



ANNUAL REPORT

WILDLIFE CONSERVATION SOCIETY
FIJI COUNTRY PROGRAM 2010



EXECUTIVE SUMMARY

This report highlights the Wildlife Conservation Society (WCS) Fiji Country Program's achievements from January to December 2010. Through activities focuses on Science, Management and Communication, WCS Fiji has helped local communities and national government to: (1) integrate ecosystem-based management principles into planning for natural resource management and strategies for climate-change adaptation; (2) design protected area networks that confer resilience to climate change disturbance and preserve ecosystem services; and (3) strengthen local and national capacity for management planning and enforcement.

Our collaborative scientific studies have focused on:

- Scaling up fish resource inventories from satellite-derived habitat data
- Planning MPA network design for reef resilience
- Incorporating relative ecological effectiveness of different management strategies into national ecological gap analyses
- Assessing biological and socioeconomic drivers of MPA effectiveness
- Identifying factors influencing the spatial and seasonal distribution of Fiji's freshwater fishes; and
- Investigating links between sub-catchment land cover, riparian condition, in-stream community health and ecosystem service provisioning

In our efforts to help strengthen natural resource management across Fiji, WCS Fiji has:

- Co-facilitated a national workshop with provincial administrators to identify candidate priority sites for new management
- Improved awareness and management capacity in Kubulau District through the Community Educators Network Training, in partnership with The Coral Reef Alliance and Seaweb; and
- Initiated management planning activities across Bua Province (Wainunu, Nadi, Sovelevu districts) and Wailevu District, Cakaudrove Province

In 2010, WCS Fiji disseminated two main communications tools to help spread awareness of ecosystem-based management and guidance for implementation. These tools include: (1) a generalized EBM plan template, based on the format used for Fiji's first ridge-to-reef plan for Kubulau District; and (2) an EBM guide for managers and conservation practitioners tailored to conditions in the tropical Western Pacific. Both tools have been translated in Fijian and distributed widely among government, NGO and private sector stakeholders. WCS Fiji has also increased general public awareness of our activities in 2010 by launching both the WCS Fiji website and Facebook page and through continued publication of our community bulletins and EBM quarterly newsletter.

Lastly, WCS Fiji has maintained a strong presence on national and regional committees and steering groups, including the: Protected Area Committee, Integrated Coastal Management Committee, Fiji Locally Management Marine Area network Executive Committee and various working groups, Fiji Sea Turtle Steering Committee, and working groups of Pacific Islands Roundtable for Nature Conservation. Through these organisations, WCS Fiji has worked to help achieve national objectives in biodiversity protection, conservation planning, coastal management and climate change preparedness.

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INTRODUCTION

This report highlights the Wildlife Conservation Society (WCS) Fiji Country Program's achievements in Fiji from January to December 2010.

Once again, our program has experienced considerable staff turnover. During our first quarter, we bid farewell to our Assistant Director Mr. Thomas Tui and Logistics Officer Mr. Wayne Moy, who have gone on to positions with SeaWeb and the Dive Centre, respectively. We hired two new Field Officers, Ms. Yashika Nand and Ms. Margaret Fox, in time for our dive surveys of Kubulau in April. In late May, Ms. Janette Kaipio came on board as a new Program Manager in time to assist a team from the Haas Business School of Berkeley, California, to develop a 5 year business plan for the country program. In late August, we were joined by a new Postdoctoral Research Fellow, Dr. Rebecca Weeks, who arrived from the ARC Centre of Excellence for Coral Reef Studies at James Cook University and brings to WCS considerable expertise in conservation planning techniques. Finally, in our fourth quarter, we said goodbye to our Project Coordinator / Communications Officer, Mr. Sunil Prasad, who moved overseas to the USA.

WCS Fiji staff were fortunate to have many opportunities for training and mentoring programs in 2010 which has led to notable growth in leadership and management skills within our office. In January, Mr. Waisea Naisilisili participated in an Ecosystem-Based Management training course in the Cook Islands, organized in partnership by the University of Queensland's Coral Reef Targeted Research (CRTR) program and the Cook Islands Marine Resources Institutional Strengthening Project (CIMRIS). Both Mr. Sunil Prasad and Ms. Akanisi Caginitoba were accepted into the year-long Pacific NGO Leadership and Management Course, run by UNITEC and funded by the David and Lucile Packard Foundation. Our GIS Officer, Ms. Ingrid Qauqau, received focused training at our headquarters in New York in GIS and remote sensing methods for modeling future land clearing as a way to implement REDD policies. Similarly, our Finance Manager, Mr. Nischal Narain, attended a WCS Finance Conference for the entire Global Conservation Program to better integrate accounting policies across all programs.

At the same time, WCS Fiji also provided training and mentoring to our staff and staff of other partner organizations. We have continued our bi-weekly Peer Learning program, for which we hosted training modules which included the following topics in 2010: statistics; data interpretation; developing key communications messages; office management; cetaceans; reef resilience; and scientific writing. WCS Fiji also provided training to external partners in conservation planning, reef resilience monitoring and riparian survey methodologies.

This report focuses on WCS Fiji's achievements during 2010 under our three main themes of Science, Management and Communication. We additionally highlight our engagement with national and regional planning processes. Consistent with our Memorandum of Understanding (MoU) with the Fiji Department of Environment, we note the links to national priority strategies under the recently developed NBSAP Implementation Plan 2010-2014. Lastly, we describe our projected activities for 2011, including their: funding status; relationship to national priorities; potential outputs; location in Fiji; project partners; donors; timelines; and level of investment in conservation and management action.

SCIENCE

The following sub-sections present a synthesis of completed and ongoing scientific activities by WCS and partners for 2010.

Conservation Planning

Predictive Mapping of Fish Assemblages

STATUS: Phase I complete. Building on results with new investigations (see **Next Steps** below)

FUNDING: David and Lucile Packard Foundation (2007-31847; 2009-34839), Gordon and Betty Moore Foundation (540.01), US National Oceanic and Atmospheric Administration (NA10NOS4630052)

PARTNER ORGANISATIONS: University of Queensland (Australia), University of Waterloo (Canada)

OUTPUTS:

- *Conference Proceedings:* Roelfsema C, Phinn S, Jupiter S, Comley J, Beger M, Peterson E (2010) Object based analysis of high spatial resolution imagery for mapping large coral reef systems in the West Pacific at geomorphic and benthic community spatial scales. Proceedings of the 30th International Geoscience and Remote Sensing Symposium. Honolulu, HI. July 2010
- *Journal Article:* Knudby AK, Roelfsema CM, Lyons M, Phinn SR, Jupiter SD (in review) Mapping fish community variables by integrating field and satellite data, object-based image analysis and modeling in a traditional Fijian fisheries management area. Remote Sensing
- *Conference Presentations:* Roelfsema C, Jupiter S, Knudby A, Lyons M, Phinn S (2010) Object based analysis of high spatial resolution imagery for mapping large coral reef systems to estimate fish resources in Kubulau, Fiji. Presented at the Australian Coral Reef Symposium, Coffs Harbour, Australia, 11-13 September. (also presented at Fiji Islands EcoHealth Forum, Suva, Fiji, 25-26 November).

RESEARCH HIGHLIGHTS:

As nearly 60% of reefs globally are imperiled by human activities, protection of reef fish populations requires urgent and active management. However, tools that have long been promoted by fisheries scientists for managing single species fisheries (e.g. maximum sustainable yield) do not capture ecosystem complexities of multispecies coral reef fisheries. Meanwhile, newer advanced models applied to coral reef fisheries (e.g. Ecopath with Ecosim) require large amounts of data that are often resource intensive to acquire and do not include spatially explicit outputs. Marine protected areas (MPAs) have emerged as an alternative, widespread tool for coral reef fisheries management. As the placement of MPAs in naturally productive areas in one of the drivers of MPA success, coral reef managers could benefit greatly from comprehensive fish resource maps.

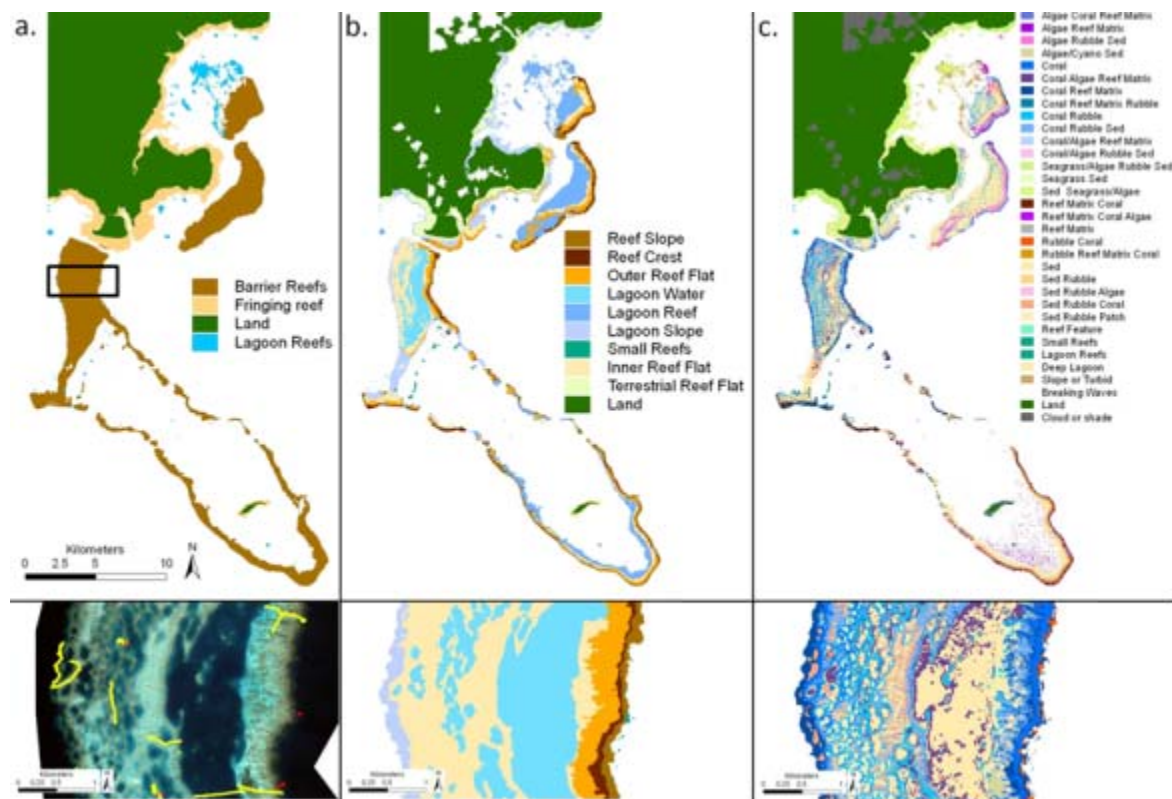


Figure 1. Hierarchical class structure diagram of mapping categories at three different spatial scales: 1) reef type, 2) geomorphic zone, and 3) benthic community. (Figure from Knudby et al. in review)

In this study, we tested the application of optical remote sensing data for predicting fish assemblage characteristics (biomass, species richness, Shannon diversity) over the entire reef complex within the 260 km² traditional fisheries management area (*qoligoli*) of Kubulau District, Bua Province. We used object-based image analysis to create near-seamless classifications of reef benthos and geomorphology from five high-spatial resolution images captured over Kubulau's *qoligoli* (Figure 1). We combined these classifications with derived water depth, as well as measures of seafloor structure and substrate diversity at varying spatial scales, to provide spatially explicit predictions of fish assemblage characteristics (Figure 2). We showed that random forest models outperformed five other model types, and that all three fish community variables can be satisfactorily predicted from the high spatial resolution data. We also showed geomorphic zone to be the most important predictor on average, with secondary contributions from a range of other variables including benthic class, depth, distance from land, and live coral cover mapped at coarse spatial scales (Table 1). These results suggest that data with lower spatial resolution and lower cost may be sufficient for spatial predictions of the three fish community variables.

