WCS

EBM FIJI ISLANDS

WILDLIFE CONSERVATION SOCIETY
FIJI COUNTRY PROGRAM 2016

FROM THE DIRECTOR

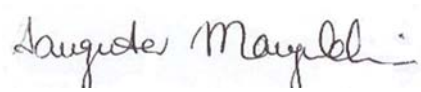
2016 has been a challenging year for Fiji, for the local communities we work with, and for the Wildlife Conservation Society (WCS) as an organization. On February 20, 2016, Fiji was hit by Category 5 Tropical Cyclone Winston. It was one of the largest cyclones the country had experienced and over a 24-hour period the cyclone left a trail of destruction. Some of the most affected by the cyclone were the 116,000 people that live in remote rural communities within the Vatu-i-Ra Seascape.

However, by diversifying our partnerships we were able to contribute positively to recovery and rehabilitation efforts in Fiji. On the request of the Ministry of Fisheries and in collaboration with local partners, we led assessments of the impact of Cyclone Winston on fisheries-dependent communities, on mud crab fishers, *tabu* areas and coral reefs. In partnership with the University of the South Pacific, the Climate Change Division, Lomaiviti Provincial Office and other government and NGO partners, we undertook an Integrated Vulnerability Assessment of Koro Island to contribute to relocation discussions to reduce communities' vulnerability to future disturbances.

We celebrated the launch of five ecosystem-based management plans for the districts of Vuya, Navakasiga, Lekutu, Solevu and Nadi. With the support of the Ministry of Forests we launched a management plan for the Kilaka Forest Conservation Area. In 2017, 402 ha of Kilaka Forest will be protected under a conservation lease agreement between WCS and *mataqali* Nadicake, in partnership with the *iTaukei* Land Trust Board. Working with the Ra Provincial Office, local communities and the tourism industry, we drafted a management plan and marine conservation agreement for the Vatu-i-Ra Conservation Park in Nakorotubu District.

WCS Fiji has maintained a strong presence on the Protected Area Committee, Integrated Coastal Management Committee, Fiji Locally Management Marine Area Network and Marine Protected Area Technical Advisory Committee, to help achieve national objectives in biodiversity protection, conservation planning, coastal management, sustainable fisheries and climate change preparedness.

On behalf of the WCS Fiji team, we look forward to continuing to work with our partners in Fiji, regionally and nationally, and support the Fiji Government co-host the high-level United Nations conference in New York, to support the implementation of Sustainable Development Goal 14, which aims to "conserve and sustainably use the oceans, seas, and marine resources for sustainable development."



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.

Upashna Prakash, Finance and Administration Officer

Upashna joined WCS in 2016 as Finance and Admin Officer, and supports the finance, administration and operations of the Fiji Country Program. She has a Post Graduate Diploma in Commerce from the University of the South Pacific (USP). She completed studies in Professional Development from the University of Southern Queensland, a Bachelor of Arts majoring in Accounting and Information Systems from USP and is currently pursuing her Masters in Commerce. She is a provisional member of the Fiji Institute of Accountants (FIA).

Jonah Vadiga

Jonah Vadiga joined WCS in 2016 as an Administration and Logistics Assistant. He has a Certificate in Business (General) and a Diploma in Business (Economics) from the Fiji Institute of Technology. Previously he worked with Musket Cove Island Resort and Marina Fiji as Human Resources Coordinator, and as a Technical Officer for the Chief Executive Officer of Investment Fiji. He has experience in human resources, administration and logistics.

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.

Kathy Chaston Radway

Dr Katherine Radway joined WCS-Fiji in 2016 as a Technical Advisor, providing technical and programmatic support on science, management and policy. Since completing her PhD in Marine Botany in 2001 from the University of Queensland, Australia, Kathy has worked on coral and catchment management, projects in Australia, American Samoa, Northern Mariana Islands, Federated States of Micronesia, Guam, Hawaii, and Palau. Before joining WCS, Kathy was the Pacific Team Lead and Watershed Specialist for NOAA's Coral Reef Conservation Program and a Coastal Specialist for NOAA's Coastal Zone Management Program, based in Hawaii.

Akanisi Caginitoba, Community Engagement Coordinator

Akanisi Caginitoba joined WCS-Fiji in 2002 as an administration officer and is currently the Community Engagement Coordinator. Akanisi led a livelihood project to build 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.

Isoa Koroiwaqa, Community Engagement Officer

Isoa Koroiwaqa joined WCS in 2016 as a Community Engagement Officer. Isoa has a Bachelor of Arts and Postgraduate Diploma in Tourism from the University of the South Pacific. Prior to joining WCS, he was with the travel company Rustic Pathways Fiji as the community service manager and with the Institute of Applied Sciences as a research assistant.

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.

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. 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 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.

Watisoni Lalavanua, Fisheries Officer

Watisoni joined WCS in 2016 as a Fisheries Officer. He has a Bachelor of Applied Science in Environmental Studies from Auckland University of Technology. Previously he worked with Partnerships in Community Development Fiji on climate change adaptation and disaster risk management, rural water security, food security and fisheries management, and was a junior fisheries scientist with the Pacific Community, supporting national fisheries in Tuvalu, Kiribati, Federated States of Micronesia (Pohnpei) and Papua New Guinea. He has experience in assessing status of fish, invertebrate and corals, socioeconomic survey and post-harvesting training.

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 support Officer. As part of the Fiji Program's Eco-health partnership with Edith Cowan University in Western Australia, Gander provided 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.

Kelera Varawa, Communication Officer

Kelera Serelini-Varawa joined WCS in 2016 as Communications Coordinator bringing with her wealth of experience in the media industry, public relations and strategic communications. She has undergone professional training in communication pertaining to human rights issues, environment journalism and strategic communications. Kelera is responsible for the coordination of WCS internal and external communications as well as the promotion of the Vatu-i-Ra Seascape, a campaign to build public support for the protection of land and sea between Fiji's two main islands.

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 a postdoctoral fellow on the Global Finprint Project, based at Curtin University in Perth, Western Australia. He was awarded a Niarchos Fellowship with WCS to facilitate collaborative research across 12 developing countries. Jordan's research focuses on the assessment of fisheries and conservation management strategies and the ecology of marine fishes. He specialises in the use of stereo video technology to sample fish assemblages and has been working with and developing this technology over the last ten years.

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

Krystelle Danford

Krystelle is doing a Master of Science at the University of the South Pacific on "Life history characteristics of two coral reef fish species in Fiji, Naso unicornis and *Siganus vermiculatus.*" She is supervised by Drs. Susanna Piovano, Sangeeta Mangubhai and Jeremy Prince.

WCS INTERNS AND FELLOWS 2016

Milena Kim

Born in Brazil, Milena has a PhD in Environmental Policy from James Cook University in 2015 and works in the interface between natural and social sciences. Milena completed an internship with WCS Fiji assisting with socioeconomic surveys to assessment conservation impact and marine conservation agreement initiatives.

Epeli Manu Loganimoce

Epeli has a Masters in Marine Biology and Ecology from the University of Porto in Portugal. Epeli is currently doing an internship with WCS-Fiji to implement socioeconomic surveys in Fijian villages to assess conservation impact and establish baselines for new payment for ecosystem service initiatives.

Lida Teneva

Born in Bulgaria, Lida Teneva has a PhD in Marine Ecology from Stanford University, and 10 years of experience in climate change science, coral reef science, ocean acidification science and policy, social-ecological systems, and seafood supply chains, acquired in Australia, Palau, Hawaii, Palmyra Atoll, Melanesia, and the Caribbean. Lida received a WCS award to assist WCS Fiji review the Namena Marine Reserve marine conservation agreement (MCA) and develop a monitoring and evaluation framework for MCAs and terrestrial payments for ecosystem services schemes. She is also a collaborator on the Ridge to Reef SNAPP Working Group.

Luke Uluiburotu

Luke has a Bachelor of Arts majoring in Geography and Marine Affairs from the University of the South Pacific. He joined WCS Fiji program as an intern in July 2016 and has been involved in multiple projects assisting with socioeconomic data collection, data entry and supporting logistics for field surveys.

Chloe Vandervord

Chloe has a Master of Science majoring in Protected Area Management from James Cook University in Australia. She completed an internship with WCS-Fiji assisting with post-cyclone impact and fisheries data analysis and report writing. She also supported the fisheries team with the 2016 Northern Fisheries Forum.

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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. The 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 2016, 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, Green Growth Framework and National Gender Policy, to enable governments and partners to assess progress towards national targets.

In 2016, WCS Fiji's scientific studies included:

- Assessments of the impact of Cyclone Winston on coral reefs, fisheries-dependent communities and mud crab fishers;
- An Integrated Vulnerability Assessment of Koro Island;
- Investigations into the impact of periodic harvests of *tabu* areas on reef fish populations;
- Investigations on the links between environmental change and waterborne bacterial disease;
- Understanding the links between local ecological knowledge, ecosystem services and resilience to climate change;
- Modeling land-based impacts on coastal fisheries;
- Assessing mud crab populations in mangrove forests in Bua Province, and conducting a value chain analysis of the fishery;
- Assessing the feasibility of sea anemone mariculture in Fiji to promote sustainable harvesting and local livelihoods for women; and
- Monitoring the impact of the MacArthur Foundation's 10 year coastal and marine strategy.

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

- Supported the five districts Lekutu, Nadi, Navakasiga, Solevu and Vuya launch ecosystem-based management plans that take a ridge to reef approach;
- Drafted a spatial plan and strategies for an integrated coastal management plan for Bua Province that brings together each of the nine district management plans;

- Supported the improvement of inshore coastal fisheries focusing on sea cucumbers, mud crabs and coral reef fish;
- Strengthen fisheries management in Fiji by implementing a women in fisheries focused initially on mud crab fishers;
- Supported local communities and tourism operators set up a voluntary contribution to conservation scheme around dive tourism;
- Completed marine spatial planning with stakeholders in the Vatu-i-Ra Seascape and identified two marine managed areas that complement and support inshore areas, while reducing conflict between competing uses.

Highlights from our communication work included:

- Up scaling our Vatu-i-Ra Seascape campaign to support both inshore and offshore marine managed areas;
- Hosting an art exhibit titled "Stronger than Winston - the Resilience of Nature and our People" with the Fiji Correctional Services at the Tagimoucia Gallery;
- Participating in a "Run for the Vatu-i-Ra Seascape" as part of the annual Suva Marathon;
- Sponsoring a young artist to develop a Vatu-i-Ra Seascape fashion line featured in the highly popular Fiji Fashion Week, making WCS the first to introduce conservation fashion on the catwalk;
- WCS featuring in over 50 articles on the environment, which has helped raise the profile of the work we do in the Vatu-i-Ra Seascape; and
- Eight new scientific publications, on a range of topics including sea cucumbers, relationships between catchment health and typhoid, periodic harvested closures, cetaceans, mangrove ecosystem services, and sharks.

