has been invited to participate as a member of the Biodiversity Finance Initiative Technical Working Committee, under the Department of Environment. BIOFIN is a global project launched in October 2012 as a partnership seeking to address the biodiversity finance challenge in a comprehensive manner, to define finance needs and gaps with greater precision through detailed national assessments, to determine challenges and opportunities for resource mobilization and build a sound case for increased biodiversity investment. BIOFIN will support the government of Fiji review its policies and institutions relevant for biodiversity finance, determining baseline investment and assess the cost of implement NBSAP, and quantifying the biodiversity finance gap.

FIJI RELEVANT PUBLICATIONS AND RESOURCES 2015

Journal Articles

Ahmadia GN, Glew L, Provost M, Gill D, Hidayat NI, **Mangubhai S**, Purwanto, Fox HE (2015). Integrating impact evaluation in the design and implementation of monitoring marine protected areas. Philosophical Transactions of the Royal Society B. 370: 20140275.

Bond ME, Tolentino E, **Mangubhai S**, Howey LA (2015). Vertical and horizontal movements of a silvertip shark (*Carcharhinus albimarginatus*) in the Fijian archipelago. Animal Biotelemetry. 3:19: 1-7.

Goetze JS, **Jupiter SD**, Langlois TJ, Wilson SK, Harvey ES, Bond T, **Naisilisili W** (2015) Diver operated video most accurately detects the impacts of fishing within periodically harvested closures. Journal of Experimental Marine Biology and Ecology 462:74-82

Gurney GG, Pressey RL, Ban NC, Álvarez-Romero JG, **Jupiter S**, Adams VM (2015) Efficient and equitable design of marine protected areas in Fiji through inclusion of stakeholder-specific objectives in conservation planning. Conservation Biology DOI: 10.1111/cobi.12514

MacNeil MA, Graham NAJ, Cinner JE, Wilson SK, William ID, Maina J, Newman S, Friedlander AM, **Jupiter S**, Polunin NVC, McClanahan TR (2015) Recovery potential of the world's coral reef fishes. Nature 520:341-344

Mangubhai S, Wilson JR, Rumetna L, Maturbongs Y, Purwanto (2015). Explicitly incorporating socioeconomic criteria and data into marine protected area zoning. Ocean and Coastal Management. 116: 523-529.

Sampson GS, Sanchirico JN, Roheim CA, Bush SR, Taylor JE, Allison EA, Anderson JL, Ban NC, Fujita R, **Jupiter S**, Wilson JR (2015) Secure sustainable seafood from developing countries. Science 348:504-506

Selig ER, Frazier M, O'Leary J, **Jupiter SD**, Halpern BS, Longo C, Kleisner KL, Sivo L, Ranelletti M (2015) Measuring indicators of ocean health for an island nation: The ocean health index for Fiji. Ecosystem Services http://dx.doi.org/10.1016/j.ecoser.2014.11.007

Book Chapters

Jenkins AP, **Jupiter SD** (2015) Natural disasters, health and wetlands: A Pacific small island developing state perspective. In: Finlayson CM, Horwitz P, Weinstein P (eds), Wetlands and Human Health, Springer, pp 169-192

Reports

WCS (2015) A facilitator's guide for ecosystem-based management planning in Fiji. Wildlife Conservation Society. Suva, Fiji. (English and Fijian versions available)

Koto K, Kubunavanua E, **Dulunaqio S, Lumelume R, Qauqau I, Mangubhai S** (2015). Developing an Integrated Coastal Management Plan for Bua Province: Outcomes of the First Planning Workshop. Wildlife Conservation Society, Suva, Fiji. 23pp.

Davies H, Lumelume R, Vosaki G, Rokoqiqi S, Mangubhai S (2015) Exploring opportunities for establishing marine managed areas in the Vatu-i-Ra Seascape: second spatial planning workshop. Wildlife Conservation Society, Suva, Fiji, 27 pp.

Lumelume R, Vosaki G, Davies H, Mangubhai S (2015) Exploring opportunities for establishing offshore marine managed areas in the Vatu-i-Ra Seascape: first spatial planning workshop. Wildlife Conservation Society, Suva, Fiji, 21 pp.

WCS (2015) National prioritization of key vulnerable reef fish species for Fiji, for targeted research. Wildlife Conservation Society Suva, Fiji

Conference Presentations

Jenkins AP, Prasad N, Naucukidi L, Rosa V, Pravin S, **Vosaki G**, Kumar R, Cambemaiwai T, Kama M, Jenkins KM, **Jupiter S**, Crump JA, Mulholland EK, Horwitz P, Strugnell R (2015) An interdisciplinary study of typhoid fever in Central Division, Republic of Fiji. 9th International Conference on Typhoid and Invasive NTS disease, Bali, Indonesia, May 1.

Jupiter SD, **Darling E** (2015) A new framework for monitoring social-ecological vulnerability of coral reef fisheries in Pacific Island coastal communities. 52nd Annual Meeting, Association for Tropical Biology and Conservation (ATBC), Honolulu, HI, July 12-16.

Ticktin T, Dacks R, Quazi S, **Jupiter S** (2015). Assessing resilience in ridge-to-reef landscapes in Fiji. 52nd Annual Meeting, Association for Tropical Biology and Conservation (ATBC), Honolulu, HI, July 12-16.

Dacks R, Ticktin T, **Jupiter S** (2015). Social drivers of ecological resilience in Fijian coral reef systems. Social drivers of ecological resilience in Fijian coral reef systems. 52nd Annual Meeting, Association for Tropical Biology and Conservation (ATBC), Honolulu, HI, July 12-16.

Dacks R, Ticktin T, **Jupiter S** (2015). Investigating drivers of ecological resilience in Fijian coastal communities. 23rd Hawaii Conservation Conference, Hilo, HI, August 3-6.

Jupiter S, Goetze J, Carvalho P, Claudet J, Hamilton R, Januchowski-Hartley F, Langlois T, Weeks R, White C, Wilson S (2015) Can you have your fish and eat them too? Effectiveness of periodically harvested closures for achieving multiple objectives. 27th International Congress for Conservation Biology, Montpellier, France, August 2-6.

Carvalho P, **Jupiter S**, Januchowski-Hartley F, Goetze J, Claudet J, Langlois T, White C (2015) Periodically harvested closures: potentially optimal fisheries management strategies. 27th International Congress for Conservation Biology, Montpellier, France, August 2-6.