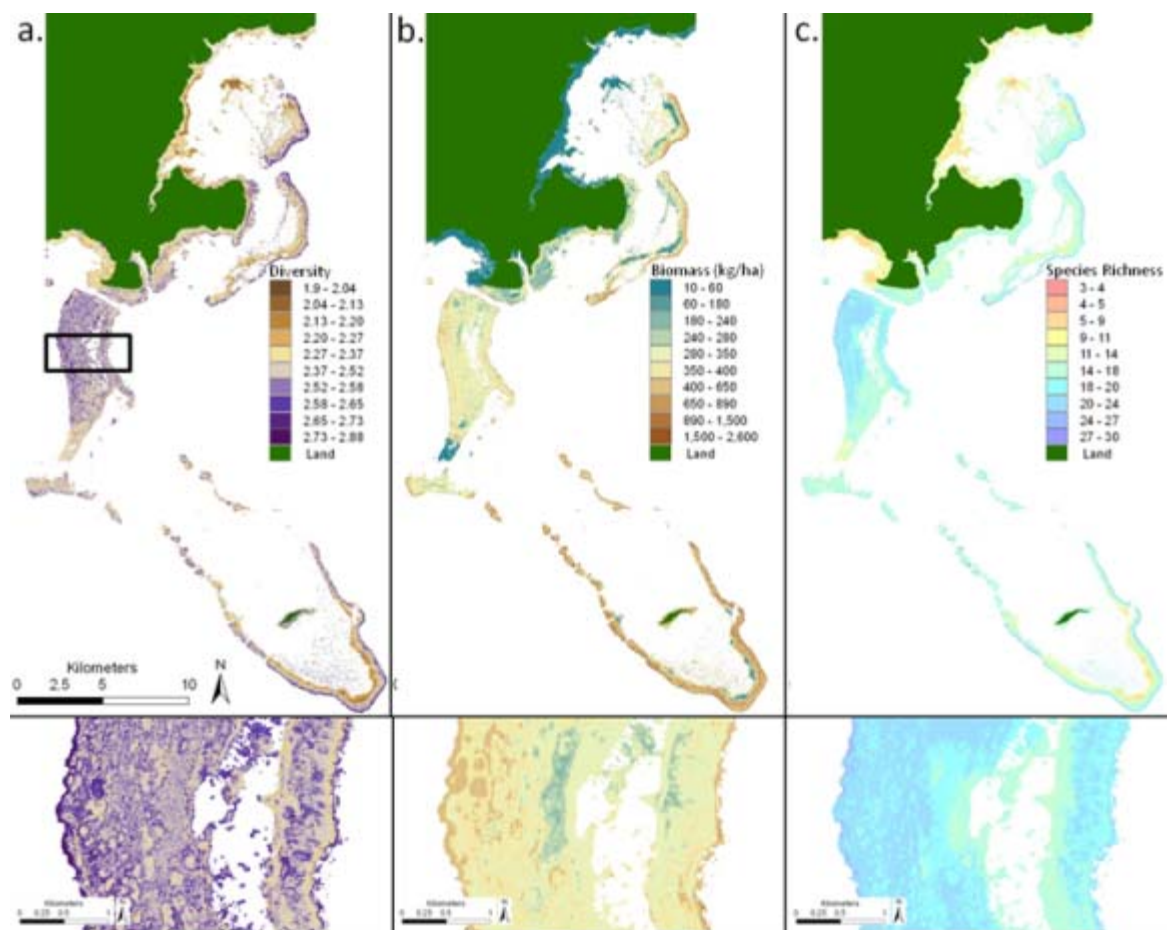


Figure 2. Predictions of the three fish response variables: (a) Shannon diversity, (b) biomass, and (c) species richness. (Figure from Knudby et al. in review)

Table 1: The six predictors with highest importance in the random forest models used to predict each response variable. Abs. Curv. = Absolute Curvature. Hab. Div. = Habitat Diversity. Number following variable indicates the radius of calculation.

Predictor variable	Species Richness (Δ RMSE)	Predictor variable	Biomass (Δ RMSE)	Predictor variable	Shannon Diversity (Δ RMSE $\times 10^{-3}$)
Geomorphic zone	0.656	Geomorphic zone	44.3	Benthos	8.46
Depth	0.183	Distance from land	25.2	Geomorphic zone	7.38
Benthos	0.135	Depth	15.1	Coral, 500 m	5.64
Coral, 500 m	0.079	Coral, 1000 m	13.2	Hab. Div., 100 m	5.00
Abs. Curv., 100 m	0.074	Hab. Div., 200 m	6.56	Abs. Curv., 50 m	3.41
Abs. Curv., 10 m	0.060	Coral, 500 m	5.63	Coral, 200 m	3.33

The predictive maps of fish biomass, species richness and diversity represent an improvement over previous spatial modeling of fish abundance and biomass in Kubulau, which only considered three habitat classes (fringing reef, patch reef, barrier reef) as well as other binary predictor variables (exposure to tides, exposure to waves, depth <10 m) and distance from

land.¹ In order to translate the results into management implementation, biomass and species diversity targets for Kubulau qoliqoli will be developed and weighed against prior calculations of opportunity costs to fishers², enabling revision of recommendations for the MPA network configuration in Kubulau before these are presented to stakeholders for consultation (see ***Planning for Reef Resilience*** below).

NEXT STEPS:

- Predictive modeling of fish assemblage characteristics from free, coarser-scale (30 m) Landsat satellite data
- Predictive modeling of key species and functional groups presence/absence

LINKS TO NATIONAL PRIORITIES:

This project supports **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries)**, **Strategy 4:** Design new ecologically relevant inshore MPAs, **Objective 4.4:** By mid-2012, options for MPA networks are produced and consulted on by all external stakeholders, specifically **Action 4.4a:** Use spatial modeling tools to identify optimum areas for a representative, resilient network of inshore MPAs.

Planning for Reef Resilience

STATUS: In progress

FUNDING: David and Lucile Packard Foundation (2009-34839), US National Oceanic and Atmospheric Administration (NA10NOS4630052), John D. and Catherine T. MacArthur Foundation (10-94985-000-GSS)

PARTNER ORGANISATIONS: N/A

OUTPUTS:

- *Updated handbook for reef resilience monitoring:* WCS (2010) WCS-Fiji marine biological monitoring handbook. Version 3.1. Wildlife Conservation Society-Fiji, Suva, Fiji, 34 pp
- *Reef resilience training tools*
- *Abstract submitted to International Marine Conservation Congress, to be held 11-14 May 2011, Victoria, CANADA*

RESEARCH HIGHLIGHTS:

Climate change is now recognised as one of the greatest threats to coral reefs worldwide. Thus, efforts to develop management strategies that can mitigate the impacts of climate change are

¹ Adams VM, Mills M, Jupiter SD, Pressey RL (2010) Improving social acceptability of marine protected area networks: a method for estimating opportunity costs to multiple gear types in both fished and currently unfished areas. Biological Conservation doi:10.1016/j.biocon.2010.1009.1012. (***See report on this project in WCS Fiji 2009 Annual Report***)

² Ibid.

urgently required. Yet, despite extensive literature on coral reef resilience, applications of this knowledge to inform conservation planning and management strategies remain rare.

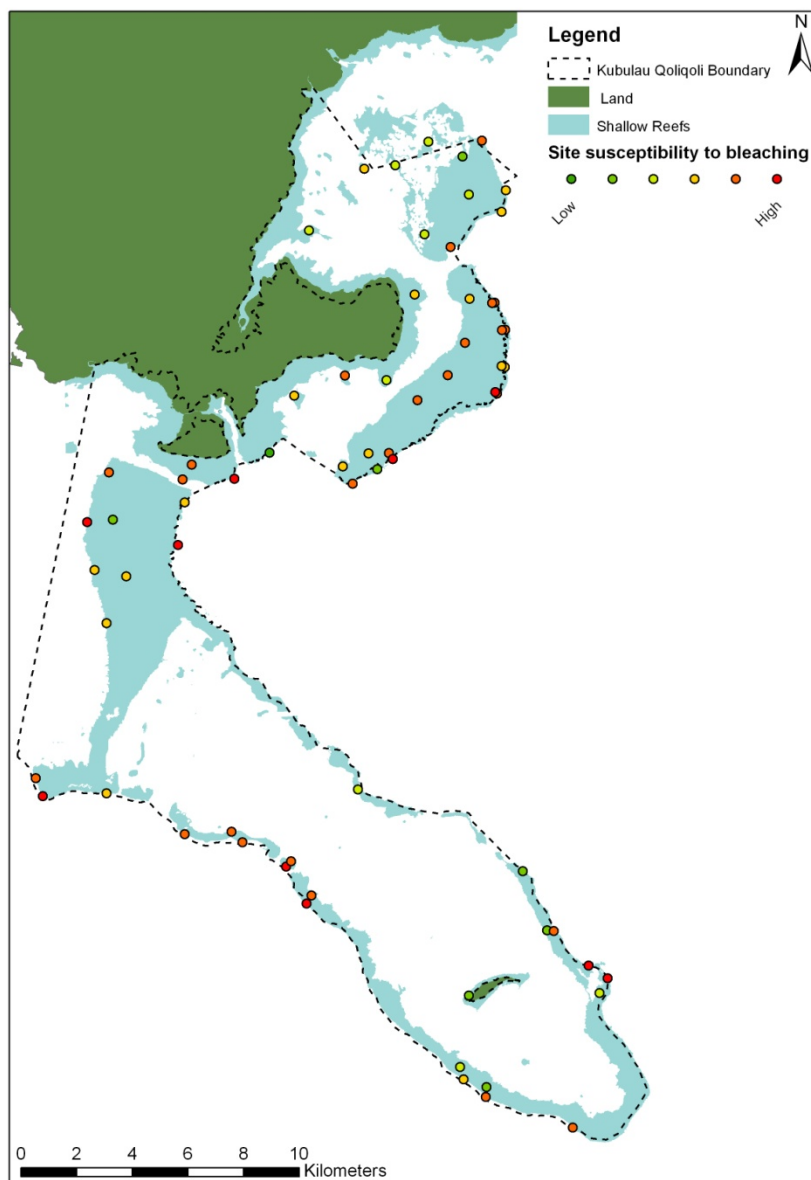


Figure 3. The relative susceptibility of sites in the Kubulau qoliqoli to climate change-induced coral bleaching events. The site susceptibility index is derived from differential susceptibility of coral genera, observed during past bleaching events (taken from the literature), and the relative abundance of coral genera at each site.

WCS Fiji is working to demonstrate an approach to identifying sites that are likely to be resilient to climate change impacts at spatial scales relevant to management in the Pacific. In March 2010, WCS Fiji led a 3 day practical training on reef resilience survey methodology for members of our staff, Fiji Department of Fisheries, and representatives from the University of the South Pacific's Institute of Marine Resources. Following the training, WCS Fiji staff and community volunteers surveyed 70 sites in Kubulau qoliqoli in April and May 2010 to collect information that collectively may reveal inherent differences in site-specific qualities related to the ability of coral reefs to resist disturbance and/or recover rapidly following disturbance. We collected

data on reef fish assemblages, coral population structure, coral recruitment, benthic cover and complexity, shading, and flushing. These data will be combined with reef classifications and predictive fish assemblages derived from satellite imagery (see **Predictive Mapping of Fish Assemblages** above) and used to rank sites against indicators likely to confer resilience to climate change-induced bleaching (Figure 3, Table 2). We will then used a decision-support tool, Marxan, to identify MPA network configurations that explicitly target sites with high resilience.

Table 2. Coral genera susceptibility to bleaching used to inform resilience classifications for sites in the Kubulau qoliqoli

Coral genera	Susceptibility to bleaching ^a	Coral genera (<i>cont.</i>)	Susceptibility to bleaching (<i>cont.</i>)
Acanthastrea	Low	Leptoseris	Low
Acropora	High	Lobophyllia	Moderate
Alveopora	High	Merulina	Moderate
Anacropora	High	Millepora	High
Astreopora	Moderate	Montastrea	Moderate
Caulastrea	Low	Montipora	High
Coscinaraea	Moderate	Mycedium	Low
Ctenactis	Moderate	Oulophyllia	Low
Cycloseris	Moderate	Oxypora	Moderate
Cyphastrea	Low	Pachyseris	Low
Diaseris	Moderate	Paraclavaria	Low
Diploastrea	Low	Pavona	Low
Echinophyllia	Low	Pectinia	High
Echinopora	Moderate	Playtygyra	Moderate
Euphyllia	Low	Plerogyra	High
Favia	Moderate	Pocillopora	High
Favites	Moderate	Podobacia	Low
Fungia	Low	Polyphyllia	Moderate
Galaxea	Low	Porites (branching)	High
Gardinoseris	Low	Porites (massive)	Low
Goniastrea	Moderate	Psammacora	Low
Goniopora	Low	Scolymia	Low
Halomitra	Low	Seriatopora	High
Herpolitha	Moderate	Stylophora	High
Hydnophora	Moderate	Symphyllia	Low
Isopora	High	Tubastrea	High
Leptastrea	Low	Turbinaria	Low
Leptoria	Moderate	Zoopilus	Moderate

^a Summarized from observations of coral genera response to past bleaching events, from the literature (e.g. Marshall & Baird 2000, Loya et al 2001, McClanahan et al 2004, Marshall & Schuttenberg 2006, McClanahan et al 2007, Penin 2007). Where sources recorded different bleaching responses for a genus, the most frequently observed response, or that from the closest geographical location to Fiji, was adopted.

Information on the relative natural resilience of sites, and the degree to which each site's resilience may be strengthened through management actions, will be presented to the Kubulau Resource Management Committee in May or June 2011 and will be used to inform ongoing adaptive management of the qoliqoli.

NEXT STEPS:

- Extrapolate site-based indices of reef resilience across Kubulau reef habitats
- Develop quantitative targets for protection
- Trial scenarios using Marxan software to provide a range of recommendations for community members to reconfigure the Kubulau MPA network
- Present MPA network options to the Kubulau community / KRMC in May-June 2011

LINKS TO NATIONAL PRIORITIES:

This project supports **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries)**, **Strategy 4:** Design new ecologically relevant inshore MPAs, **Objective 4.4:** By mid-2012, options for MPA networks are produced and consulted on by all external stakeholders, specifically **Action 4.4a:** Use spatial modeling tools to identify optimum areas for a representative, resilient network of inshore MPAs.