Lastly, WCS Fiji continued to maintain a strong presence on national committees and steering groups like the Protected Area Committee (PAC), the Integrated Coastal Management Committee (ICMC), the Fiji Locally Management Marine Area (FLMMA) Network and the Marine Protected Area Technical Advisory Committee, to help achieve national objectives in biodiversity protection, conservation planning, coastal management, sustainable fisheries and climate change preparedness.

SCIENCE

The following sections present a synthesis of completed and ongoing science projects by WCS and partners for 2016.

Assessing the impact of Cyclone Winston on coral reefs

STATUS: Completed

FUNDING: Nai'a Cruises, Waitt Foundation

OUTPUTS:

- *Report*: Mangubhai S (2016) Impact of Tropical Cyclone Winston on Coral Reefs in the Vatu-i-Ra Seascape. Report No. 01/16. Wildlife Conservation Society, Suva, Fiji. 27 pp.

HIGHLIGHTS AND NEXT STEPS:

On 20 February 2016, one of the largest cyclones on record in the Southern Hemisphere passed through Fiji, with winds up to 185 mph, and gusts of 225 mph. Cyclone Winston left a trail of destruction, with some of the most impacted landscape and communities located in the Vatu-i-Ra Seascape. A rapid assessment of coral reefs in the Vatu-i-Ra Seascape was conducted from 6–15 March 2016 focusing on tourist sites, using rapid assessment techniques. The objectives of these surveys were to assess: (a) impact of Cyclone Winston on coral reefs in the Vatu-i-Ra Seascape; (b) extent and intensity of coral bleaching on corals; and (c) the health and diversity of areas being considered for inclusion in deeper water marine managed areas. Over 10 days, 26 sites were surveyed covering reef within and around the proposed Vatu-i-Ra Conservation Park in Nakorotubu District, Gau, Batiki and Wakaya Islands, the Namena Marine Reserve in Kubulau District, reefs in the Eastern Bligh Waters. Data were collected on benthic cover and coral bleaching, and observations of damage to coral reefs were recorded.

The surveys found that tropical Cyclone Winston not only altered landscapes and communities along its main pathway, but caused significant damage to coral reefs up to 20-30 m below the surface in the Vatu-i-Ra Seascape. Damage to coral reefs was highest in the north where the eye of the cyclone passed, and lowest in the south. However, the level of destruction was highly variable and patchy between reefs. There was no clear pattern to the damage, with both windward and leeward reefs equally impacted. There was extensive coral breakage, coral abrasion, dislodgement of large coral colonies and structural damage to the reef framework. While no data were collected on reef fish, there will likely be changes to fish species composition and biomass, especially in areas that sustained high coral and reef structural damage, like the Namena Marine Reserve. A reduction in corals and the reef structure will reduce the available habitat, which may make some species more vulnerable to predators.

Recovery from these types of disturbances, especially cyclones, can take decades, depending on frequency of these events, the scale and intensity of structural damage caused, and compounding anthropogenic stresses (e.g. pollution, overfishing) on coral reefs, that might

hinder or slow recovery. However, in additional to mechanical and structural damage, Fiji's reefs have the additional stress of coral bleaching. At the time of the surveys, the bleaching was mild and quickly dissipated after the cyclone. The ability of Fiji's coral reefs to persist and recover from Cyclone Winston and bleaching stress is dependent on a number of factors including the intensity, severity and frequency of the disturbance, successful reproduction, availability of viable larvae, oceanic current dynamics influencing larval dispersal, and settlement and recruitment processes.

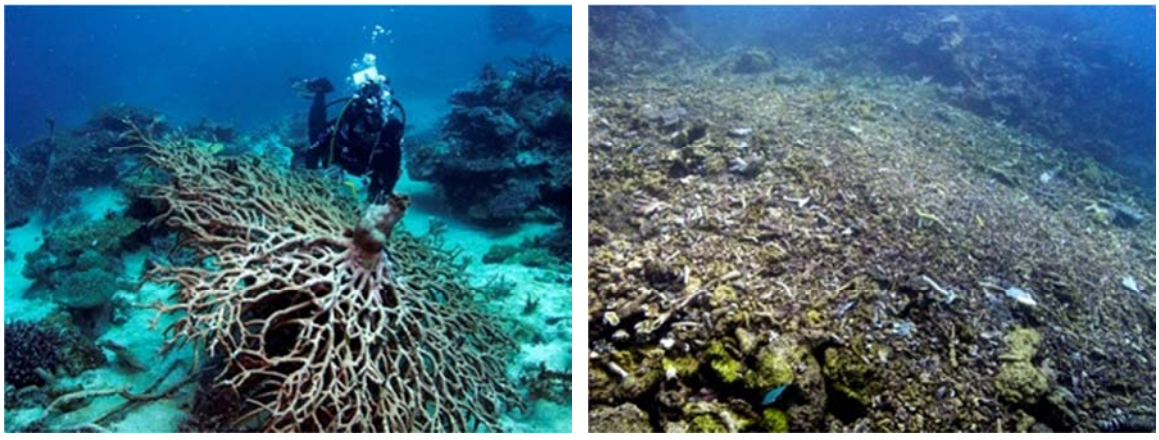
RECOMMENDATIONS:

Given the findings of the study, it is recommended that:

i) actions should be taken to minimize human-stresses to coral reefs (e.g. overfishing, pollution), especially areas that are heavily impacted;
ii) protection should be provided to coral reefs that were undamaged by the cyclone, as these will play a critical role in the recovery of adjacent more impacted reefs;
iii) more comprehensive assessments should be undertaken of coastal coral reefs to document the intensity and scale of damage, to determine the potential impact to local subsistence and commercial fisheries, and inform marine resource management decisions;
iv) data from assessments should be reviewed in parallel with fisheries data, Household Income Expenditure Surveys (HIES) and other socioeconomic surveys, to determine the impact of the cyclone on community food security and fisheries livelihoods; and
v) Lastly, monitoring programs be extended to measure the recovery of coral reefs over the next 2–5 years, and ensure they are linked to management actions.

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.



Damage to Namena Marine Reserve caused by Tropical Cyclone Winston. ©Jack & Sue Drafahl

The impact of Cyclone Winston on fisheries-dependent communities

STATUS: Completed

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

PARTNER ORGANISATIONS: Ministry of Fisheries, Fiji Locally Managed Marine Area Network (FLMMA), Coral Reef Alliance, Global Volunteers International (GVI), University of the South Pacific Institute of Applied Sciences (USP-IAS)

OUTPUTS:

- *Report:* Chaston Radway K, Manley M, Mangubhai S, Sokowaqanilotu E, Lalavanua W, Bogiva A, Caginitoba A, Delai T, Draniatu M, Dulunaqio S, Fox M, Koroiwaqa I, Naisilisili W, Rabukawaqa A, Ravonoloa K, Veibi T (2016) Impact of Tropical Cyclone Winston on Fisheries-Dependent Communities in Fiji. Report No. 03/16. Wildlife Conservation Society, Suva, Fiji. 105 pp.

HIGHLIGHTS:

On 20 February 2016, Fiji was hit by Category 5 Tropical Cyclone Winston. On the request of the Ministry of Fisheries, WCS developed a post-disaster socioeconomic questionnaire with inputs from Fiji-based partners, to assess the impact of Cyclone Winston on fisheries-dependent communities in Fiji and to inform national recovery and rehabilitation efforts. Specifically, the assessment aimed to:

i. estimate the impacts of Cyclone Winston on fishing infrastructure (e.g. boats, engines and gear) and provide a monetary estimate to government and donor agencies for recovery efforts;
ii. assess the communities' dependence on local fisheries to determine the impact on food security and livelihoods; and
iii. provide a transparent system for ranking impact to local communities to help guide the recovery and rehabilitation efforts of government and development agencies.

Surveys were conducted in April and May 2016 across 154 villages, 36 districts and 6 provinces that were directly along the path of the cyclone in Fiji. Surveys focused on coastal villages as we assumed that they would be more reliant on fisheries resources than inland villages, and thus most impacted on the larger islands. The only province that was not surveyed was Lau due to inaccessibility and challenges conducting the assessment.

The study documented the overall damages and losses to boats, engines, fishing and post-harvest gear, and to fish aggregating devices ranged from $205,578 to $954,581, and totaled $2,964,139. There were large differences in the losses and damages to boats and engines across districts and provinces, often based on their precise location within the cyclone impact zone. Individual districts recorded losses and damages were up to $93,481 for boats, and up to $151,834 for boat engines. One of the more dramatic impacts perhaps of Cyclone Winston is the sharp reduction in the number of times a week communities were eating fresh fish. Many

coastal villages ate fresh fish over 6 times a week pre-cyclone, and this decreased to less than 2.5 times per week post-cyclone.

With inputs from the Ministry of Fisheries and partners, a number of criteria were selected and scored to rank the impact of Cyclone Winston on fisheries infrastructure, livelihoods and subsistence within the surveyed districts. This approach provides a fair and transparent way to guide and target recovery and rehabilitation efforts to communities that suffered the greatest impacts and therefore in most need. The criteria selected for ranking were:

Impacts on the ability to restore fishing activities and livelihoods

- Proportion of boats and engines damaged and lost
- Proportion of fishing gear damaged and lost
- Proportion of post-harvest equipment damaged and lost

Dependency on fisheries for food security and livelihoods

- Percentage of households relying on fishing for subsistence (food security) pre-cyclone
- Percentage of households relying on fishing as main source of livelihood pre-cyclone
- Change in fish consumption (pre-cyclone to post-cyclone)

Based on the scored criteria the districts of Dawasamu, Nakorotubu, Mudu, Naiyalayala, Navitlevu, Raviravi, Bulu, Naweni, Navolau and Cawa were ranked the most impacted by Cyclone Winston.

RECOMMENDATIONS:

Twenty-one recommendations were provided to government and are summarized below.

Provision of replacement fishing gear

1) Target initial recovery efforts on replacing low-cost, low-impact gear (such as hook and line) to pre-cyclone levels, to promote food security and livelihood recovery.
2) Care should be taken to ensure that differences in the ownership and use of gear by women and men are taken into account and that distribution mechanisms also ensure that both men and women have equitable access to the gear provided.
3) The ecological impact of fishing methods as well as the condition of habitats should be considered when prioritising fishing gear for replacement.
4) Avoid providing impacted communities with more fishing gear and infrastructure than they had pre-cyclone.
5) Target boat and engine repairs and replacement in communities that have been significantly impacted by the cyclone**.**
6) Ensure that any deployment of Fishing Aggregating Devices (FADs) takes into account the boating infrastructure available to access the FAD.
7) Work through existing governance structures at the local and sub-national level (such as Provincial and Commissioner's offices) to complement national efforts to distribute fishing gear to ensure the involvement of trusted actors and reinforce the importance of good governance.

Livelihoods

8) For fisheries dependent communities a package of support is likely to be necessary to recover these livelihoods including boat and engine repairs, and fish gear supplies.
9) In some communities providing alternative non-fisheries livelihoods, in particular agricultural, may provide a faster opportunity to restore food security and help to reduce pressure on impacted fisheries resources.
10) Coordination between sectors, especially fisheries and agriculture, to avoid duplication of effort and to reduce the pressure on damaged habitats and impacted fisheries.
11) Ensure that there is adequate women's representation at all consultations, to enable them to articulate their needs and priorities separately, if preferred.

Food Security

12) The provision of low impact fishing gear can support a recovery of food security for fishing communities. Supporting the recovery of agricultural crops – through the provision of seeds and planting material – can also restore food security.
13) Support to restore food security should include nutrition awareness sessions to ensure that communities are aware of the higher nutritional content in locally grown and caught food, rather than relying on bought or processed food provided during the relief efforts.
14) A strategy to restoring the availability of fresh fish in schools should be developed locally.

Community Management

15) Guidance should be provided through the FLMMA network on sustainable fishing practices and the opening and closing of *tabu* areas to minimise conflict in local communities, while promoting local solutions to aid in the recovery of impacted habitats communities are dependent on for food and livelihoods.
16) Community, district and provincial natural resource and development plans should be complementary to each other and take into account future impacts from cyclones as well as from climate change to reduce the risk to local communities.

Prioritising and supporting recovery efforts

17) Tables in the report provide information on the most impacted districts based on the evidence gathered through these surveys. These should be used to guide where recovery efforts are most needed, and complemented with village level information.
18) Data from Lau were not available, and the Department of Fisheries and Lau Provincial Office should collect information from the province to ensure remote communities are not forgotten or neglected in the recovery efforts.
19) Complementary in-water surveys should be done to provide accurate advice to communities on the condition of habitats and fisheries resources, to ensure sufficient management measures are in place to ensure the recovery of these resources.
20) The PDNA estimates ongoing production losses from Cyclone Winston will continue to 2021. In order to give the resource a change to recover, commercial fishing licences should be restricted to areas not impacted by the cyclone.
21) Data collection systems should be developed for the fisheries sector to ensure the impact from future disturbances and natural disasters are taken into consideration.

LINKS TO NATIONAL PRIORITIES:

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. **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.

Damage to fishing-dependent communities caused by Cyclone Winston. ©FLMMA (top), WCS (bottom)

The impact of Cyclone Winston on mud crab fishers in Bua Province

STATUS: Completed

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

PARTNER ORGANISATIONS: Ministry of Fisheries, FLMMA

OUTPUTS:

- *Report:* Vandervord C, Fox M, Nand Y, Veibi T, Dulunaqio S, Mangubhai S (2016) Impact of Cyclone Winston on the Wild Caught Mud Crab Fishery in Fiji. Wildlife Conservation Society. Report No. 04/16. Suva, Fiji, 17 pp.

HIGHLIGHTS:

A socioeconomic questionnaire was conducted from April–May, 2016 to assess the impact of Cyclone Winston on the mud crab fishery in Bua Province 2–3 months after the cyclone, and provide recommendations for government and development partners on where recovery and rehabilitation efforts should be directed. To compare the pre- and post-cyclone responses of fishers, the majority of the questions asked were identical or complementary to a value chain analysis questionnaire implemented in late 2015. The questionnaire provided a quantitative approach designed to obtain information on mud crab dependency and how mud crab fishing activities, such as site, catch and fate of mud crabs had changed since the cyclone. It also examined price changes, the ability of fishers to sell mud crabs, as well as the impact of the cyclone on mangrove habitats and fisheries infrastructure.

Across the 8 districts, 51.5% of mud crab fishers stopped fishing, with notable differences between districts 2–3 months following the cyclone. For example in Kubulau District all fishers stopped collecting mud crabs, compared to Lekutu where only 30% of fishers had stopped. Damage to infrastructure and collection sites (i.e. mangroves and crab holes) were the main reasons given for fishers to stop collecting mud crabs. Other reasons included bad weather, the presence of a mangrove *tabu* area, illness or being busy with village repairs following the cyclone. For those that were collecting mud crabs stated they had recommenced harvesting 2 to 77 days after the cyclone.

Although fishing sites, gear and travel time did not change significantly after the cyclone, the main use of mud crabs did. Pre-cyclone the most common fate was ‘eaten by households’ (25%), ‘sold to middlemen/agents’ (24%) or ‘sold at the market’ (23%). Post-cyclone most fishers were preferentially selling to middlemen/agents. The survey also found that while the price of mud crabs increased post-cyclone, women earned less for their mud crabs then men.

Over half of the respondents (68%) noticed a change in the number of crabs caught post-cyclone. Whilst the majority of these respondents noted that they were catching less mud crabs after the cyclone, 25% of respondents (from the districts of Bua, Dama and Lekutu) actually

noted an increase in the number of mud crabs caught. Less than half (42.5%) of the respondents thought the actual size of mud crabs had changed post-cyclone.

RECOMMENDATIONS:
The study recommended:

(i) government support to fishing communities should be gender sensitive and take into consideration the losses and damages incurred by women fishers;
(ii) up to date information be provided to women fishers to ensure they get a fair price for their mud crabs;
(iii) villages and districts establish regulations or guidelines for the mud crab fishery which promote recovery and sustainable harvest practices;
(iv) districts with damaged mangrove *tabu* areas remain closed to help promote recovery; and
(v) continuing monitoring the recovery of the mud crab fishery and the impact to subsistence and livelihoods in Bua Province.

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 mud crab fishers from Bua Province. ©Yashika Nand/WCS (right), Margaret Fox/WCS (left)

An integrated vulnerability assessment of Koro Island

STATUS: Ongoing

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

PARTNER ORGANISATIONS: Climate Change Division of the Ministry of Finance, Lomaiviti Provincial Council Office, University of the South Pacific's Pacific Centre for Environment and Sustainable Development (PaCE-SD), iTaukei Affairs Board (iTAB), Commissioner Eastern Division, FLMMA and International Labour Organisation

HIGHLIGHTS:
WCS and partners camped on Koro Island from 8–17 June 2016, to carry out Integrated Vulnerability Assessment (IVA) to quantify the level of vulnerability of communities and their resources, to cyclones and other natural disasters, as well as climate change. The IVA is a key approach adopted by the Fiji government that will be used to inform discussions around the relocation of people further inland. Using a combination of community participation, GIS and image analysis tools as well as secondary data, the Koro IVA sought to address the following objectives:

i. Describe in detail the environmental, social and economic characteristics of Koro Island and related changes in recent decades, the impacts of Tropical Cyclone Winston on Koro Island, and the factors (e.g. environmental, social, economic, infrastructure) if any, that provided protection from cyclone damage;
ii. Map the storm and wave surge reach from Cyclone Winston; identify areas that may be categorised as 'unsafe' and 'safe' for permanent housing and communal settlement; and other information related to natural resource and infrastructure rebuilding on the island (part of this has been completed by Mineral Resources Division);
iii. Based on community perceptions, systematically assess the current conditions and capacity of accessible livelihood assets (including natural resources, infrastructure, human resources, finance and governance) to meet community food, water, settlement, health, energy, income, environmental and social needs for all 14 villages on Koro Island.; and
iv. Consult the villages and relevant extension officers on Koro Island on their views about the proposed relocation and how it may be best addressed.

WCS hopes that the report generated from this assessment would assist stakeholders to identify and formulate an integrated approach to address five critical areas for the people of Koro, namely food security, human health, water security, ecosystems health, and energy security.

NEXT STEPS:

- Results of the IVA were presented to government on 7 June, 2016, and a final report is currently being prepared.
- The data and results of the IVA will be incorporated in the island Ecosystem-Based Management Plan for Koro in 2017, in partnership with the Lomaiviti Provincial Office.

LINKS TO NATIONAL PRIORITIES:

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. **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.

Damaged infrastructure on Koro Island. ©Akanisi Caginitoba/WCS

Assessing impacts of periodic harvests on reef fish populations

STATUS: Completed

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

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

OUTPUTS:

- *Journal article:* Goetze J, Claudet J, Januchowski-Hartley F, Langlois T, Wilson S, White C, Weeks R, Jupiter SD (in review) Demonstrating multiple benefits from periodically harvested fisheries closures. Journal of Applied Ecology
- *Journal article:* Goetze JS, Januchowski-Hartley FA, Claudet J, Langlois TJ, Wilson SK, Jupiter SD (in review) Fish behaviour is a more sensitive indicator to changes in fishing pressure than abundance, length or biomass. Ecological Applications
- *Journal article:* Jupiter SD, Epstein G, Ban NC, 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. Society and Natural Resources
- *Journal article:* Goetze J, Langlois T, Claudet J, Januchowski-Hartley F, Jupiter SD (2016) Periodically harvested closures require full protection of vulnerable species and longer closure periods. Biological Conservation 203:67-74
- *Conference presentation:* Jupiter SD, Goetze JS, Carvalho P, Claudet J, Hamilton RJ, Januchowski-Hartley FA, Langlois TJ, Weeks R, White C, Wilson SK, Almany GR (2016) How to have your fish and eat them too: Managing periodically harvested closures for long-term sustainability. 13th International Coral Reef Symposium, Honululu, Hawaii, 19-24 June
- *Conference presentation:* Carvalho P, Jupiter SD, Januchowski-Hartley F, Goetze J, Claudet J, Weeks R, White C (2016) Periodically-harvested closures emerge as optimal management strategies when fish behavior is considered. 13th International Coral Reef Symposium, Honululu, Hawaii, 19-24 June
- *Conference presentation:* Goetze JS, Jupiter SD, Claudet J, Januchowski-Hartley F, Langlois T, Weeks R, White C (2016) Periodically harvested closures provide short-term fisheries benefits. 13th International Coral Reef Symposium, Honululu, Hawaii, 19-24 June
- *Factsheet:* WCS (2016) Best practice management of *tabu* areas. Wildlife Conservation Society, Suva

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, 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. We found from analyzing data collected in the field that, on average, PHCs provide short-term protection benefits to targeted fishery species (fish and invertebrates), and that these benefits were greater when PHCs were larger, closed for longer periods, well enforced and had high fishing pressure outside PHCs in the broader fisheries management area (which incentivizes management). This translates into tangible harvest benefits, with fishers removing a large proportion of targeted populations within PHCs during pulse harvest events.

Results from our modeling work indicate that use of PHCs can be a highly effective and potentially optimal fisheries management strategy in both well-managed and overfished systems, largely because, with PHCs, fishermen can exploit changes in fish wariness for enhancing harvest efficiency. PHC effectiveness for achieving multiple goals for conservation and livelihoods depends on its design (size, open-closed schedule, and associated harvest effort) in relation to the spatial and temporal population dynamics of the target fish.

RECOMMENDATIONS:
- If fishing pressure is very light outside PHCs, then they can be harvested every 1–2 years.
- If fishing pressure is very heavy outside PHCs, then they should be closed for at least 3 or more years before harvests.
- Harvests should be restricted to 1–2 days to reduce risk of overexploitation.
- During harvests, fishers should avoid fish species that are particularly vulnerable to fishing pressure, including: large predatory species (e.g., grouper, sweetlips, jacks, jobfish, sharks); large herbivorous species (e.g., big parrotfish); and species that may be protected or subject to trade restrictions (e.g., humphead wrasse).