Fiji National Marine Ecological Gap Analysis

STATUS: Complete

FUNDING: John D. and Catherine T. MacArthur Foundation (10-94985-000-GSS)

PARTNER ORGANISATIONS: ARC Centre of Excellence for Coral Reef Studies, James Cook University (Australia)

OUTPUTS:

- *Interim Report:* Jupiter S, Mills M, Comley J, Batibasaga A, Jenkins A (2010) Fiji marine ecological gap assessment: interim progress report. Wildlife Conservation Society, Suva, Fiji, 26 pp.
- *Journal Article:* Mills M, Jupiter S, Pressey R, Ban N, Comley J (in review) Assessing effectiveness of community-based management strategies towards achieving national biodiversity targets: A new approach for marine conservation in Fiji. Conservation Biology
- *Conference Presentation:* Mills M, Adams V, Jupiter S, Pressey B, Singh P (2010) Planning for action: Tackling the mismatch of scales between regional planning and local implementation in Fiji. Presented at the 24th Annual Meeting of the Society for Conservation Biology, Edmonton, Alberta. 3-7 July.
- *PAC Provincial Planning Meeting Report:* Jupiter S, Mills M, Weeks R, Adams V, Qauqau I, Tora K (in prep) Filling the gaps: identifying candidate sites to expand Fiji's national protected area network: Outcomes report from provincial planning meeting, 20-21 September 2010. Wildlife Conservation Society, Suva, Fiji.

RESEARCH HIGHLIGHTS:

Overfishing has contributed to massive declines of fisheries and marine species' biomass, with large effects on marine ecosystem services and human well-being. Consequently, many countries have committed (e.g., by signing the Convention on Biological Diversity, CBD) to effectively managing a proportion of their marine resources to reduce or halt declines. Signatories to the CBD commit to establishing networks of representative and effectively managed national and regional protected areas in marine environments, aimed at the conservation of all levels of biodiversity. Approaches to representing biodiversity generally rely on surrogates such as focal species and ecosystems to compensate for the lack of data on genetic and species diversity. In this study, we assessed Fiji's progress towards meeting its commitments to the CBD by carrying out gap analyses under different assumptions about the relative effectiveness of community-based management strategies.

Gap analyses measure progress towards commitments such as those of the CBD. Many countries, including Fiji, set a broad national goal of effectively managing 30% of representative inshore marine waters. In May 2009, WCS Fiji facilitated a workshop to identify key marine species and surrogate habitat targets, which was later refined based on data availability and a follow-up workshop in March 2010 (Table 3).

To assess achievement towards the conservation targets set at the March 2010 workshop, we collated information on the distribution of ecosystems, management strategies, and the ecological effectiveness of strategies. We then used three alternative gap analyses to assess achievement of national marine conservation objectives in Fiji. Each gap analysis had a different assumption:

- (1) Areas covered by locally managed marine areas (LMMAs) are fully effective for species and ecosystem conservation;
- (2) Areas covered by closures are fully effective for species and ecosystem conservation but areas outside closures provide no protection, and;
- (3) Different management strategies vary in their effectiveness for species and ecosystem conservation.

Assumptions (1) and (2) represented, respectively, the most optimistic and pessimistic views on ecological effectiveness in Fiji, and represent how gap analysis have been undertaken in the scientific literature so far. These optimistic and pessimistic scenarios in this study represent this traditional approach to assessing conservation achievements. Assumption (3) was based on scientific consensus at the March 2010 workshop about the ecological effectiveness of management strategies and represents a new approach to assessing total ecological effectiveness across multiple managed zones.

Table 3. Surrogate habitat targets for marine biodiversity conservation in Fiji

Habitat	Main Species	% Target	Data Source
Intertidal mudflats	Shorebirds, invertebrates	30% (with 100% of mudflats known to be important to waders in 2009)	Fiji Department of Lands, digitized from aerial photographs captured in 1986 and validated in 1995
Mangroves	Fish, invertebrates, seabirds, bats, mangroves	30%	Fiji Department of Forestry, digitized from 2001 Landsat ETM+ data
Fringing reef	Coral, invertebrates, fish	30%	Fiji Department of Lands, exposed and submerged reefs digitized from aerial photographs captured in 1994 and 1996. Reefs that had sections less than 100m from the coastline were classified as fringing, all others were non-fringing
Non-fringing reef	Coral, invertebrates, fish	30% (with 100% of reef channels known to support spawning aggregations)	As above
Other benthos < 30 m	Invertebrates, fish, seagrass, turtles	10% (with 100% of highest quality turtle feeding ground known from 2009)	General Bathymetric Chart of the Oceans
Permanent sandy cays, beaches and coastal littoral forests	Turtles, seabirds	50% (with 100% of priority seabird and turtle nesting sites known from 2009)	N/A

Empirical data on the ecological effectiveness of different marine management strategies in Fiji are unavailable. Expert advice was consequently considered the best source of information until field data are collected. In this study we used a combination of methods from the management and social science literature to obtain such scores. Twelve participants were invited for their knowledge of fauna and flora and local experience with resource management. Participants included representatives from the Institute of Applied Science (University of South Pacific), International Union for Conservation of Nature, Department of Fisheries, Wetlands International-Oceania, Wildlife Conservation Society, and National Trust of Fiji, all of whom have expert knowledge of local flora and fauna and have considerable experience with local resource management. Once participants were critically thinking about differential management, they were then asked to scale the ecological effectiveness of different management types based on a continuous scale, from 0 to 1. A value of 1 represented maximum level of protection from fishing and associated damage (e.g. one would expect local fish populations to return to non-exploited levels if the population has not fallen below critical

thresholds) and 0 represented no benefit from management. No-take closures, all given a value of 1, were assumed to be fully ecologically effective.³

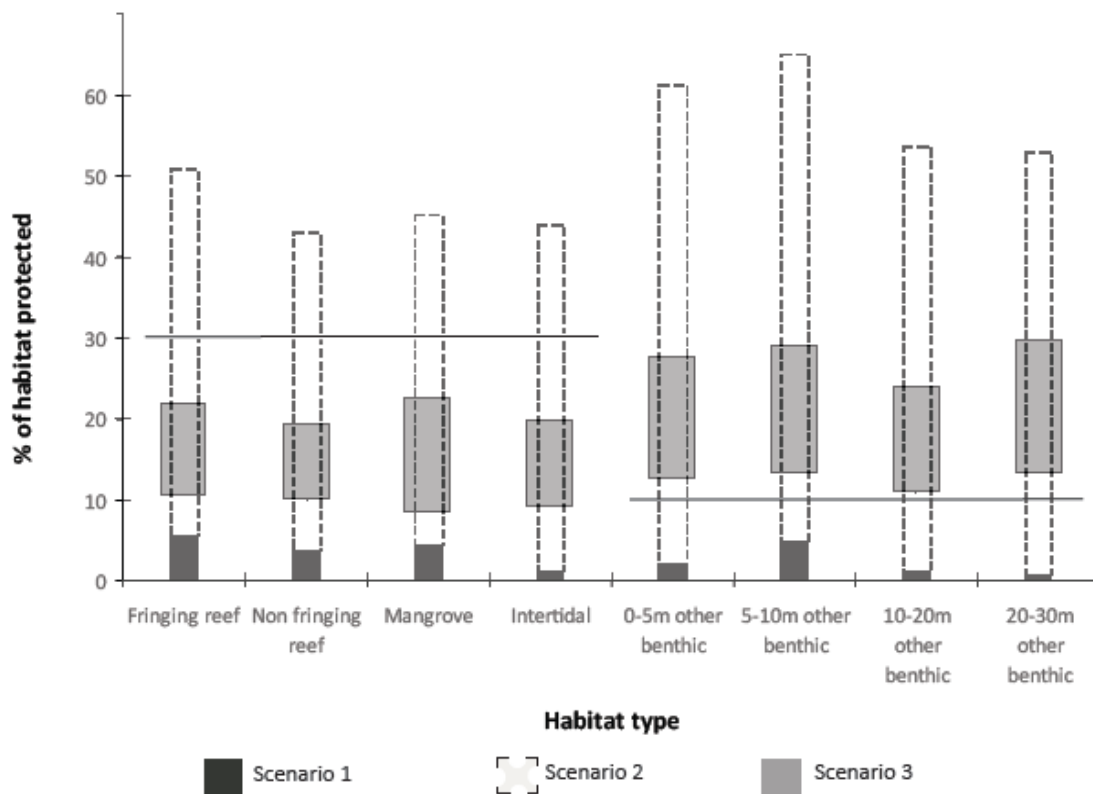


Figure 4. Graph showing the percentage of area under effective protection according to three management effectiveness scenarios. Scenario 1: Considers all closures are 100% effective. Scenario 2: Considers LMMAs are 100% effective. Scenario 3: Considers differential effectiveness of the different management strategies (range based on upper and lower effectiveness limits). (Figure from Mills et al. in review)

When all management strategies within LMMAs were assumed to be fully effective (assumption 1), Fiji exceeded its conservation objectives for all ecosystems (Figure 4), coverage of all ecosystems was higher than 40%. The highest percentage coverage was for ‘other benthic’ ecosystems at depths of 0-5 m and 5-10 m (59% and 60% respectively). LMMAs ranged in size from 0.01 to 4,168 km² (mean 119 km², median 11 km²). When all types of closures were assumed to be fully effective but other management strategies made no contribution (assumption 2), none of Fiji’s conservation objectives were met (Figure 4). Coverage ranged from a maximum of 6% for fringing reefs to 1% for intertidal ecosystems. Closures were generally very small, ranging in size from 0.01 to 66 km² (mean 3 km², median 1 km²). When

³ All effectiveness weighting scores are found in the following report: Jupiter S, Mills M, Comley J, Batibasaga A, Jenkins A (2010) Fiji marine ecological gap assessment: interim progress report. Wildlife Conservation Society, Suva, Fiji, 26 pp.

different management strategies had different ecological effectiveness scores (assumption 3), Fiji only met or exceeded its conservation objectives for 'other benthic' ecosystems in all depth classes (Figure 4). Additional coverage of between 10 and 20% of fringing reef, non-fringing reef, mangrove and intertidal ecosystem is still required to meet objectives.

In September 2010, WCS Fiji and partners facilitated a workshop with the Roko Tui (Provincial Administrators) from all 14 provinces across Fiji where we: (1) presented the results of the marine ecological gap analyses; (2) described national marine priority locations for Fiji; and (3) worked with the representatives from each province to identify candidate sites for future protection and management that met both provincial and national objectives. WCS Fiji prepared a report of the outcomes, with maps of the proposed sites, for distribution to each province.

NEXT STEPS:

- Work through the Protected Area Committee with Provincial Offices to implement site-based management at candidate sites
- Source funding for sustainable financing of candidate sites
- Use modeling software to simulate growth of LMMA network through status quo methods versus decision-support software to identify alternative mechanisms to meet national targets

LINKS TO NATIONAL PRIORITIES:

This project supports:

- **NBSAP Implementation Plan Thematic Group 6 (Protected Areas), Strategy 1:** Identify gaps in biodiversity protection against national targets, **Objective 1.1:** By end 2010, initial iteration of terrestrial and marine gap analyses complete, specifically **Actions 1.1a-d**
- **NBSAP Implementation Plan Thematic Group 6 (Protected Areas), Strategy 2:** Expand protected area network in priority sites at the national level and provincial level to achieve national targets, **Objective 2.1:** By end 2011, complete list of priority terrestrial and marine sites developed, **Actions 2.1a-c**

Marine Protected Area Effectiveness

Drivers of Effectiveness in Kubulau MPA Network

STATUS: Complete

FUNDING: David and Lucile Packard Foundation (2007-31847), Gordon and Betty Moore Foundation (540.01), National Oceanic and Atmospheric Administration (NA07NOS4630035)

PARTNER ORGANISATIONS: Wetlands International-Oceania

OUTPUTS:

- *Journal Article:* Jupiter SD, Egli DP (2011) Ecosystem-based management in Fiji: successes and challenges after five years of implementation. *Journal of Marine Biology*. doi:10.1155/2011/940765
- *Journal Article:* Clarke P, Jupiter SD (2010) Law, custom and community-based natural resource management in Kubulau District (Fiji). *Environmental Conservation* 37:98-106
- *Technical Report:* Jupiter SD, Egli DP, Jenkins AP, Yakub N, Hartley F, Cakacaka A, Tui T, Moy W, Naisilisili W, Dulunaqio S, Qauqau I, Prasad S (2010) Effectiveness of marine protected area networks in traditional fishing grounds of Vanua Levu, Fiji, for sustainable management of inshore fisheries. Wildlife Conservation Society-Fiji and Wetlands International-Oceania Technical Report no. 03/10. Suva, Fiji, 59 pp.
- *Technical Report:* Jupiter SD, Clarke P, Prasad SR, Egli DP, Tui T, Caginitoba A, Qauqau I (2010) Non-compliance with management rules and its implications for traditional fisheries in Fiji. Wildlife Conservation Society-Fiji Technical Report no. 04/10. Suva, Fiji, 29 pp.
- *Technical Report:* Egli DP, Tui T, Jupiter SD, Caginitoba A (2010) Perception surveys of coastal resource use and changes following establishment of a marine protected area network in Kubulau, Fiji. Wildlife Conservation Society - Fiji Technical Report no. 07/10. Suva, Fiji, 16 pp.