NEXT STEPS:

In early 2017, WCS will be working with one of our collaborators from ARC CoE to integrate the outputs of our science into curriculum that will be used to train local community, government fisheries managers and members of the FLMMA network on best practices for using PHCs. Ideally, should further funding become available, we will aim to work with LMMA network advisors and practitioners to develop communication products that can be disseminated through the FLMMA network to improve management. These are likely to include posters showing sustainable versus unsustainable PHC harvest regimes and an illustrated guide that identifies combinations of fish species, gear types, and PHC management strategies that are sustainable versus those that should be avoided.

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.


Working with local communities to assess the impact of periodic harvests on fish populations. ©Emily Darling/WCS

Investigating links between environmental change and waterborne bacterial disease

STATUS: Completed

FUNDING: Edith Cowan University Industry Linkage Grant

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

OUTPUTS:

- *Journal article:* Jenkins A, Jupiter SD, Jenney A, Varanisese R, Naucukidi A, Prasad N, Vosaki G, Mulholland K, Strugnell R, Kama M, Crump J, Horwitz P (in review) Environmental determinants of Typhoid fever in the Fijian residential setting. Environmental Health Perspectives
- *Journal article:* Brito IL, Yilmaz S, Huang K, Xu L, Jupiter SD, Jenkins AP, Naisilisili W, Tamminen M, Smillie CS, Wortman JR, Birren BW, Xavier RJ, Blainey PC, Singh AK, Gevers D, Alm EJ (2016) Mobile genes in the human microbiome are structured from global to individual scales. Nature 535:435-439
- *Journal article:* Jenkins AP, Jupiter SD, Mueller U, Jenney A, Vosaki G, Rosa V, Naucukidi A, Mulholland K, Strugnell R, Kama M, Horwitz P (2016) Health at the sub-catchment scale: typhoid and its environmental determinants in Central Division, Fiji. EcoHealth DOI 10.1007/s10393-10016-11152-10396
- *Magazine article:* Yudan W (2016) The social network in your gut. The New Yorker, 9 August 2016 http://www.newyorker.com/tech/elements/the-social-network-in-your-gut

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 conditions. In the first study called FijiCOMP, we partnered with Dr. Ilana Brito, formerly of Massachusetts Institute of Technology and now from Cornell University, to identify the major routes by which bacteria are transferred in order to better understand pathways for how pathogenic diseases like typhoid might spread across districts in Fiji. In the second study, we partnered with Aaron Jenkins, formerly of Wetlands International-Oceania and now from Edith Cowan University, to identify potential environmental associations with typhoid incidence and recurrence in Fiji.

Field data for the FijiCOMP study was collected 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: (1) to validate a technique used to investigate bacterial transmission; and (2) to use this technique to evaluate the transfer of bacteria based on individuals' behaviors, demographics and locations.

The results were published in 2016 in the prestigious journal *Nature* and included the following main findings:

- The Fijian microbiome contains many uncharacterized species and genes.
- Transmission can be seen within households, rather than families.

- There was a surprising absence of endemic pathogens.
- Genes transferred amongst bacteria represent local pools of functional and antibiotic resistance genes.

Field data for the typhoid-specific study was conducted in Central Province where we looked at potential environmental correlates of recent typhoid cases. We found several landscape-level environmental factors associated with typhoid incidence and recurrence, including:

- Type of soil: more cases were recorded from areas of highly erodible soil. This may be because typhoid bacteria potentially can adhere to and grow on sediment.
- Fragmented riparian forests: In fragmented riparian zones, there is less sediment trapping by trees and grasses. In addition, less shade from reduced canopy cover means higher water temperatures that can facilitate bacterial growth.
- Density of creek crossings in catchment: A higher density of roads crossing creeks leads to more opportunities for sediment to get into waterways.

There were additional residential scale environmental factors significantly associated with typhoid risk, including:

- Gardens located below toilet drainage.
- High fecal bacteria load and phosphate in toilet drainage soil.
- Contaminated water stored in the house.

In conducting this study, our partners at ECU have developed a screening tool that can be used by rural health inspectors in Fiji to rapidly assess typhoid risk in Fijian villages. This tool was utilized during post-cyclone Winston assessments in partnership with UNICEF.

NEXT STEPS:

- Dissemination of research results to the Ministry of Health and WASH coalition members in Fiji to aid in the design of management strategies for typhoid prevention.

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.

Modelling land-based impacts on coastal fisheries

STATUS: Ongoing

FUNDING: Science for Nature and People Partnership (SNAPP), Australian Research Council (ARC) Linkage grant (LP150100934)

PARTNER ORGANISATIONS: University of Queensland (UQ), Griffith University

OUTPUTS:

- *Journal article:* Brown CJ, Jupiter SD, Albert S, Klein CJ, Mangubhai S, Mbui M, Mumby P, Olley J, Stewart-Koster B, Tulloch V, Wenger A (in review) Tracing the influence of land-use change on water quality and coral reefs using a Bayesian model. Marine Pollution Bulletin
- *Journal article:* Lin H-Y, Jupiter SD, Jenkins A, Brown C (in review) Impact of anthropogenic disturbances on a diverse riverine fish assemblage predicted by functional traits. Freshwater Biology
- *Conference presentation:* Brown CJ, Jupiter SD, Klein CJ (2016) Tracing the impacts of land-use change to coral reef fisheries. 13th International Coral Reef Symposium, Honululu, Hawaii, 19-24 June
- *Conference presentation:* Brown CJ, Jupiter SD, Klein CJ (2016) Tracing the impacts of land-use change to coral reef fisheries. 4th Society for Conservation Biology Oceania Conference, Brisbane, Australia, 5-8 July

RESEARCH HIGHLIGHTS:

Since 2014, WCS has participated in a working group with partner researchers from UQ, Griffith University, James Cook University, The Nature Conservancy and others to develop methods to assess land-based impacts on coral reef fisheries. We first developed a technique to use freely available satellite data to assess the connection between land-uses in catchments and water clarity in coastal waters. We applied the model to estimate the influence of land-use change on water clarity in lagoonal waters of western Vanua Levu. We tested the model's predictions against underwater surveys of benthic cover collected by WCS staff between 2010 and 2012 and found that predictions of poor water quality were consistent with observations of high siltation and low cover of sediment-sensitive coral genera. The model thus provided a means to link land-use change to declines in coastal water quality.

We then used the outputs of this model to investigate how land-based runoff affects variability in coral reef fish populations. Our analysis showed strong associations between fishing pressure and reductions in large fish, as well as an effect of turbidity on most fish functional groups via the mediating effects of habitat. Thus, our results suggest that simultaneous management of catchments and fisheries is important for the conservation of Fiji's reef fish populations. WCS, along with our collaborators from UQ and Griffith University, presented outputs of our integrated land-sea fisheries model to stakeholders in Bua Province, Fiji. The presentation was part of a workshop to develop the building blocks of a province-wide integrated coastal management plan, where there are high levels of threats to native forests from logging, mining and road building activities, all of which increase sedimentation to nearshore marine

ecosystems. Outputs from research under this project were used to help identify locations for new protected areas and advise on forestry practices that will minimize sedimentation on reefs.

NEXT STEPS:

- Complete write-up of paper looking at tradeoffs between terrestrial activities and impacts on downstream fisheries.
- Complete assessment of how coral communities change along the turbidity gradient observed off western Vanua Levu.
- Apply techniques to an area in Western Province, Solomon Islands, which has present and historical logging operations.
- Incorporate results from SNAPP Working Group into the Bua Province Integrated Coastal Management Plan.

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. **Integrated Coastal Management Framework of the Republic of Fiji (2011).**

Participants of the second Integrated Coastal Management workshop for Bua Province. @Jonah Vadiga/WCS

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, USP

OUTPUTS:

- *Conference presentation:* Dacks R, Jupiter SD, Ticktin T, Hunter C, Friedlander A (2016). *Investigating social drivers of fishing and market influences on increasingly exploited small-scale coral reef fisheries*. International Coral Reef Symposium. Honolulu, Hawaii, 19-24 June
- *Conference presentation:* Dacks R, Jupiter SD, Ticktin T, Hunter C, Friedlander A (2016). *Of Markets And Middlemen: Investigating Drivers Of Decline In Increasingly Exploited Small-scale Coral Reef Fisheries*. Tester Annual Symposium. University of Hawaii at Manoa

RESEARCH HIGHLIGHTS:

This collaborative project with University of Hawaii focuses on social-ecological systems and resilience. The project aimed to model and test the relationships among local ecological knowledge (LEK) systems and indicators of adaptive capacity and social-ecological resilience to climate change in coastal Fijian communities. It also aimed to 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.

To date most data analyses have been completed and researchers have modeled and tested the relationships between LEK and indicators of social-ecological resilience on land and sea in Fiji. This included the development of structural equation models to identify social-ecological drivers of resilience in agroforests and on coral reefs.

Through this work researchers have identified social drivers of biodiversity conservation and ecological resilience not previously reported, with important implications both for understanding social-ecological system functioning on land and sea, and for increasingly resilience and sustainability in Pacific Island communities. For example, using structural equation modeling the study showed that LEK is the strongest driver of native plant richness and several indicators of ecological resilience in Fijian agroforests. They showed also that contrary to the literature, proximity to markets does not drive fishing pressure, nor indicators of reef resilience. On the contrary, households further from markets are fishing at higher levels than those closer to markets. This highlights the important role of middlemen and the need to further investigate their involvement in understanding and fostering sustainability of small-scale fisheries.

An interactive coloring book for school children about local ecological knowledge and its importance for communities was produced in partnership with WCS, and distributed in September 2016 to schools in the districts of Suva and Nakorotubu. Results of this research were also shared to government and NGO staff in Fiji, through oral presentations and discussions in multiple meetings.

NEXT STEPS:

- Researchers from University of Hawaii will write up publications from this work over the next 12–24 months and will continue distributing the coloring book to other districts.

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.

Rachel with her research team in Natokalau Village (left). Kilaka Forest in Kubulau District (right).

Understanding the state of the sea cucumber fishery in Fiji

STATUS: Completed

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

PARTNER ORGANISATIONS: Ministry of Fisheries

OUTPUTS:

- *Report*: Mangubhai S, Lalavanua W, and Purcell S (eds.) (draft). Fiji's Sea Cucumber Fishery: Advances in Science for Improved Management. Wildlife Conservation Society. Suva, Fiji.
- *Report*: Mangubhai S, Nand Y, Ravinesh R, Fox M (2016) Value chain analysis of the wild caught sea cucumber fishery in Fiji. Wildlife Conservation Society and Department of Fisheries. Report No. 02/16. Suva, Fiji, 58 pp.
- *Conference*: Mangubhai S, Nand Y, Fox M (2016) Using value chain analysis to improve fisheries management in the Fiji Islands. 13th International Coral Reef Symposium, Hawaii, , 19-24 June

RESEARCH HIGHLIGHTS AND RECOMMENDATIONS:

WCS and the Ministry of Fisheries completed Fiji's first comprehensive value chain analysis (VCA) of the wild caught sea cucumber fishery, which was presented at the 2015 Northern Fisheries Forum. All data have been analysed and a report has been produced and shared with the Ministry of Fisheries. The study made a number of key recommendations:

i) Sea cucumber management plan: Poor management of sea cucumber stocks means that most fishing grounds do not have sufficient densities to sustain harvesting levels or reproduce to maintain the fishery. The National Sea Cucumber Management Plan should be passed by Cabinet and implemented immediately, with adequate control and enforcement measures in place to ensure there recovery of depleted stocks.
ii) Banning use of UBA: The use of UBA has resulted in the depletion of sea cucumber populations to greater depths, and with it increasing diving-related accidents and deaths. Most divers interviewed were not certified and did not know safe diving depths and practices, with high social costs to local communities. UBA should be banned, and exemptions should be stopped to both protect stocks of sea cucumbers and human life. When UBA is prohibited, there is a natural sanctuary for sea cucumbers below the depth possible for free diving. The sanctuary allows re-population of overfished areas.
iii) Transparency in grading prices: The establishment of industry grades and standards in Fiji is critical to guide transactions along the value chain, and to ensure fishers and processors receive a fair price for their product. This will remove the standards being set solely by exporters and ensure greater transparency for the fishery.
iv) Limiting the number of exporters: The number of licenses issued should be limited to reduce the pressure on the resource. Areas allowed for harvesting should be specified on licenses to encourage sustainable harvesting, and prevent serial depletion.
v) Process upgrading: The biggest opportunity to upgrade the value chain is to improve the quality of the processing of sea cucumbers, especially at the community level. This requires

training on processing techniques, as well as systems to be put in place to enable them to access materials such as rock salt. A semi- or full-processed product would allow fishers to hold onto their product as they negotiated a good price, without the fear of spoilage, and raising the quality of products from Fiji.

vi) Communal harvesting: Although there were only a small number of examples, there was evidence to suggest that communities that had well-enforced *tabu* areas, and that sold sea cucumbers as a community (rather than as individual fishers), received a greater price for their product. Communities could also potentially negotiate prices with exporters before the harvest to ensure receiving the best price for their sea cucumbers while minimising spoilage.

vii) Enforcement: Given the hour glass model of the fishery, enforcement efforts are more cost effective when focused at the export level. Stronger controls over what species, sizes and volumes leave Fiji, would have a quick 'trickledown effect' throughout the value chain. Fisheries officers in the export division should coordinate with customs on both enforcement and data collection to accurately record export volumes of sea cucumbers from Fiji. Data collected should be used to inform number of permitted licenses and adaptive management of the fishery

A second report is been compiled on the all new research and studies that have been completed since the 2013 sea cucumber fishery status report by SPC. The report covers a range of topics including ecological surveys, fisher perceptions about abundance and catch rates, value chain analysis of the fishery, sizes of exported sea cucumbers, post-harvest processing of sea cucumbers, the social and economic cost of the use of underwater breathing apparatus to Fiji, effect of sea cucumber density on health of reef flat sediments, and genetic connectivity amongst populations of lollyfish, *Holothuria atra*.

NEXT STEPS:

- Both reports will be launched in early 2017, as part of a one day forum on the sea cucumber fishery.

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.

A value chain analysis of the mud crab fishery in Bua Province

STATUS: In progress

FUNDING: Flora Family Foundation (Grant #2015-2694) and the David and Lucille Packard Foundation (Grant #2014-4054)

PARTNER ORGANISATIONS: Ministry of Fisheries, FLMMA

RESEARCH HIGHLIGHTS:

WCS, Ministry of Fisheries and FLMMA led Fiji's first comprehensive value chain analysis (VCA) of the wild caught mud crab fishery in November 2015. A total of 240 people were interviewed, including mud crab fishers, boat owners, middlemen, seafood shops/retailers, resorts, hotels, restaurants, exporters and consumers.

Of the fishers interviewed, 88% were women with most earning $8-17/kg, compared to middlemen and exporters who earned $17-25/kg and $40/kg. Our analysis shows most fishers have a poor understanding of market needs (e.g. size, shell to meat ratio) and the diversity of players operating in the fishery. This is the first VCA conducted for this fishery in Fiji and the wider Pacific Region. Understanding the commercial aspects of the fishery is critical to implementing sound management at the community level.

NEXT STEPS:

- Report to be completed in 2017 for submission to the Ministry of Fisheries.
- Share results of VCA with local communities, middlemen and exporters.

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.

Assessing mud crab populations in mangrove forests in Bua Province

STATUS: Completed

FUNDING: Flora Family Foundation (Grant #2015-2694) and the David and Lucille Packard Foundation (Grant #2014-4054)

PARTNER ORGANISATIONS: Ministry of Fisheries, FLMMA

OUTPUTS:

- *Report:* Nand Y, Fox M, Mangubhai S (2016) A preliminary assessment of mud crab stocks in mangrove forests in Bua Province, Fiji. Wildlife Conservation Society, Suva, Fiji. 9pp.

RESEARCH HIGHLIGHTS AND RECOMMENDATIONS:

Coastal communities in Fiji rely heavily on inshore fish and invertebrate fisheries for food and livelihoods. WCS launched a women in fisheries program in 2015 focused around mud crabs (*Scylla serrata)* known locally as *qari*. The mud crab fishery is largely dominated by women who collect crabs mainly by hand or using small hand nets during the low tide from mangrove forests adjacent to their villages. The mud crab fishery in Fiji is understudied, with very little information on population status, distribution patterns, abundance, threats, and their economic value. There is a growing concern for the increase in undersized crabs being sold in local markets, suggesting declines in local stocks likely from over harvesting.

To address this gap, WCS undertook a preliminary assessment of select mangrove forests in Bua Province to estimate the density and biomass of mud crab stocks using a small quadrat depletion technique. The information gathered through this method can be used to estimate crab density by extrapolating the relationship between harvest area and crab removal, over a fixed period of time. A total mangrove area of 30,800 m^2 was surveyed in the districts of Dama (7,200 m^2), Navakasiga (14,000 m^2) and Lekutu (9,600 m^2). A total of 18 mud crabs was recorded. Prevalence was low with crabs only present in a third of the quadrats surveyed. The highest densities of crabs were recorded in Dama District (12.5 ± 1.2 crabs/ha) while lowest densities were recorded in Lekutu District (2.3 ± 3.9 crabs/ha) (Table 2). Within Bua province, the largest mangrove area surveyed was in Navakasiga District which also had the highest number of crab fishers. The average mud crab carapace width was 13 cm (± 3.4). There was some variation in size of crabs between males and females and between districts, with females slightly larger across all districts. Interestingly, despite being closer to markets Navakasiga District recorded bigger size crabs than other districts, though there were variations in crab sizes at each site.

An analysis of sex-ratios showed an overall dominance of male mud crabs at the sites surveyed. The districts of Dama and Navakasiga recorded a higher ratio of male crabs during the survey, while Lekutu recorded a high ratio of females. None of the female crabs were gravid (i.e. with eggs) at the time of survey. Life stage ratios showed an overall dominance of adults compared

to juveniles in mangrove systems (Table 2). Very few juveniles were recorded in general during the study.

Given the size of mud crabs recorded and discussions with local fishers with a long history with the mangrove forests surveys, it is unlikely that the densities recorded in Bua Province are indicative of highly overexploited populations. This study does not enable us to conclude whether the low densities recorded reflect the choice of method that was used (i.e. depletion technique), size of quadrats, areas covered, or the patchy distribution of natural populations. There were also significant challenges in laying transect lines to mark quadrats in *Rhizophora* forests, especially since the tides limited the amount of time available for sampling. Given it took an average of 45 minutes to set up the quadrats for *Rhizophora* forest, the depletion technique may be better suited to *Bruguiera* or mixed mangrove forests where there are more spaces between the trees.

Moving forward, a more useful way to assess trends in the population may be through catch per unit effort logbooks, which are currently being trialed by local fishers in Bua Province in partnership with WCS.

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.


People setting up quadrats in a Bruguiera forest (left) and fisher women tying up crab in a Rhizophora mangrove forests (right). ©Margaret Fox/WCS (left) and Yashika Nand/WCS (right)

Sea anemone mariculture in Fiji to promote sustainable harvesting and local livelihoods for women

STATUS: In progress

FUNDING: Marine Ecology Research Center – Southern Cross University (SCU)

PARTNER ORGANISATIONS: SCU National Marine Science Center (NMSC)

RESEARCH HIGHLIGHTS AND RECOMMENDATIONS:

Meeting with aquarium trader Walt Smith. ©Deborah Smith

The trade of marine ornamentals for aquariums is rapidly expanding, causing concerns about the sustainability and environmental impacts of the industry. Sea anemones are highly sought after in the trade and localised depletions have been documented especially in developing island nations such as Fiji. Sea anemones are also collected by women for household consumption and are considered a local delicacy in Fiji (S. Siwatibau, pers. comm.). Although marine ornamental aquaculture is in its infancy, the propagation of animals for the trade will become more important as further restrictions are placed on wild collection and consumers become more aware of the potential adverse impacts of these activities. Developing reliable and cost-effective methods for culturing anemones could facilitate the supply of animals for the aquarium trade and replenish reefs that have been depleted, thus supporting biodiversity conservation.

Because aquarium collecting provides employment in rural low-income coastal areas that have otherwise limited resources and economic options, it would be preferable if aquaculture occurred in the areas that are currently exporting anemones. This project determines the feasibility of the practical application of a sea anemone propagation technique developed by Dr. Anna Scott, from NMSC at SCU in Australia, to facilitate the creation of a new industry, which would have long-term economic and environmental benefits to Fiji. In addition, this work will document the role and the extent of the collection of sea anemones in community subsistence fisheries.

LINKS TO NATIONAL PRIORITIES:

NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries), 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.

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, JCU

RESEARCH HIGHLIGHTS:

Dr Georgina Gurney (JCU) supports WCS staff with socioeconomic surveys in Ra Province. ©Sangeeta Mangubhai/WCS

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. WCS and our partners in key geographies have refined 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. 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 were collected across eight sites across four districts in three provinces in Fiji. Biological monitoring was conducted 2–3 months after Cyclone Winston, using standard underwater visual census techniques. Socioeconomic household and key informant surveys were also conducted across the 8 villages previously surveyed in 2014 and 2015, using a standardised protocol in October-November 2016. WCS Fiji are testing the use of KOBO BOX, to enter and store data for analysis.

NEXT STEPS:

- Report on the key changes in biological and socioeconomic indicators between 2015 and post-cyclone 2016.

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.

MANAGEMENT

The following sections present a synthesis of completed and ongoing activities that have strengthened and supported community-based natural resource management in Fiji in 2016.