RESEARCH HIGHLIGHTS:

Over the past two decades, hundreds of communities in the western Pacific have established locally managed marine areas (LMMAs) to control the perceived decline of marine natural resources. The primary tool applied for the management of coastal marine resources within LMMAs is the use of traditional temporary closures, where the local community chooses the location, size, and management regime for their closed area. These areas tend to be small, averaging just 0.2–3.3 km² for the Cook Islands, Fiji, Papua New Guinea, Samoa, Solomon Islands, and Tonga. Because their boundaries tend to fall within the secure, customary tenure of one village or clan, they are typically easy to manage because there are no overlapping governance constraints and their location is often within visual distance from villages. However, while the benefits of many, small reserves can theoretically maximize fisheries yields, there may be a threshold size below which potential benefits of protection are outweighed by negative edge effects. Furthermore, the reserves must be placed in appropriate habitat that will maximize fisheries production. There is strong evidence to support reduced fish biomass in habitats characterized by macroalgae and unconsolidated sediments, which are typically found on fringing reef flats and backreef lagoons where traditional closures are often established.

WCS Fiji initiated an alternative, complementary approach in Kubulau District in 2005, representing one of the first efforts in Oceania to design and implement an ecologically functional MPA network. Traditional-style periodic closures were combined with large, permanent, no-take reserves in a network design using ecosystem-based management (EBM) principles, with approximately 30% of the qoliqoli area under closure to maximize fisheries and biodiversity benefits. Initial placement of MPAs was based on baseline biological surveys and

design criteria that considered size, spacing, and representation of habitats and critical processes (e.g., spawning aggregations) in a multispecies framework. The design was subsequently modified following extensive socioeconomic assessments and consultations with resource owners in order to spread cost and maximize compliance. An ecosystem based management plan was completed for the protected area network in Kubulau District and qoliqoli and was endorsed by the hierarchy council of chiefs (*Bose Vanua*) in July 2009. The planning process was informed by extensive scientific and socioeconomic research as well as local and traditional ecological knowledge. Conceptual modeling methods were used to define conservation targets, threats, and management strategies both for the qoliqoli and the adjacent catchments lands in order to embed the MPA network in a broader management framework.

This study program evaluated the biological and socioeconomic factors that have contributed to the effectiveness of the MPAs within the Kubulau network to achieve their goal of increasing fish biomass following the first five years of management. In particular, we asked: (1) which factors are responsible for positive responses of fish populations to management; and (2) which factors have contributed to a lack of response in certain cases. We surveyed fish populations inside and adjacent to five different MPAs and tabu areas with a range of histories and level of compliance with management rules. Our survey data yielded mixed results (Figure 5), leading to the following main conclusions:

- (1) In the Kubulau MPA network, the factors which appeared to have the most influence on the success of management to provide protection of exploited species included: size; placement of reserves in naturally productive habitats; visibility from land; distance from potential poaches; and degree and longevity of protection;
- (2) MPAs need to be larger than the home ranges of targeted fish species to avoid catching species with large home ranges when they forage outside of the MPA;
- (3) Where poaching by people from outside the district is a problem (e.g. Nasue MPA), district managers need to approach the neighbouring districts to both raise awareness of the management rules in the Kubulau ecosystem based management plan and to assist the districts to establish their own protected area networks;
- (4) Where non-compliance by traditional resource rights owners is a problem because local residents are likely targeting areas with high fish biomass (e.g. Namuri MPA in 2009), more careful attention needs to be paid with respect to dissemination of sensitive monitoring information which in the future should only be shared during restricted meetings; and
- (5) Where non-compliance by traditional resource rights owners is a problem due to perceived inequity of costs, the options are to: (a) consider MPA network configurations that better spread cost among resource users; and/or (b) amend current Fiji fisheries legislation to give legal legitimacy to community no-take closures.

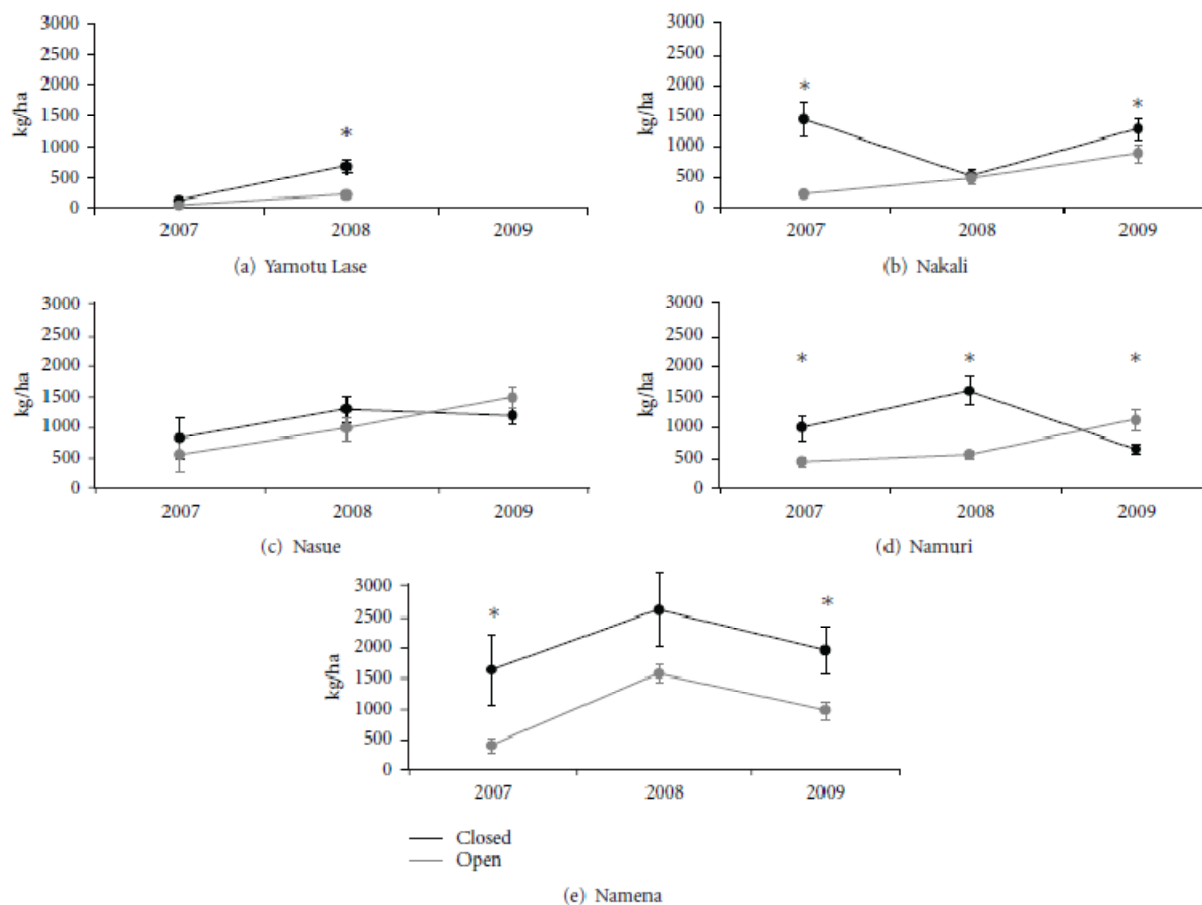


Figure 5. Mean total fish biomass (kg/ha) in closed (black) and adjacent open (grey) areas of: (a) Yamotu Lase tabu; (b) Nakali tabu; (c) Nasue MPA; (d) Namuri MPA; and (e) Namena MPA for survey periods between 2007 and 2009. Error bars are ± 1 standard error. * denotes significant difference to at least $P < 0.05$ with PERMANOVA test. (Figure from Jupiter and Egli 2011)

NEXT STEPS:

- Identify reconfiguration options for Kubulau MPA network to reduce conflict and improve reef resilience (see also **Planning for Reef Resilience** above)
- Continue to provide input to Fiji Department of Fisheries on draft *Inshore Fisheries Decree*

LINKS TO NATIONAL PRIORITIES:

This project supports **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries)**, **Strategy 3:** Maintain existing MPAs, **Objective 3.2:** By 2014, biodiversity surveys show no decline in numbers related to 2010 levels and there is a 15% increase (which must be a significant difference) in biomass of targeted species inside MPA compared with outside, **Action 3.2a:** Monitor core set of existing MPAs for biodiversity and fisheries resources compared with unmanaged sites.

Catchment to Reef Processes and Human Livelihoods

Factors Influencing Freshwater Fish Assemblages

STATUS: Complete

FUNDING: David and Lucile Packard Foundation (2007-31847), Gordon and Betty Moore Foundation (540.01)

PARTNER ORGANISATIONS: Wetlands International-Oceania (Aaron Jenkins - lead)

OUTPUTS:

- *Journal article:* Jenkins AP, Jupiter SD, Qauqau I, Atherton J (2010) The importance of ecosystem-based management for conserving aquatic migratory pathways on tropical high islands: A case study from Fiji. *Aquatic Conservation: Marine and Freshwater Ecology* 20:224-238
- *Journal article:* Jenkins AP, Jupiter SD (in review) Spatial and seasonal patterns in freshwater ichthyofaunal communities of Vanua Levu, Fiji. *Environmental Biology of Fishes*
- *Conference presentation:* Jenkins A, Jupiter S (2010) Seasonal patterns in fish abundance and diversity in Vanua Levu catchments. Presented at the Fiji Islands EcoHealth Forum, Suva, Fiji, 25-26 November

RESEARCH HIGHLIGHTS:

In the WCS Fiji 2009 Annual Report, we presented findings showing that loss of catchment forest cover and presence of non-native tilapia fish are both significantly associated with declines in native freshwater fish species. These results are now published in Jenkins et al. (2010).

To our knowledge, very few studies have examined seasonality in freshwater fish assemblages of Pacific island communities. To address this information gap, we investigated differences in fish communities along lower, mid and upper reaches of Kubulau District and Macuata Province of Vanua Levu, during the wet and dry seasons, to assess the main drivers of community composition as well as specific differences related to seasonality. We hypothesized that in near pristine, tropical high island catchments, the wet season offers greater habitable space for freshwater fishes and cues upward migrations of amphidromous species. In addition, given that Jenkins et al. (2010) showed significant loss of fish diversity when catchment forest cover fell below 50%, we postulated that increased sediment-laden runoff during the wet season in the more degraded catchments of Macuata may negatively affect fish diversity and abundance in degraded catchments.

We collected or observed 1616 individual fishes from 32 families, 19 genera and 87 species over both seasons and regions. This amounts to approximately half of the species of freshwater and estuarine fishes recorded from Fijian rivers. Position in reach was a more dominant driver of

fish community composition than region or season: lower reach sites were significantly distinct from mid and upper sites in Kubulau and Macuata (Figure 6).

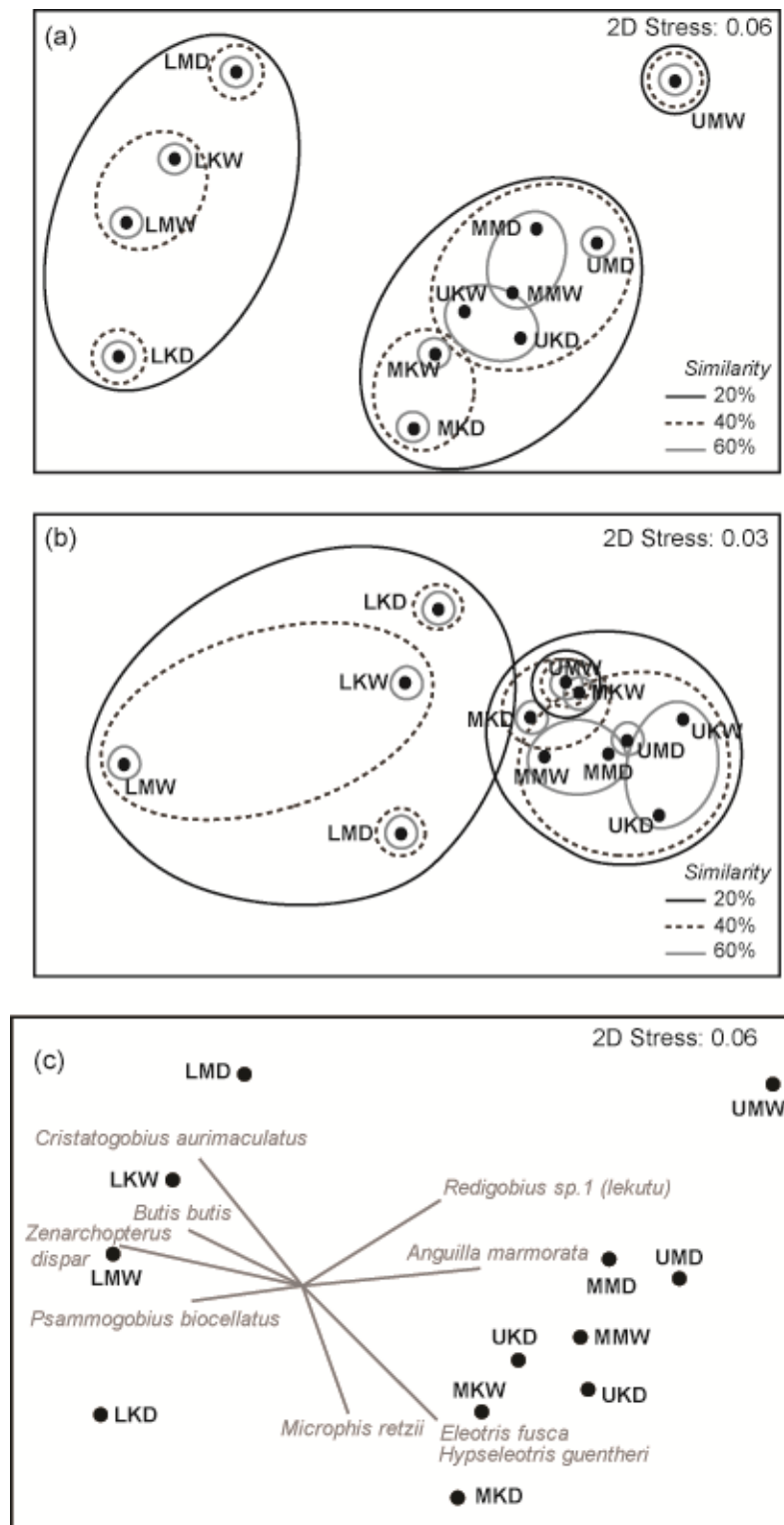


Figure 6. Two-dimensional multidimensional scaling (MDS) plots of (a) freshwater fish presence/absence pooled by reach and season and (b) mean environmental variables (temperature, turbidity, width) which explained the most variance in fish communities. (c) freshwater fish presence/absence pooled by reach and season overlaid with vectors for the subset of fish species with the consistently highest correlation ($\rho_s = 0.952$) with the full resemblance matrix. Three letter codes indicate: (first letter) L/M/U: lower/mid/upper; (second letter) M/K: Macuata/Kubulau; (third letter) W/D: wet/dry season). (Figure from Jenkins and Jupiter in review)

Temperature, turbidity and river width were selected as environmental variables with the best match to explain community structure composition and were significantly correlated ($\rho_s = 0.569$, $p < 0.01$) to the fish community presence-absence matrix. The MDS plot of temperature, turbidity and river width data show similar breaks between lower reach versus mid and upper reach sites (Figure 6b), with higher temperatures, greater turbidity and wider river beds in lower reach sites.

Overall, we observed 12% more species during the wet season (68 vs 58). However, ANOVA tests showed significant interaction terms between region and season, whereby we observed higher species abundance and diversity in the wet season in Kubulau District versus the opposite pattern in the dry season in Macuata Province (Figure 7). Amphidromous species accounted for a considerable proportion of the increase in species richness in the wet season in Kubulau across all reaches, but this was not observed in Macuata.

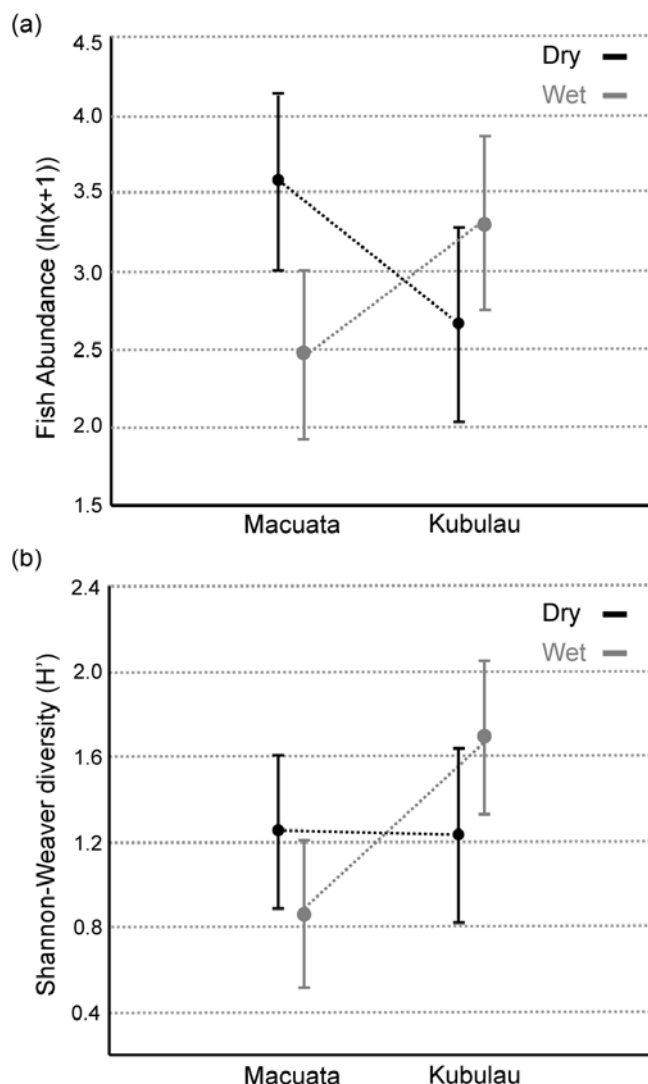


Figure 7. Differences by region and season for: (a) transformed fish abundance; and (b) Shannon-Weaver diversity (H') index. Error bars represent $\pm 95\%$ confidence interval. (Figure from Jenkins and Jupiter in review)

The loss of fish species during the wet season in the more cleared and cultivated catchments of Macuata indicate the need for enhanced land management, particularly along river margins. As many freshwater fishes in Fiji move across multiple habitats during their life cycles, the management unit for these fish should be the entire river basin, including the adjacent estuarine and marine ecosystems (Jenkins et al. 2010). Specific management actions, such as permanent bans on harvesting sensitive species, are also warranted to protect distinctive fish communities within each reach. The strong break between lower reach and mid to upper reach fish communities in Fiji emphasizes the need to sample all reaches at a minimum when conducting diversity surveys of tropical high islands. In addition, given the high number of seasonally exclusive species that contribute to the higher overall diversity within Vanua Levu river basins, sampling

should be conducted across both wet and dry seasons in order to completely understand species composition.

NEXT STEPS:

- Investigate links between seasonal food availability, catchment condition and nutrition (see *Ecosystem Links to Human Health* below)

LINKS TO NATIONAL PRIORITIES:

This project supports **NBSAP Implementation Plan Thematic Group 7 (Inland Waters), Strategy 1: Improve and update information on status of wetlands and wetland biodiversity, Objective 1.1:** By end 2011, national wetland inventory of habitats (as well as their flora and fauna) produced as baseline for national planning, **Action 1.1b:** Collate and update information into spatially registered database.

Links Between Catchment, Riparian and In-stream Conditions

STATUS: In progress

FUNDING: David and Lucile Packard Foundation (2009-34839)

PARTNER ORGANISATIONS: Wetlands International-Oceania

OUTPUTS:

- *Training materials:* Training course developed for riparian and freshwater surveys

RESEARCH HIGHLIGHTS:

WCS Fiji and WIO are involved in a collaborative project to answer the question: "How does catchment land cover and riparian forest width influence in-stream fish communities and biophysical characteristics of streams?" To date, work on this project has included staff training, site selection and data collection, which will be followed by comprehensive data analysis in 2011.

WIO conducted a three day lecture and practical training course between 5-7 October with considerable input from WCS Fiji for staff of WIO, WCS, Fiji Department of Fisheries, University of the South Pacific and Resort Support. Participants were: (1) given background on links between land cover change, water quality degradation and loss of biodiversity and ecosystem services; (2) trained in freshwater fish identification; and (3) instructed in the fundamentals of riparian and freshwater surveys.

A team consisting of staff from WCS Fiji, WIO, Department of Fisheries and Department of Forestry conducted riparian and freshwater surveys between 15 October and 15 November 2010. We selected sites in southern Bua Province and Macuata Province using a stratified design with two treatment levels. We first selected sub-catchments with > or < 50% forest

cover. Within each sub-catchment forest cover group, we selected 4 sub-catchments each with riparian cover $>$ or $<$ 30 m. We conducted 2 replicates within each sub-catchment for a total of 32 sites (Figure 8). Some sites were modified upon reaching the field due to access issues and/or dried up streams.

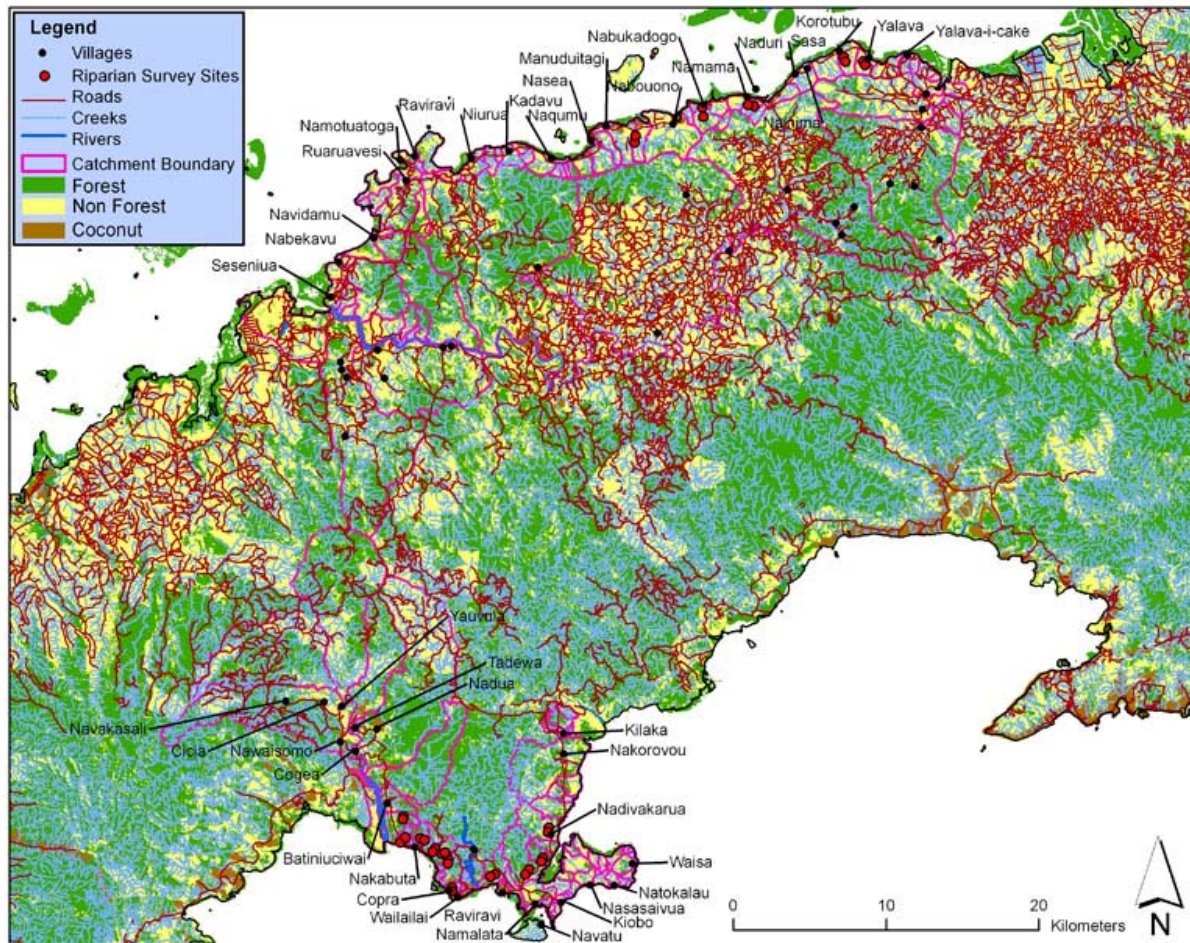


Figure 8. Map of planned survey sites in Wainunu and Kubulau districts of Bua Province and Macuata and Sasa districts of Macuata Province. Sites are overlaid on 1994 Fiji Forest Function Map from the Fiji Department of Forestry.

We will be testing the hypothesis that intact riparian systems, even within highly modified sub-catchments, offer strong ecosystem services benefits for food security, water quality and biodiversity protection.

NEXT STEPS:

- Multivariate data analysis to determine whether significant differences exist between treatments (sub-catchment forest cover/riparian width)

LINKS TO NATIONAL PRIORITIES:

This project supports:

- **NBSAP Implementation Plan Thematic Group 1 (Forest Conversion), Strategy 2:** Promote research and awareness on forests and terrestrial resources, **Objective 2.2:** By 2012, promote at least 2 case studies on the relationship between forests cover and ecosystem services, **Action 2.2h:** Undertake a survey on current status of biological resources, specifically those of subsistence and economic importance and those that are threatened or need attention for protection
- **NBSAP Implementation Plan Thematic Group 7 (Inland Waters), Strategy 1:** Improve and update information on status of wetlands and wetland biodiversity, **Objective 1.1:** By end 2011, national wetland inventory of habitats (as well as their flora and fauna) produced as baseline for national planning, **Action 1.1b:** Collate and update information into spatially registered database.