Spreading District-Scale Ecosystem-Based Management in 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 (iTAB), iTaukei Lands and Fisheries Commission (TLFC), c-Change, Bua Yaubula Management Support Team (BYMST), FLMMA, USP-IAS

OUTPUTS:

- *Management Plan*: WCS (2016) *Ecosystem-Based Management Plan: Nadi district, Bua Province, Fiji*. Wildlife Conservation Society, Suva, Fiji. 83pp.
- *Management Plan*: WCS (2016) *Ecosystem-Based Management Plan: Lekutu and Navakasiga Districts, Bua Province, Fiji.* Wildlife Conservation Society, Suva, Fiji. 87pp.
- *Management Plan*: WCS (2016) *Ecosystem-Based Management Plan: Solevu district, Vanua Levu, Fiji*, Wildlife Conservation Society, Suva, Fiji. 87pp.
- *Management Plan*: WCS (2016) *Ecosystem-Based Management Plan: Vanua Vuya, Vuya district, Bua Province, Fiji*, Wildlife Conservation Society, Suva, Fiji. 73pp.

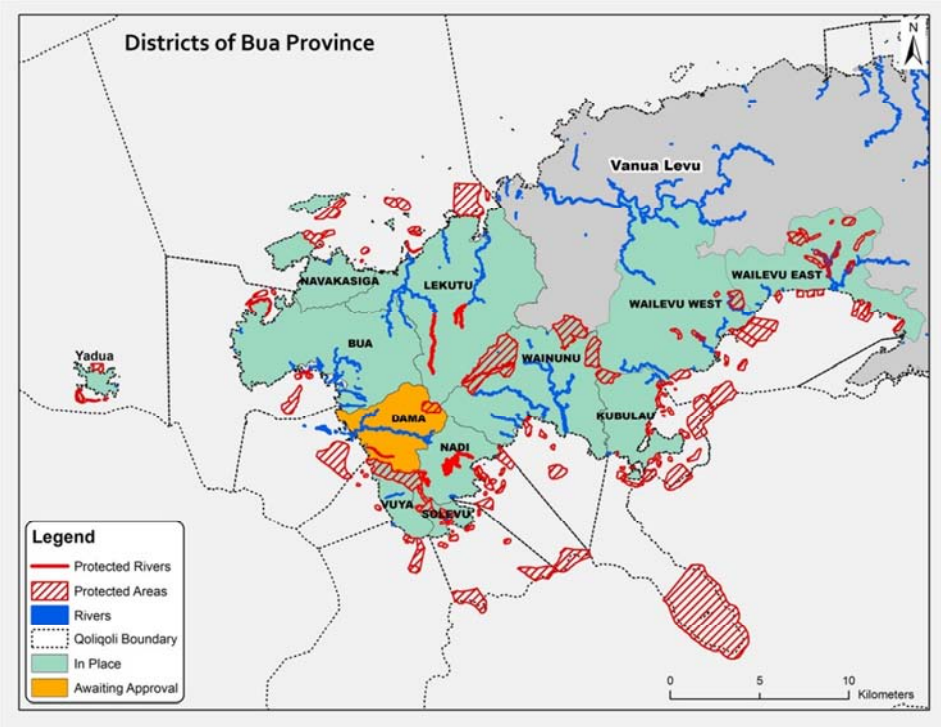
HIGHLIGHTS AND RECOMMENDATIONS:

WCS successfully supported the six districts of Nadi, Vuya, Wainunu, Solevu, Navakasiga and Lekutu to complete and launch bottom-up, community-driven ecosystem-based management (EBM) plans. With the exception of Dama, eight of the nine district EBM plans have been completed for Bua Province. The launching of EBM plans strengthened existing *tabus,* resulted in creation of new *tabus* across terrestrial, freshwater, and marine habitats, and formalized suites of community rules regulating use of natural resources on their land and customary fishing grounds. These measures combined should lead to improved natural resource management and more sustainable practices, and improved ecosystem health and fisheries productivity.

Community facilitators and the Bua YMST members are trained in community engagement and EBM planning using new outreach tools developed by cChange and WCS. At the same time, management support workshops with Resource Management Committees (RMCs) build and strengthen their capacity in EBM planning and has equipped them with the skills needed to oversee the design and implementation of EBM plans. Lessons learned in local-level management were synthesized and strengthened through the publication of a practical facilitator's guide to community EBM planning that can be applied at a village, district and island scale.

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.



Map showing the EBM plans that have been formally launched in Bua and Cakaudrove Provinces. Source: WCS

Launching of EBM plans for Navakasiga (left), Solevu (right), Nadi (bottom) ©WCS

Provincial-scale engagement in Bua Province

STATUS: Ongoing

FUNDING: John D. and Catherine T. MacArthur Foundation (13-104090-000-INP), SNAPP, Australian Research Council (ARC) Linkage grant (LP150100934)

PARTNER ORGANISATIONS: Bua Provincial Council Office, Commissioner Northern Office, iTAB, Ministry of Fisheries, Ministry of Forestry, Department of Agriculture, BYMST

HIGHLIGHTS AND NEXT STEPS:

Reviewing land-based activities in Bua Province ©Sangeeta Mangubhai/WCS

With the successful completion of eight of the nine district EBM plans for Bua Province, we have begun to integrate and synthesize these into a single integrated coastal management (ICM) plan for the province. The second ICM workshop was held in November, 2016 in Nabouwalu with representatives from Bua Provincial Office, each of the 9 districts in Bua, Department of Environment and Ministry of Fisheries. The objectives of the workshop were: to understand and consider the potential impact of upstream activities like deforestation on freshwater and coastal fisheries and associated livelihoods in Bua Province; identify potential zoning scenarios for Bua Province that support sustainable development; and incorporate strategies to strengthen coastal resilience to natural disasters and climate change.

A key outcome of the workshop was the drafting of a spatial plan for Bua Province that balances environmental protection with use and development. Incompatible uses were identified and mechanisms or decisions to resolve them were discussed. Participants identified activities, timelines, roles and responsibilities for implementing management strategies for threats that need to be addressed at the provincial level, and finalized developments strategies for communication, enforcement and financing of the ICM plan. The workshop provided the opportunity to present and use models developed through SNAPP (pages 26-27).

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: Ministry of Fisheries, Fiji Environmental Law Association, Biospherics, World Wide Fund for Nature, FLMMA, WiFN-Fiji,

OUTPUTS:

- *Videos*: https://www.youtube.com/watch?v=lxO5WwC6GhA
- *Videos*: https://www.youtube.com/watch?v=uR12g3IzTMc

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. Despite the challenges we faced in the aftermath of Tropical Cyclone Winston, key highlights for 2016 were:

- Invertebrate fisheries: Completed value chain analyses and perception surveys for the sea cucumbers and mud crabs fishery in Fiji. In partnership with cChange produced two videos on the biology and ecology of sea cucumbers and mud crabs and management approaches to support local communities manage these fisheries.
- Size at maturity: Fishers from Bua and Navakasiga Districts were trained in the assessment of size at maturity of coral reef fish focusing on 6 key species that are important to local communities – *Naso unicornis*, *Siganus vermiculatus, Lutjanus agentimaculatus, Acanthurus xanthopterus, Lethrinus harak and L. nebulosus*. This work was complemented by market surveys led by WCS staff in Suva to collect maturity data on a wider range of fish species. Krystelle Danford was awarded a WCS scholarship to undertake a Master of Science degree at USP to document and describe life history parameters of *Naso unicornis* and *Siganus vermiculatus*, and to determine if there are geographic differences between Viti Levu and Vanua Levu.
- Impact of Cyclone Winston: Socioeconomic assessment was undertaken on the impact of Cyclone Winston on fisheries-dependent communities (pages 13-16). A database and report was produced and shared with the Ministry of Fisheries, and has been used to inform post-recovery support and rehabilitation efforts across the cyclone impact zone.
- Fisheries Forum: The Ministry of Fisheries and WCS hosted the 2016 fisheries forum for the Northern Fisheries Division in September, 2016. The two day forum brought together over

70 participants from government organizations, provincial office representatives, commercial fishers, exporters and middlemen, NGOs, and community members (including fish wardens). The forum provides the opportunity to share results of fisheries assessments, inventories and new research, and allows for focused dialogue on sustainable fisheries development. The main objectives of the 2016 were: (i) get an understanding of the impact of cyclone Winston on inshore fisheries in the Northern Division, and recovery efforts; (ii) update communities and the fishing industry on the new inshore fishing licensing arrangement, and get stakeholder feedback; and (iii) discuss current fisheries policies and to get feedback from stakeholders.

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.

The 2016 Northern Fisheries Division forum in Labasa (top) ©WCS. Size at maturity workshops with local communities in Bua Province (bottom) ©Watisoni Lalavanua/WCS

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: Ministry of Fisheries, WiFN-Fiji, FLMMA, Ministry of Women, Children and Poverty Alleviation

HIGHLIGHTS AND NEXT STEPS:
WCS continued to support mud crab fishers are part of its Women in Fisheries Programme. 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. Key highlights for 2016 include:

- Catch-per-unit-effort (CPUE) logbook: Following successful field testing, WCS and FLMMA trained 18 women mud crab fishers from 9 villages across the districts of Dama, Bua, Navakasiga and Lekutu on how to use and complete a CPUE logbook for mud crabs. During the training participants also learned about the ecology and reproductive biology of mud crabs and the importance of complying with the national size limit. These logbooks, if successful, will help women fishers track the health of their fisheries and provide valuable information for the Ministry of Fisheries.

Ecological surveys: WCS piloted a new methodology to assess the population density and biomass of mud crabs in a select number of forests (page 33-34).

- Impact of cyclone Winston**:** On behalf of the DoF, WCS and FLMMA led an assessment of the impact of the Cyclone Winston on women fishers, including 68 mud crab fishers. Most fishing activities stopped in the first weeks and months post-cyclone as many women had lost equipment, were busy rebuilding their homes, or were not able to access mangrove areas due to debris and broken branches (page 17-18).
- Supporting FLMMA: WCS supported the FLMMA network to hire their first female community representative, Ms. Tausile Veibi, to ensure women's views are included in community discussions about natural resource management. FLMMA and the WiFN-Fiji conducted education and awareness workshops with mud crab fishers in Tailevu, Ba and Macuata Provinces.
- Mud crab feasibility study: Dr. Colin Shelley, a global crab specialist, was contracted to complete a market and feasibility study of the mud crab fishery in Fiji. In order to access both domestic tourism and export markets, the report found the quality of mud crabs needs to be dramatically improved and cooperation between fishers is necessary to provide the volume of product required by the markets. Currently women mud crab fishers operate

largely at a subsistence level and opportunistically sell to middlemen and regional market centers. To transition to a business approach will require substantial efforts in training, cooperation and business development. It is unlikely that fishers will change their traditional harvesting and marketing methods without external support and assistance. The report provides solid recommendations that can be discussed with women from Bua Province to determine if there is an interest in taking a more business approach to the harvesting and sale of mud crabs.