Ecosystem Links to Human Health

STATUS: In progress

FUNDING: TBD

PARTNER ORGANISATIONS: Columbia University (Dr. Ilana Brito - lead), Wetlands International-Oceania, Ministry of Health, Fiji National University

OUTPUTS:

- *Conference presentation:* Brito I (2010) Tracing bacterial transmission between people and their environment. Presented at Fiji Islands EcoHealth Forum, Suva, Fiji, 25-26 November

RESEARCH HIGHLIGHTS:

Our capability to predict outbreaks of infectious diseases depends on knowing which factors are crucial for the spread of pathogens. Ecological factors, including weather, and human behaviors, including livestock husbandry practices, are hypothesized to be important for the transmission of bacterial diseases among human populations and between humans and their livestock. The existence of pathogenic bacteria capable of colonizing both human and livestock gut suggests that benign bacteria may be similarly transferred and shared among these populations. Using high throughput sequencing, the modes of transmission of benign bacteria can be quantitatively assessed and applied to epidemiological models in order to test whether observations of benign bacteria transmission may serve as a proxy for pathogenic bacteria. This data can inform epidemiological forecasting to predict pathogen spread and more precisely determine what the key ecological and behavioral factors are that govern bacterial transmission. The goal for this collaborative project led by Dr. Ilana Brito of Columbia University, in partnership with WCS Fiji, WIO, the Ministry of Health and Fiji National University, is to validate this approach to quantitatively explore landscape epidemiology without the requirement of a pathogenic species.

Bacterial diseases, including typhoid and leptospirosis, are endemic to the relatively isolated, traditional communities of Vanua Levu, Fiji. Regular outbreaks appear broadly linked with climatic changes, land use and animal husbandry practices, suggesting that this location will be apt for justifying this approach and putting into public health use. The goals of this study are synergistic with ongoing studies in Fiji by WCS Fiji and WIO defining and quantifying the links between environment and health. The project has been approved by the Ministry of Health's ethics board.

Specific Aim 1: To determine the microflora composition of domesticated animals and compare this with empirical and published studies of human microflora. The microflora of domesticated animals has not yet been assessed. Two-thirds of human diseases are caused by generalist pathogens which can infect livestock species, yet it is unknown whether this is indicative of the overlap between microbial communities or it represents the opportunistic pathogen's ability to invade. Understanding the composition of livestock bacterial communities would have immediate usage for the agricultural industry, maintaining veterinary health, and for public health in decreasing food-borne illness, antimicrobial resistance and zoonotic disease.

Specific Aim 2: To combine bacterial metagenomics with epidemiological surveys to inform models of disease spread among human populations. Surveys and contact tracing of infections have been the traditional means of studying bacterial spread. Comparing these techniques with bacterial community profiling of individual hosts will determine whether sampling the benign microbial sub-communities in an otherwise healthy population could be a useful tool for predicting pathogenic bacterial spread.

Specific Aim 3: To determine environmental and temporal factors in environmental bacterial spread. Humans and animals can acquire infections through contact, ingestion or inhalation of bacteria present in soil. Environmental changes, including weather patterns, erosion and flooding, contribute to disease spread and presumably, benign bacterial transfer. These events may homogenize bacterial populations. To understand how human and livestock bacterial communities are affected by their environment, bacterial populations pre- and post- rainy season from humans, livestock and soil will be compared. Clustering bacterial populations across gradients of abiotic factors (i.e. soil moisture and acidity), geospatial attributes (including altitude and gradient), and land use will determine the ecological drivers of bacterial exchange.

NEXT STEPS:

- Field data collection will take place between February - April 2011

LINKS TO NATIONAL PRIORITIES:

This project supports **NBSAP Implementation Plan Thematic Group 7 (Inland Waters), Strategy 4:** Conduct valuation of wetland services so that they are properly accounted for in decision-making, **Objective 4.1:** By 2013, economic valuations are performed for important wetland ecosystems, species and functions and the value of wetland conservation, **Action 4.1a:** Investigate impact of wetland degradation to public health, food security and poverty prevention

MANAGEMENT

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

National-scale engagement

Protected Area Committee Provincial Planning Workshop

STATUS: Complete

FUNDING: John D. and Catherine T. MacArthur Foundation (10-94985-000-GSS), UNDP-GEF Early Action Grant to National Trust of Fiji (Focal Point for PAC)

PARTNER ORGANISATIONS: Fiji Protected Area Committee, National Trust of Fiji, FLMMA, iTaukei Affairs Board, Birdlife International, Nature Fiji, Conservation International, WWF, WIO, Ministry of Agriculture, Fisheries and Forests, Department of Culture and Heritage

OUTPUTS:

- *Technical Report:* Jupiter S, Mills M, Weeks R, Adams V, Qauqau I, Tora K (in prep) Filling the gaps: identifying candidate sites to expand Fiji's national protected area network: Outcomes report from provincial planning meeting, 20-21 September 2010. Wildlife Conservation Society, Suva, Fiji.

HIGHLIGHTS:

For the first time ever, Roko Tui and Senior Assistant Roko Tui of the 14 provinces of Fiji were invited to join members of the national Protected Area Committee and the Fiji Locally Managed Marine Area network to a National Planning Workshop, facilitated by WCS Fiji at Nadave training centre between 20-21 September 2010 (Figure 9). During the workshop, the participants were briefed on the following issues: (1) the work to date by the National Protected Area Committee in assessing progress against Fiji's national biodiversity targets under the current system of terrestrial and marine protected areas; (2) the role that government, NGOs and other agencies have played in prioritising areas for protection and management to conserve Fiji's unique biodiversity and preserve livelihoods; and (3) the partnership arrangement that exists amongst these agencies and the local communities in terms of the management of their protected areas.

The Roko Tui were exposed to a series of related lectures on Fiji's national gap analysis, various prioritization processes to identify areas of national biodiversity significance, and the evolution of both the Fiji Locally Managed Marine Area (FLMMA) and the terrestrial protected area networks to allow them to have an in depth knowledge of the conservation strategies employed in both ecosystems. A major part of the workshop was devoted to conservation planning using maps and charts to assist the Roko Tui and their community leaders involved with both the marine and terrestrial protected to identify critical areas within both ecosystems into which the villages, tikina and provinces could expand their conservation activities.



Figure 9. Roko Tui, Senior Assistant Roko Tui and representatives of partner conservation and natural resource management organisations at the PAC workshop in Nadave.

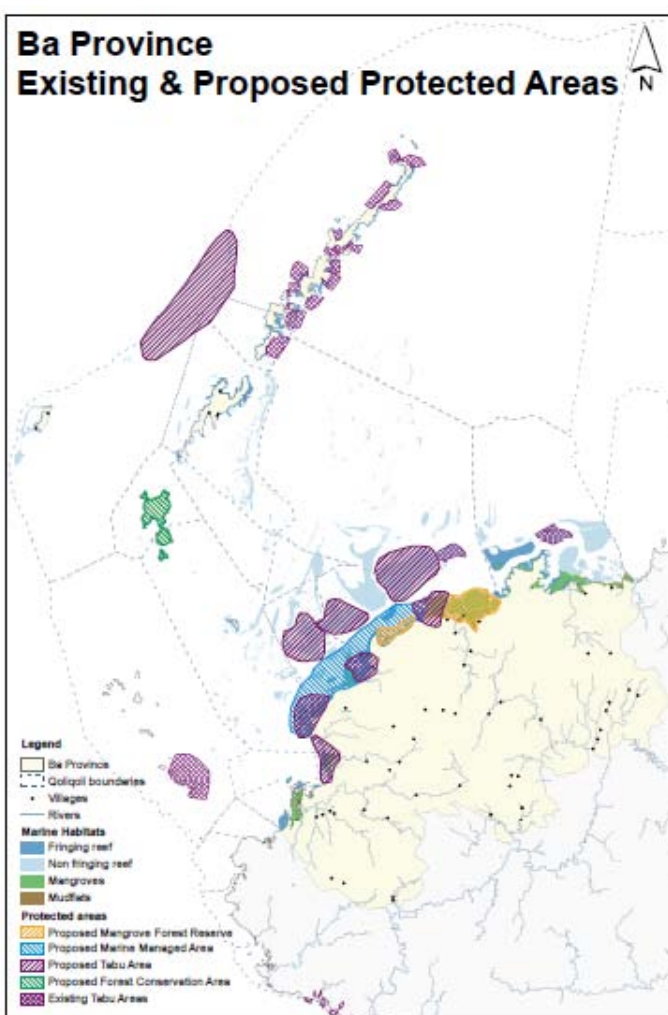


Figure 10. Example of map output from workshop for Ba Province showing the locations of marine habitats, proposed mangrove protected areas and forest reserves, proposed tabu areas, proposed forest conservation areas, and existing tabu areas.

Workshop outputs included: (1) maps of candidate natural and cultural heritage sites proposed for protection (Figure 10); (2) strategies on how to communicate to their communities critical issues discussed in the workshop; and (3) action plans for next steps implementation

NEXT STEPS:

- Distribute outcomes report to all provincial offices
- Source finances to host stakeholder workshops and develop implementation plans

LINKS TO NATIONAL PRIORITIES:

This project supports **NBSAP Implementation Plan Thematic Group 6 (Protected Areas), Strategy 2:** Expand protected area network in priority sites at the national level and provincial level to achieve national targets, **Objective 2.1:** By end 2011, complete list of priority terrestrial and marine sites developed, **Actions 2.1a-c**

Spreading Ecosystem-Based Management

Introducing EBM to Wainunu/Wailevu Districts

STATUS: Complete

FUNDING: John D. and Catherine T. MacArthur Foundation (10-94985-000-GSS), David and Lucile Packard Foundation (2010-35664), US National Oceanic and Atmospheric Administration (NA10NOS4630052)

PARTNER ORGANISATIONS: FLMMA, Kubulau Resource Management Committee (KRMC)

HIGHLIGHTS:

WCS and the Kubulau Resource Management Committee (KRMC) recently completed introductory workshops in Wainunu District in Bua Province and Wailevu District of Caukaudrove Province in order to share lessons learned by Kubulau in implementing EBM and to begin to develop management institutions and plans for the neighbouring districts (Figure 11). The districts of Nadi and Solevu (Bua Province) also attended the Wainunu workshop at their own expense to learn about establishing their own resource management committees and management plans.



Figure 11. Photographs from Wailevu (LEFT) and Wainunu (RIGHT) management planning workshops

The workshops presented the principles of EBM and sustainable financing. Groups did mapping exercises highlighting their traditional ecological knowledge. Participants listed their future vision for their respective tikina, identified threats and management solutions to the threats. The platform was also set for the establishment of new district resource management committees.

NEXT STEPS:

- Collection of socioeconomic and biological baseline data (Feb-Apr 2011)
- Application for funding to US National Fish and Wildlife Foundation to support surveys in Nadi and Solevu districts
- Conceptual modeling workshop to build EBM plans

LINKS TO NATIONAL PRIORITIES:

This project supports **NBSAP Implementation Plan Thematic Group 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.**

Presentations at Provincial Meetings

STATUS: Complete

FUNDING: David and Lucile Packard Foundation (2010-35664)

PARTNER ORGANISATIONS: N/A

HIGHLIGHTS:

As a direct result of facilitating the Provincial Planning Meeting in Nadave in September 2010 and distribution of the EBM Guide (see **Launch of EBM Guide** below), WCS Fiji received invitations to present on the PAC meeting outputs and EBM principles at the Ba and Bua fourth quarterly provincial meetings. Presentations were made in Fijian on the Kubulau EBM plan template, EBM principles, and how to carry forward management implementation from the PAC Provincial Planning Meeting.

LINKS TO NATIONAL PRIORITIES:

These activities support **NBSAP Implementation Plan Thematic Group 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 2.2d-e.**

Building Management Capacity and Awareness

Community Educators Network Training

STATUS: Ongoing

FUNDING: David and Lucile Packard Foundation (2010-35664)

PARTNER ORGANISATIONS: The Coral Reef Alliance (CORAL - lead), SeaWeb

OUTPUTS:

- *Abstract submitted to International Marine Conservation Congress, to be held 11-14 May 2011, Victoria, CANADA*

HIGHLIGHTS:

Challenges in communication can often result in misinterpretation and limited awareness that inevitably impedes successful management. In response to such challenges, The Coral Reef Alliance and SeaWeb adapted the CORAL Reef Leadership Network model (designed for use within the marine recreation industry) for Fijian communities and created the Community Educators Network (CEN). This project is being trialed and developed with Fijian community managers from Kubulau District, Vanua Levu, to strengthen the implementation of Fiji's first ridge-to-reef management plan, developed with assistance from the Wildlife Conservation Society. The CEN aims to strengthen awareness and improve management implementation by equipping village-based 'Leaders' with key communication tools that empower them to message, present, communicate and facilitate conversations in the village setting. Recognising the distinct social groupings within Fijian communities, the Leaders target groups who have been previously under-represented in past management planning workshops, such as women and younger people whom culturally may not be recognised within the patriarchal society.