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.

The Flora Family Foundation visit Fiji. ©Cherie Carter/WCS

Sustainable financing for local community protected areas

STATUS: Ongoing

FUNDING: WCS (Fellowship to Dr. Lida Teneva), John D. and Catherine T. MacArthur Foundation (13-104090-000-INP), RESCCUE Project funded by the French Development Agency (AFD) and the French Global Environment facility (FFEM) and implemented by SPC.

PARTNER ORGANISATIONS: Ra Provincial Council, USP-IAS, Volivoli Resort, Wananavu Resort, Nai'a Cruises, SPC, Fiji Environmental Law Association (FELA), BirdLife International

OUTPUT:

- *Management Plan*: Wildlife Conservation Society (2016) Vatu-i-Ra Conservation Park Management Plan. Wildlife Conservation Society, Suva, Fiji. 25 pp.
- *Report***:** Teneva L, Mangubhai S (2016) Principles for conservation agreements in terrestrial and marine settings in Fiji. Wildlife Conservation Society. Report No. 5/16. Suva, Fiji. 26 pp.
- *Report***:** Teneva L, Mangubhai S (2016) Monitoring and Evaluation Framework for Marine Conservation Agreements in Fiji. Wildlife Conservation Society. Report No. 06/16. Suva, Fiji. 17 pp.

HIGHLIGHTS:

A management plan was drafted for the Vatu-i-Ra Conservation Area Park, and encompasses an existing conservation area established by communities since 2011, within the Nakorotubu District and covers an area of 105.3 km^2. The Management Plan establishes the vision, strategies and framework for sustainably managing Vatu Island, the surrounding customary fishing grounds *i qoliqoli* Cokovata Nakorotubu, and adjacent deeper waters. The objectives of the Vatu-i-Ra Conservation Park are to: (i) protect the unique biodiversity of the island and the surrounding reefs; (ii) protect the unique cultural history of the area; (iii) protecting critical breeding grounds for fish so that the 'spillover' from this Conservation Park supports community fisheries in the adjacent *qoliqoli* Cokovata Nakorotubu area; (iv) to establish a voluntary mechanism through sustainable tourism, that will ensure the sustainable financing of the Conservation Park while supporting the sustainable development of resource owners; and (v) to establish the Vatu-i-Ra as the leading Conservation Park for the Fiji and the wider South Pacific.

The Vatu-i-Ra Conservation Park is an example of a Marine Conservation Agreement (MCA). Marine Conservation Agreements (MCAs) are "*any formal or informal contractual arrangement that aims to achieve ocean or coastal conservation goals in which one or more parties (usually right-holders) voluntarily commit to taking certain actions, refraining from certain actions, or transferring certain rights and responsibilities in exchange for one or more other parties (usually conservation-oriented entities) voluntarily committing to deliver explicit (direct or indirect) economic incentives*" (*The Nature Conservancy, www.mcatools.org*). MCAs have been used in the past in many countries to aid in the creation of marine reserves ('no-take' areas) or multiple use marine protected areas (MPAs). Many factors for success, or enabling conditions include perceived benefit from MCA, functional financial management infrastructure, effective

governance, compliance with resource rules set forth in the MCA, desire to conserve nature, clear legal structure, performance-based payments, and monitoring and evaluation.

WCS facilitated a meeting on October 26, 2016, between the key dive operators, Volivoli Resort, Wananavu Resort, and Nai'a Cruises to: (i) finalise a governance system for the Vatu-i-Ra Conservation Park; (ii) get agreement between tourism operators and local communities on the voluntary contribution to conservation scheme (including voluntary donations to the scheme, the type of account/fund to be set up, the use of any funds generated by the Conservation Park); and (iii) outlining next steps to launch the Vatu-i-Ra Conservation Park and Voluntary Contribution to Conservation Scheme. The meeting resulted in agreement between community representatives and tourism operators on the establishment of a Trust Deed and the governance mechanism for a voluntary contribution to conservation scheme.

Lastly, baseline ecological surveys conducted inside and outside the Vau-i-Ra Conservation Park, to establish a baseline to measure conservation impact. Complementary socioeconomic surveys were conducted across 10 villages inside and outside Nakorotubu District in Ra Province. The surveys were designed in collaboration with Drs. Georgina Gurney (JCU) and Lida Teneva (WCS fellow), and implemented by WCS staff. The questionnaire incorporated key questions develop by WCS as part of the global MacArthur Monitoring program (page 36).

NEXT STEPS:

- Analysis of ecological and socioeconomic data and produce a report to summarise the results of baseline surveys.
- Conduct a roadshow in Nakorotubu District to ensure there is wide knowledge, understanding and support for the proposed Vatu-i- Ra Conservation Park and the voluntary contribution to conservation scheme.
- Finalise and launch the Vatu-i- Ra Conservation Park Management Plan.
- Develop a Trust Deed in partnership with the FELA.

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: Ministry of Fisheries, Department of Environment, IUCN, WWF, Conservation International

OUTPUT:

- *Management Plan*: Wildlife Conservation Society (draft) Bligh Waters and Central Viti Marine Managed Areas Management Plan: 2017-2027. Wildlife Conservation Society, Suva, Fiji

HIGHLIGHTS:

WCS worked with key government ministries, most notably the Ministry of Fisheries, the private sector (i.e., fishing, tourism, mining, and shipping) and provincial offices, to identify and establish deeper water Marine Managed Areas (MMAs) in the Vatu-i-Ra Seascape. The two proposed multiple use MMAs supports the Government of Fiji's international commitment to protect 30 percent of its seas by 2020. WCS has undertaken consultations on the specific MMAs, including the numbers and types of zones within each MM, and a management plan has been drafted. The final names and objectives of each of the zones will be determined by the Marine Protected Areas Technical Committee, with support from the Marine Working Group of the National Protected Areas Committee.

In partnership with WWF, a contract was issued to New Zealand-based Nimmo-Bell Consultants to: (a) develop a model to estimate the cost of implementing/managing MMAs in the Vatu-i-Ra Seascape, Great Sea Reef, and Lau Seascape in Fiji; (b) estimate the costs of running a national network of MMAs; and (c) identify existing and potential sources of long-term sustainable financing for a national network of marine and terrestrial protected areas, and their feasibility. On January 28, 2016, the consultant presented the cost model to 30 representatives from government, NGO, and FLMMA to obtain their feedback. The model calculates the costs of establishing and implementing MMAs over 10 percent of Fiji's waters to meet commitments under the Convention on Biological Diversity, and over 30 percent of Fiji's waters, as committed at the Small Islands Developing States Conference in Mauritius in 2005. Developing the cost model was challenging given Fiji does not have an established network of MMAs, and offshore MMAs have only been proposed for the Vatu-i-Ra Seascape.

In May 2016, a draft report on sustainable financing options for marine and terrestrial protected areas in Fiji to 15 representatives from the government (including the Ministry of Finance, Department of Environment, and Ministry of Fisheries), NGO and FLMMA, as well as United Nations consultants for the Biodiversity Financing Initiative (BIOFIN), to obtain their feedback. Participants reviewed and discussed existing legal and institutional frameworks to establish sustainable financing for protected areas and funding opportunities and mechanisms that might be feasible in Fiji. The final report was submitted on June 15, 2016 and was shared

with the national Protected Areas Committee (PAC) for their review and endorsement. WCS Melanesia Director, Dr. Stacy Jupiter, is working to distil the final report on sustainable financing options for MMAs into a shorter, more digestible policy brief. We will seek endorsement of the draft brief to circulate to key stakeholders at the next sitting of the PAC in January 2017.

NEXT STEPS:

- Complete consultations with each of the sectors, especially fisheries
- In partnership with Ministry of Fisheries, distribute draft management plan to stakeholders for their final inputs
- Explore options with the Fiji Government to announce the two MMAs at the high-level United Nations conference in New York, planned for June 5-9, 2017. The conference, to be co-hosted by the governments of Fiji and Sweden, will coincide with World Oceans Day and seeks to support the implementation of Sustainable Development Goal 14, which aims to "conserve and sustainably use the oceans, seas, and marine resources for sustainable development."

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.

Healthy coral reefs in the Vatu-i-Ra Seascape, untouched by Tropical Cyclone Winston. ©Jack & Sue Drafahl

Kilaka Forest Conservation Area

STATUS: Ongoing

FUNDING: Harvey and Heidi Bookman, Australian Government through the Fiji Community Development Programme (FCDP), John D. and Catherine T. MacArthur Foundation (13-104090-000-INP)

PARTNER ORGANISATIONS: Nadicake *mataqali*, *iTaukei* Land Trust Board (TLTB), Ministry of Forests, Kubulau Resource Management Committee (KRMC)

HIGHLIGHTS:
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 TLTB and the Nadicake *mataqali* since 2015 to establish a conservation lease over 402 ha of Kilaka Forest. 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. The Management Plan for the Kilaka Forest Conservation Area was finalised with inputs from the community and the Ministry of Forests, and launched by the Minister for Forests on 24 November, 2016 in Kilaka Village. The final management plan was signed by the Minister for Forests, head of *mataqali* Nadicake, Turaga ni Yavusa, traditional leaders, Bua Provincial Office, the KRMC, TLTB, and WCS.

A community development plan (CDP) was completed for Kilaka Village and launched on 17 November, 2016, using tools, approaches and the template developed by FCDP. During the development of the plan, community consultations were undertaken with particular attention to the inclusion of women, youth and people with disabilities. The final CDP reflects the development needs and aspirations of the people of Kilaka Village for the next 5 years. To support the CDP, WCS and FCDP purchased water pipes to transport water from catchment sources to tanks in the village and to individual homes and 34 solar panels for each of the households in Kilaka village to provide much needed lighting in people's homes.

NEXT STEPS:
- Finalise the conservation lease with TLTB, for commencement in January 2017.

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.

Finalising the community development plan for Kilaka Village (top left, ©Jonah Vadiga/WCS). WCS staff in Kilaka Forest (top right, ©Sangeeta Mangubhai/WCS). Launching of Kilaka Forest Conservation Area Management Plan by the Honorable Minister for Forests (bottom), ©Jonah Vadiga/WCS).

COMMUNICATIONS: CAMPAIGNING FOR THE VATU-I-RA SEASCAPE

STATUS: Ongoing

FUNDING: Waitt Foundation, WCS

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.

In the media: The public and the media became increasingly more aware of the campaign this year, with increased articles and quotes in the local and international media. Over the last 12 months, WCS has featured in over 50 articles on the environment, which has helped raise the profile of the work we do in the Vatu-i-Ra Seascape.

Suva marathon: In July, the Suva Marathon championed a run for the the Vatu-i-Ra-Seascape to inspire the public to care about the seascape. Two hundred volunteers, youth, families and friends ran for the Seascape.