From 22-26 June 2010, the KRMC, Turaga-ni-koro, Turaga-ni- Yavusa, community facilitators, Roko Tui Bua, and Cakaudrove provincial office representatives met with participants from CORAL, SeaWeb, and WCS-Fiji for the first "training of trainers" workshop. This initial training covered topics on: (1) presentation techniques; (2) leading discussions with target audience; and (3) using data to support messages. The participants also practiced working in groups to address issues affecting their daily lives from environmental degradation to loss of traditional values. The training also offered an interesting overview of the legends and traditional stories from Kubulau that was shared during the workshop. These stories have been recorded and will be presented in an EcoGuide to the flora and fauna of Kubulau, which is being developed by WCS-Fiji and CORAL.

The second workshop in the "Training the Trainers" series took place in from 27 September - 1 October 2010 in Savusavu (Figure 12). The workshop was coordinated by the CORAL and supported by WCS, SeaWeb, Partners in Community Development, WWF and the Fiji Department of Fisheries. Members of the Kubulau Resource Management Committee (KRMC),

Tui Kubulau, Vakatawa of Namalata, Turangi ni Yavusas of Kilaka, Nakorovou and Namalata attended the workshop. Participants were trained on various areas of the marine and terrestrial environment, including: the ecology cetaceans, marine turtles and invertebrates; and best practices and enforcement protocols for sustainable forest management. Fliers were distributed on terrestrial enforcement as well as factsheets produced by the Environmental Law Association of Fiji on Environmental Impact Assessments, Forestry Law and Reporting Breaches of Laws and Policies that WCS translated into Fijian. The workshop continues to focus on the concept of empowering the community members and specifically the KRMC representatives to be able to carry out awareness training in their own communities. Observed outcomes to date include: increased enthusiasm for coral reef conservation; increased community organization; and improved awareness of how to mitigate threats to reefs.



Figure 12. Photographs from the second "training of trainer" CEN workshops in Savusavu.

NEXT STEPS:

- Next CEN workshop is schedule for the last week of February 2011

LINKS TO NATIONAL PRIORITIES:

This project supports:

- **NBSAP Implementation Plan Thematic Group 1 (Forest Conversion), Strategy 2:** Promote research and awareness on forests and terrestrial resources, **Objective 2.4:** All communities with PAs are aware of PA benefits, **Actions 2.4a,c.**
- **NBSAP Implementation Plan Thematic Group 1 (Forest Conversion), Strategy 3:** Improve land-use practices through enforcement with well monitored land-use policy and logging codes, **Objective 3.1:** By 2014, 50% compliance with the Environmental Assessment Regulatory requirements is achieved, **Actions 3.1b-f** AND **Objective 3.2:** By 2011, riparian vegetation rehabilitation is underway in 10% of major areas, **Actions 3.2c,l,m.**
- **NBSAP Implementation Plan Thematic Group 2 (Invasive Alien Species), Strategy 5:** Raise awareness with Fiji public and tourists to reduce invasive alien species introductions, **Objective 5.1:** By 2015, invasive alien species awareness programs are in place at all ports of entry into Fiji, as well as at major inter-island transport locations,

Action 5.1b: Develop awareness materials for local communities on invasive alien species

- **NBSAP Implementation Plan Thematic Group 5 (Species Conservation), Strategy 5:** Improved communication amongst stakeholders (including communities) on threatened & endangered species, **Objective 5.3:** By 2014, empower communities through knowledge to protect and conserve endangered and threatened species, **Actions 5.3a,b**

COMMUNICATIONS

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

Newsletters

Community Bulletin

STATUS: Ongoing

FUNDING: David and Lucile Packard Foundation (2007-31847, 2010-35664), Gordon and Betty Moore Foundation (540.01), John D. and Catherine T. MacArthur Foundation (10-94985-000-GSS)

PARTNER ORGANISATIONS: Wetlands International-Oceania, WWF, The Coral Reef Alliance

OUTPUTS:

- *Vatu-i-Ra Community Bulletin:* Bi-monthly newsletters distributed to all 10 villages in Kubulau District and more recently to adjacent districts of Wainunu, Nadi, Solevu (Bua Province) and Wailevu (Cakaudrove Province)

EXAMPLE:

In 2010, WCS Fiji changed the name of the EBM Kubulau Bulletin to the Vatu-i-Ra Community Bulletin to reflect the expanding nature of EBM across the seascape. The bulletin is released every two months in English and Fijian and distributed to all the 10 villages in Kubulau and villages in adjacent districts via communication focal points (Figure 13). The communication focal points are volunteers who are responsible for distribution of the bulletin in their specific villages.

The articles in the bulletin cover: updates of recent WCS Fiji and EBM activities; emerging findings of the scientific team; management planning updates; and upcoming activities. The bulletin is aimed mainly for community members, however, it is also used to update key external stakeholders of the ongoing EBM activities in Kubulau, specifically: 1) Provincial Officer-Bua; 2) Assistant Roko-Kubulau; 3) Environmental officer-Fijian Affairs Board; 4) Fisheries officer-Bua; and 5) Forestry officer-Dreketi.

LINKS TO NATIONAL PRIORITIES:

This awareness activity supports the Department of Environments International Year of Biodiversity (IYOB) Communications Strategy.

Fiji ECOSYSTEM BASED MANAGEMENT (EBM) = HEALTHY PEOPLE, PROCESSES AND SYSTEMS



VATU-I-RA COMMUNITY BULLETIN



Ni sa bula vinaka! Welcome to the fourteenth edition of the VATU-I-RA COMMUNITY BULLETIN. The bulletin brings together news and results from ongoing activities by the Wildlife Conservation Society within the Vatu-i-Ra group.

VOL. 14. JUL 2010

KUBULAU STAKEHOLDERS MEETING

On 21st June, the Bose Vanua, Kubulau Resource Management Committee (KRMC), and community facilitators, met with stakeholders, including WCS-Fiji and CORAL, to get an update on the natural resource management activities in Kubulau and other related issues. The meeting was held in Savusavu and facilitated by the KRMC chairperson Mr. Paulo Kolikata.

This was the first time in 2010 for the stakeholders to meet with the Bose Vanua, KRMC, and other community reps. This was also the first time the whole Bose Vanua had convened with all the KRMC reps.

The meeting proceeded with all stakeholders giving presentations about their work update and future workplans. WCS-Fiji's rep Sunil Raj. Prasad presented the planned activities for the next quarter of 2010. He also mentioned the launch of the recently developed EBM Guide which will be done during the Convention of Biological Diversity's (CBD) 10th Conference of Parties (CoP) 2010 in Nagoya, Japan. The launch will be done in partnership with Fiji government's Department of Environment, International Union for the Conservation of Nature (IUCN), and other groups from the Pacific.

Apart from this, WCS-Fiji also presented and reminded the participants about the proposed



Participants of the stakeholders meeting that was held in Savusavu on June 21st.

Cetacean research in Kubulau by Dr. Cara Miller. This project is aimed at investigating number and movement pattern of Odontocetes (including spinner dolphins, short-finned pilot whales, false killer whales, and sperm whales) in Kubulau.

One of the other important upcoming event discussed at this meeting was the CORAL and SeaWeb led 'train the trainer' workshop which was held from 22nd (see next page for full story on this).

Fiji's IYOB theme for June was 'waste and pollution' and for July is 'Invasive species'. Please keep reading the Vatu-I-Ra bulletin to get more information on these themes and how you can help to protect Vatu-I-Ra's unique biodiversity.

KEY EBM MESSAGES:

- Preservation of functional integrity of Fiji's ecosystems through community based management.
- Successful 'ridge-to-reef' management depends on broad stakeholder input
- Inland and coastal communities need to manage their actions and resources together
- 'Ridge-to-reef' management protects habitat for all stages of life
- The success of protected areas for conservation and livelihoods relies on combining bottom-up community engagement with top-down planning
- Public health and livelihoods depend on environmental health
- Healthy ecosystems are the best defense against climate change impacts to livelihoods

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Figure 13. Front page of volume 14, July 2010 edition of the Vatu-i-Ra Community Bulletin

EBM Partnership Newsletter

STATUS: Ongoing

FUNDING: David and Lucile Packard Foundation (2007-31847, 2010-35664), Gordon and Betty Moore Foundation (540.01), John D. and Catherine T. MacArthur Foundation (10-94985-000-GSS)

PARTNER ORGANISATIONS: WWF, Wetlands International-Oceania, various

OUTPUTS:

- *EBM Newsletter:* Quarterly newsletters distributed to external stakeholders to promote projects within Fiji and regionally that are using ecosystem-based management principles

EXAMPLE:

The EBM partnership newsletter was released at the end of 2008 with aspirations to advocate to our non-community based stakeholders the adoption and practice of the EBM approach in Fiji and the region (Figure 14).

Since its release, articles have covered topics such as: integrated coastal zone management; water catchment management; habitat and faunal connectivity; and multi-sectoral approach towards conservation. 2010 editions have included articles on:

- New Ecosystem-Based Management Guide (see ***Launch of EBM Guide*** below)
- Cook Islands EBM course
- Namena Marine Reserve
- Econesian Society youth engagement for sustainable development
- Maintaining freshwater to marine migration pathways
- Annual Turtle Ball
- National Environment Week
- World Oceans Day
- Ridge-to-Reef update meeting for Kubulau-Suva residents
- Sustainable land use practices
- Traditional weaving skills and restored wetlands of Macuata
- Development of flood risk management plan
- Sustainability plan for Ono-i-Lau
- Freshwater-riparian surveys of Vanua Levu
- Sustainable reforestation
- Eco-Health Symposium
- PAC provincial planning workshop
- Wainunu/Wailevu management planning workshops

This newsletter is aimed at external stakeholders, electronically sent to various government departments, NGOs, academic institutions, donors, and regional agencies such as SPREP, SOPAC, and SPC.

LINKS TO NATIONAL PRIORITIES:

This awareness activity supports the Department of Environments International Year of Biodiversity (IYOB) Communications Strategy.



Figure 14. Front cover of August 2010 issue of the EBM partnership newsletter

Websites

WCS Fiji website

STATUS: Ongoing

FUNDING: WCS core funding

PARTNER ORGANISATIONS: Links to webpages for WWF South Pacific Programme, Wetlands International-Oceania, University of Western Australia, University of the South Pacific, University of Queensland, Canada Centre for Remote Sensing, ARC Centre of Excellence for Coral Reef Studies, James Cook University, Locally Managed Marine Area Network, The Coral Reef Alliance

OUTPUTS:

- Website: <http://www.wcsfiji.org>

HIGHLIGHTS:

In 2010, WCS Fiji launched a new website as a resource and awareness tool for the public and interested stakeholders (Figure 15).

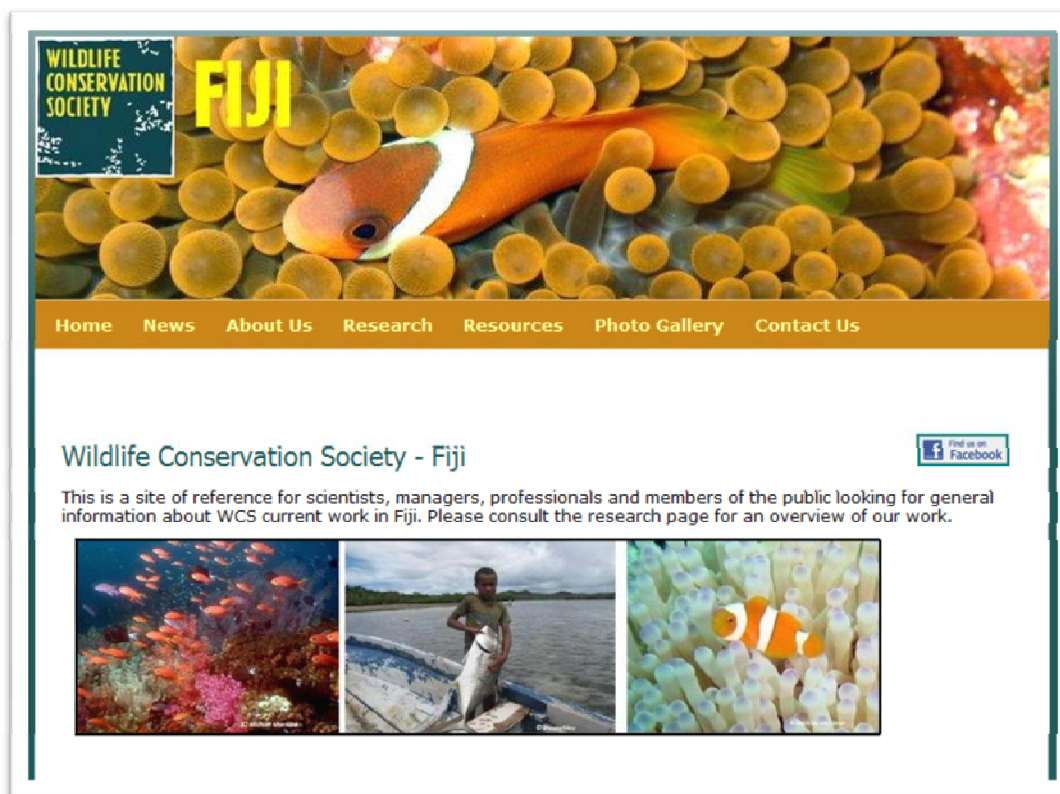


Figure 15. Homepage of WCS Fiji website (<http://www.wcsfiji.org/>)

The site contains specific pages to provide information and resources on:

- Recent news
- WCS Fiji mission, staff and where we work
- Research projects
- Resources for download (annual reports, community bulletins, conference proceedings, guides, journal articles, management plans, newsletters, WCS Fiji prospectus, reports, and theses)
- Photo gallery
- Contact information

WCS Fiji Facebook site

STATUS: Ongoing

FUNDING: WCS core funding

PARTNER ORGANISATIONS: N/A

OUTPUTS:

- Website: <http://www.facebook.com/pages/WCS-Fiji/128744560502559>

HIGHLIGHTS:

In 2010, WCS Fiji also launched a Facebook organisation page to publicize WCS Fiji activities and relevant media stories (Figure 16).