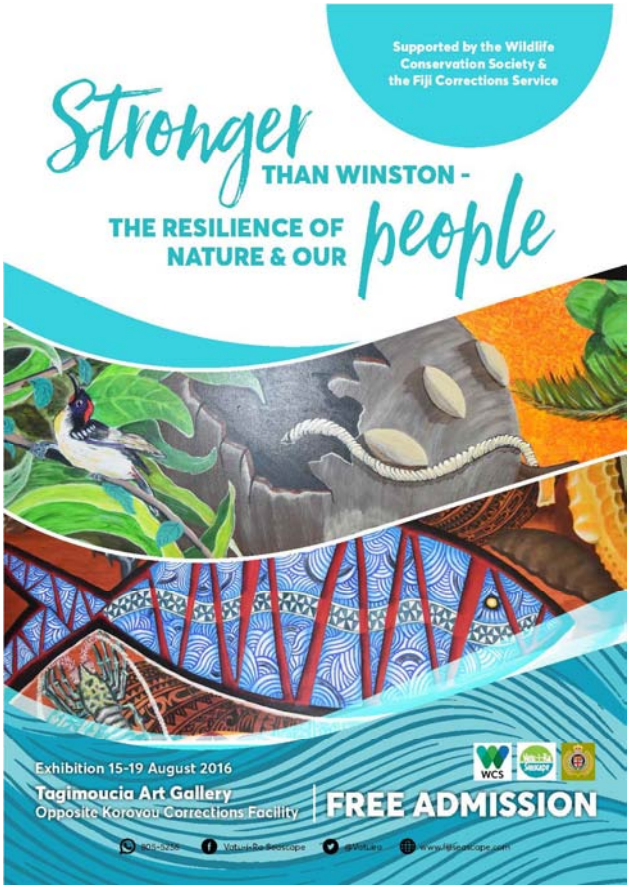
*Art exhibition***:** In August, WCS formed a partnership with the Fiji Correctional Services who run a yellow ribbon program for long-term prisoners using art as a tool for rehabilitation. Together we hosted an art exhibit titled "Stronger than Winston - the Resilience of Nature and our People" at the Tagimoucia Art Gallery in Korovou, Suva. Fifty percent of the sale of the artwork was donated to the Prime Minister's National Disaster Relief and Rehabilitation Fund.

Vatu-i-Ra fashion line: In September, the Vatu-i-Ra Seascape fashion line featured in the highly popular Fiji Fashion Week and the Hibiscus Festival, making WCS the first to introduce conservation fashion on the catwalk and in a beauty pageant. Through these events we showcased how the nature and the seascape can serve as a source of inspiration for fashion designs and prints. During the pageant, two contestants spoke on the conservation of Fiji's natural resources and the spectacular beauty of the seascape during public appearances. These events were televised locally and throughout the Pacific, and were also shared extensively on social media. Local fashion designer Epeli Tuibeqa designed a fashion line using prints, *tapa* (traditional cloth), and other locally sourced nature-based fibers for Fiji Fashion Week. His collection won the Rising Star Award for the couture and evening wear category, while the pageant contestant in the queen category won the Miss Hibiscus Festival crown, making both events a huge success for WCS.

Media partnerships: Local television station Fiji TV continued to broadcast environmental documentaries including "Roots to Happiness" throughout this year. WCS also partnered with Communications Fiji Limited during the celebration of World Food Day where messages of conservation was broadcast by the popular radio station to create awareness on managing and

adopting sustainable practices of our natural resources for future generation for the whole month of October, 2016.

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 2016.

Protected Area Committee

WCS participated in the three meetings of the national Protected Areas Committee (PAC) under the Department of Environment, established under the Environmental Management Act (2005). Discussions in 2016 focused largely around the Fiji Government commitment to protect 30% of its seas by 2020, and the designation of new forest conservation areas. WCS-Fiji Director, Dr. Sangeeta Mangubhai chaired the Marine Working Group for PAC. The Marine Working Group led two workshops in 2016, in partnership with IUCN and WCS to (i) identify significant and unique priority marine areas for Fiji, and (ii) identify inshore and offshore marine bioregions for Fiji. Both these workshops showed highlighted the uniqueness of the Vatu-i-Ra Seascape, and the need for adequate protection and management. The Marine Working Group also oversaw a marine legal review led by IUCN, and a report on sustainable financing options for marine and terrestrial protected areas in Fiji led by WCS and WWF.

Integrated Coastal Management Committee

WCS participated in the national Integrated Coastal Management (ICM) Committee under the Department of Environment, established under the Environmental Management Act (2005). The committee provides technical advice to ICM efforts in Fiji.

Marine Protected Areas Advisory Committee

WCS participated and provided secretarial support to the national Marine Protected Area Technical Advisory Committee chaired by the Ministry of Fisheries, established under the Offshore Fisheries Management Decree (2012).

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 2016

Journal Articles

Purcell SW, Ngaluafe P, Foale SJ, Cocks N, Cullis BR, Lalavanua W (2016) Multiple Factors Affect Socioeconomics and Wellbeing of Artisanal Sea Cucumber Fishers. PLoS ONE 11(12): e0165633. doi:10.1371/journal.pone.0165633

Jenkins AP, Jupiter SD, Mueller U, Jenney A, Vosaki G, Rosa V, Naucukidi A, Mulholland K, Strugnell R, Kama M, Horwitz P (2016) Health at the sub-catchment scale: typhoid and its environmental determinants in Central Division, Fiji. EcoHealth DOI 10.1007/s10393-10016-11152-10396

Purcell SW, Ngalufe P, Aram KT, Lalavanua W (2016) Trends in small-scale artisanal fishing of sea cucumbers in Oceania. Fisheries Research 183: 99-110

Goetze J, Langlois T, Claudet J, Januchowski-Hartley F, Jupiter SD (2016) Periodically harvested closures require full protection of vulnerable species and longer closure periods. Biological Conservation. 203:67-74

Brito IL, Yilmaz S, Huang K, Jupiter SD, Jenkins A.P, Naisilisili W, Tamminen M, Smillie CS, Wortman JR, Birren BW, Xavier RJ, Blainey PC, Singh AK, Gevers D, Alm EJ (2016) Mobile genes in the human microbiome are structured from global to individual scales. doi:10.1038/nature18927

Miller C, Batibasaga A, Chand P, Dulunaqio S, Fox M, Jupiter SD, Naisilisili W, Nand Y, Sharma-Gounder S, Smith B (2016) Cetacean diversity, common occurrence and community importance in Fijian waters. Pacific Conservation Biology. http://dx.doi.org/10.1071/PC14933

Atkinson SC, Jupiter SD, Adams VM, Ingram JC, Narayan S, Klein CJ, Possingham HP (2016) Prioritising mangrove ecosystem services results in spatially variable management priorities. PLoS ONE 11(3): e0151992. doi:10.1371/journal.pone.0151992

Jaiteh JF, Lindfield SJ, Mangubhai S, Warren C, Fitzpatrick B, Loneragan NR (2016) Higher Abundance of Marine Predators and Changes in Fishers' Behavior Following Spatial Protection within the World's Biggest Shark Fishery. Frontiers in Marine Science. 3: 1-5

Reports

Teneva L, Mangubhai S (2016) Monitoring and Evaluation Framework for Marine Conservation Agreements in Fiji. Wildlife Conservation Society. Report No. 06/16. Suva, Fiji. 17 pp.

Teneva L, Mangubhai S (2016) Principles for conservation agreements in terrestrial and marine settings in Fiji. Wildlife Conservation Society. Report No. 5/16. Suva, Fiji. 26 pp.

Purcell SW, Ngaluafe P, Aram KT, Lalavanua W (2016) Variations in postharvest processing of sea cucumbers by fishers and commercial processors among three Pacific Island countries. SPC Beche-de-Mer Information Bulletin 36: 58-66

Chaston Radway K, Manley M, Mangubhai S, Sokowaqanilotu E, Lalavanua W,Bogiva A, Caginitoba A, Delai T, Draniatu M, Dulunaqio S, Fox M, Koroiwaqa I, Naisilisili W, Rabukawaqa A , Ravonoloa K, Veibi T (2016) Impact of Tropical Cyclone Winston on Fisheries-Dependent Communities in Fiji. Report No.03/16. Wildlife Conservation Society, Suva, Fiji. 105 pp.

Obura D, Donner SD, Walsh S, Mangubhai S, Rotjan R (2016) Phoenix Islands Protected Area climate change vulnerability assessment and management. Report to the New England Aquarium, Boston, USA. 35 pp (download)

Mangubhai S (2016) Impact of Tropical Cyclone Winston on Coral Reefs in the Vatu-i-Ra Seascape. Report No. 01/16. Wildlife Conservation Society, Suva, Fiji. 27 pp

Conference Presentations

Jupiter SD, Goetze JS, Carvalho P, Claudet J, Hamilton RJ, Januchowski-Hartley FA, Langlois TJ, Weeks R, White C, Wilson SK, Almany GR (2016) How to have your fish and eat them too: Managing periodically harvested closures for long-term sustainability. 13th International Coral Reef Symposium, Honululu, Hawaii, 19-24 June

Carvalho P, Jupiter SD, Januchowski-Hartley F, Goetze J, Claudet J, Weeks R, White C (2016) Periodically-harvested closures emerge as optimal management strategies when fish behavior is considered. 13th International Coral Reef Symposium, Honululu, Hawaii, 19-24 June

Goetze JS, Jupiter SD, Claudet J, Januchowski-Hartley F, Langlois T, Weeks R, White C (2016) Periodically harvested closures provide short-term fisheries benefits. 13th International Coral Reef Symposium, Honululu, Hawaii, 19-24 June

Brown CJ, Jupiter SD, Klein CJ (2016) Tracing the impacts of land-use change to coral reef fisheries. 13th International Coral Reef Symposium, Honululu, Hawaii, 19-24 June

Brown CJ, Jupiter SD, Klein CJ (2016) Tracing the impacts of land-use change to coral reef fisheries. 4th Society for Conservation Biology Oceania Conference, Brisbane, Australia, 5-8 July

Dacks R, Jupiter SD, Ticktin T, Hunter C, Friedlander A (2016) Investigating social drivers of fishing and market influences on increasingly exploited small-scale coral reef fisheries. International Coral Reef Symposium. Honolulu, Hawaii, 19-24 June

Dacks R, Jupiter SD, Ticktin T, Hunter C, Friedlander A (2016) Of Markets And Middlemen: Investigating Drivers Of Decline In Increasingly Exploited Small-scale Coral Reef Fisheries. Tester Annual Symposium. University of Hawaii at Manoa

Nand Y, Jupiter SD, Bythell J (2016)Comparing differential disease and bleaching responses of Pacific corals from Leleuvia, Fiji and Moorea, French Polynesia. International Coral Reef Symposium. Honolulu, Hawaii, 19-24 June

Sadovy de Mitcheson Y, Fox M, Batibasaga A, Jupiter SD. Exporting Fiji's natural capital: challenges for the sustainable management and international trade of inshore resources in the Pacific. International Coral Reef Symposium. Honolulu, Hawaii, 19-24 June