Figure 16. Homepage of WCS Fiji Facebook site as of 14 December 2010

Launch of EBM Guide

STATUS: Complete

FUNDING: David and Lucile Packard Foundation (2006-30719, 2009-34839, 2010-35664)

PARTNER ORGANISATIONS: Fiji Department of Environment, Wetlands International-Oceania, WWF, Conservation International, The Nature Conservancy, Palau Conservation Society, University of the South Pacific

OUTPUTS:

- *Guide:* Clarke P, Jupiter S (2010) Principles and practice of ecosystem based management: A guide for conservation practitioners in the tropical Western Pacific. Wildlife Conservation Society, Bronx, USA, 80 pp.

HIGHLIGHTS:

On 25 October 2010, WCS Fiji and the Fiji Department of Environment co-hosted a side event at the Convention of Biological Biodiversity in Japan, to promote the application of ecosystem-based management in the Pacific (Figure 17). The event featured a launch of a new handbook written by Pepe Clarke and Stacy Jupiter: "Principles and Practice of Ecosystem-Based Management: A Guide for Conservation Practitioners in the tropical Western Pacific".

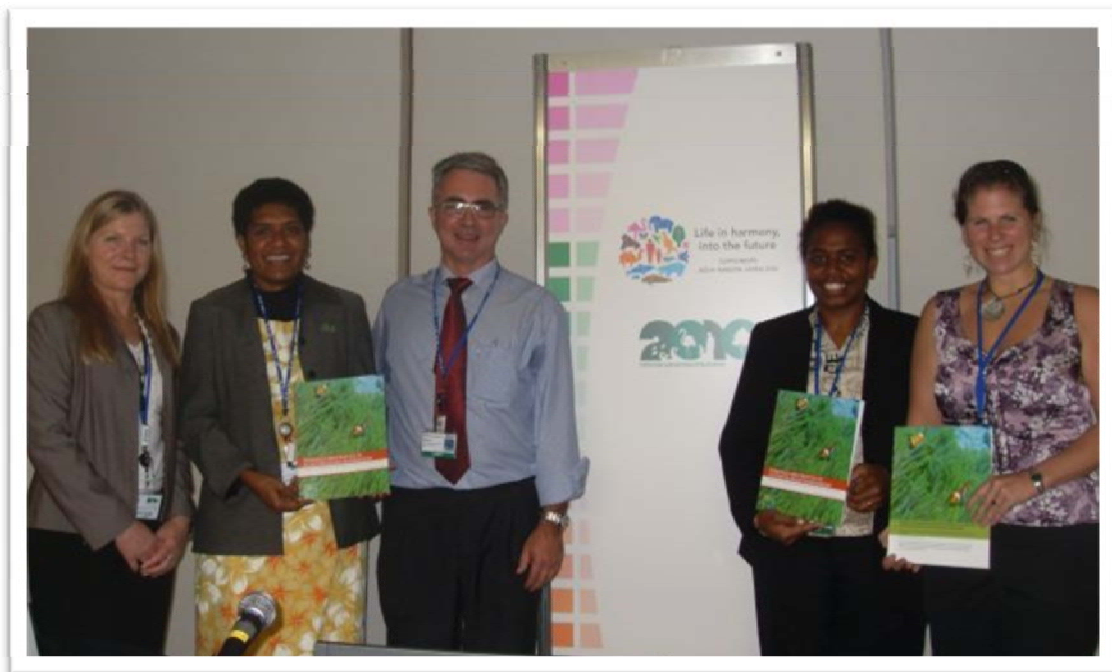


Figure 17. Launch of the EBM Guide during the CBD COP10 side event

The guide was launched by Dr. Jupiter, followed by a presentation by Senior Environment Officer of the Fiji Department of Environment, Ms. Eleni Tokaduadua, on ways that ecosystem-

based management (EBM) is being mainstreamed into national policy in Fiji. Other speakers at the launch included: Ms. Jackie Thomas (Climate Change Policy Officer for WWF South Pacific Programme), Ms. Touasi Tiwok (Senior Biodiversity Officer for the Vanuatu Department of Environment), and Mr. Bernard O' Callaghan (IUCN Oceania Programme Manager). The EBM guide has also been translated into Fijian distributed to all 14 provincial offices in Fiji as well as to many community members of the Fiji Locally Managed Marine Area network.

This handbook presents lessons learned from five years of researching and implementing EBM in the Western Pacific. The guide is designed for use by managers, particularly in developing nations where EBM approaches used in industrialized countries may not be feasible or appropriate. It shares experiences with implementing EBM from Fiji, Indonesia and Palau. Some key lessons from the guide include:

- Ecosystem management processes should respect the needs, interests, rights and aspirations of local communities, and contribute to local as well as national goals;
- Effective EBM requires an understanding of social and biological connectivity;
- Management should be adaptive and iterative as new information becomes available;
- Collaborative partnerships and broad stakeholder participation greatly enhance management effectiveness; and
- EBM provides a cost-effective for reducing vulnerability to climate change impacts.

The Guide was additionally distributed at the International Coral Reef Initiative 25th Annual General Meeting in Apia, Samoa in November 2010.

LINKS TO NATIONAL PRIORITIES:

This activity supports **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 5:** Strengthen natural resource leadership, management and governance, **Objective 5.5:** By 2014, report will be made of best available knowledge for dissemination to management units, **Action 5.5a:** Produce a synthesis report on best available, peer-reviewed knowledge for biodiversity conservation and fisheries management

Eco-Guide to the Flora and Fauna of Kubulau

STATUS: In progress

FUNDING: David and Lucile Packard Foundation (2010-35664), John D. and Catherine T. MacArthur Foundation (10-94985-000-GSS)

PARTNER ORGANISATIONS: The Coral Reef Alliance

OUTPUTS:

- *Conference presentation:* Fox M, Tokota'a M, Dulunaqio S, Williams H, Jupiter S (2010) Using local knowledge of traditional management practices from Kubulau District to inform current actions to maintain livelihoods through future uncertain climate change.

Presented at the Future Challenges, Ancient Solutions conference, Suva, Fiji, 29 November - 3 December 2010.

HIGHLIGHTS:

In partnership with CORAL, WCS Fiji is producing an Eco-Guide to the flora and fauna of Kubulau and adjacent districts from ridge to reef in order to engage and educate tourists on local biodiversity threats and what can be done to minimize them. The guide will be the first of its kind for Fiji and will be sold at tourist outlets. All proceeds from the guide will be returned to the communities in line with the new Department of Environment's Access and Benefits Sharing protocol in order to support management activities.

The guide will include photographs of charismatic and totem species and habitats, as well as traditional stories collected from village elders of their past associations with plants and animals and their former management practices. Permissions will be obtained from the Bose Vanua and the iTaukei Affairs Board before publication of any traditional knowledge to ensure that the publication is in line with the new traditional knowledge policy.

LINKS TO NATIONAL PRIORITIES:

This project supports **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries)**, **Strategy 6:** Promote education and awareness in environmental science, **Objective 6:** By 2014, traditional and local knowledge will be collated by cultural sector and made available upon request to traditional owners and Education Department under the conditions of the new legislation for intellectual property rights, **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

ENGAGING WITH NATIONAL AND REGIONAL PROCESSES AND PLANNING

The following sub-sections present a synthesis of ways that WCS Fiji has participated in development of national and regional conservation and resource management planning and policies during 2010.

Protected Area Committee

WCS Fiji has continued to take an active role in the PAC via leading the work on the marine gap analysis. In partnership with collaborators from the ARC Centre of Excellence for Coral Reef Studies, James Cook University node, a new technique was trialed for the marine gap analysis that incorporated the relative ecological effectiveness weightings of each marine management strategy (see ***Fiji National Marine Gap Analysis*** above). The results have been:

- Presented back to the Protected Area Committee
- Presented to regional PoWPA focal points at the Pacific Islands Roundtable for Nature Conservation annual meeting in Apia, Samoa (see below)

- Submitted for publication to Conservation Biology
- Shared informally with other interested Parties in the region

To follow up on the gap analysis work, WCS Fiji co-facilitated with the National Trust of Fiji, a 2-day workshop from 20-21 September in Nadave for provincial administrators from across the country (see ***Protected Area Committee Provincial Planning Workshop*** above). The outputs from this workshop are being written as a forthcoming report to be disseminated to all provincial offices for focused implementation activities.

On 22 September, WCS Fiji and colleagues from the ARC Centre of Excellence for Coral Reef Studies, James Cook University node led a 1 day intensive training course on the principles of conservation planning (Figure 18). Topics included:

- Key concepts in systematic planning
- Interactive reserve design activity
- Introduction to decision support tools
- Case studies from Fiji
- Data requirements and issues
- Dealing with opportunity costs
- Discussion of local applications



Figure 18. Participants at work on reserve design activity during Conservation Planning training

The participants represented a strong cross-section of NGO and government planning agencies, including: Institute of Applied Science/USP; National Trust of Fiji; Conservation International; Department of Agriculture Land Use Section; iTaukei Affairs Board; Native Lands Trust Board; Wildlife Conservation Society; and Department of National Heritage, Culture and Arts.

Integrated Coastal Management Committee

WCS Fiji maintained its position as an NGO member to the ICMC during 2010, and served on a special working group to provide input into the multi-day workshop held in March 2010 to determine an outline for the framework for a National Coastal Plan. Unfortunately, WCS Fiji was not able to participate in the actual workshop due to timing conflicts with fieldwork. WCS Fiji

has subsequently provided information to the consultant hired by the Department of Environment to complete the Fiji National Coastal Plan Framework document.

Direct Assistance to Fiji Department of Environment

WCS Fiji has seconded one of its staff, Mr. Naushad Yakub, 50% time to work on Department of Environment projects. For 2010, the major projects included: (1) completion of the NBSAP Implementation Plan 2010-2014 document; and (2) collation of stakeholder feedback for development of the Access and Benefit Sharing (ABS) Protocol. WCS Fiji has been invited to sit as a core member of the ABS oversight committee, which had its first meeting in November 2010.

Dr. Stacy Jupiter, WCS Fiji Director, was additionally nominated to be part of Fiji's delegation to the Convention of Biological Diversity's 10th Conference of Parties in Nagoya, Japan. Dr. Jupiter assisted the Fiji Department of Environments with national stakeholder consultations and development of Fiji's positions on key issues. She also participated in the SPREP-led 3-day pre-COP meeting in August 2010 in Nadi, Fiji, to build a collective Pacific voice and receive training on negotiations skills. During the COP10, Dr. Jupiter negotiated on behalf of Fiji for the Marine and Coastal Biodiversity decision, assisted with preparation of Fiji's interventions and provided broad support to the Pacific delegation (Figure 19).



Figure 19. Stacy Jupiter with members of the Fiji and Pacific delegations at the CBD COP10

Fiji Locally Managed Marine Area Network

WCS Fiji continues to strongly support the FLMMA network through participation on the Executive Committee, Biological Working Group, Socioeconomic Working Group, DAM Working Group, and Communications Working Group. In 2010, WCS Fiji staff assisted in facilitation of the:

- Workshop to establish the Lomaiviti Yaubula Management Support Team
- Bua provincial learning meeting
- Macuata provincial learning meeting
- Cakaudrove provincial learning meeting
- Annual General Meeting at Solevu village, Malolo Island

Fijian versions of the EBM Guides were distributed at various FLMMA provincial learning meetings to spread lessons learned.

Pacific Islands Roundtable for Nature Conservation

WCS Fiji attended the Pacific Islands Roundtable for Nature Conservation meeting in Apia, Samoa from 5-8 July 2010, where we were eager to engage in the discussions among the PoWPA focal points from multiple Pacific Island countries to discuss common challenges and proposed strategies for completing national gap analyses and developing protected area legislation. WCS Fiji also serves on the Coral Triangle Initiative working group and the Monitoring working group of PIRT.

PUBLICATIONS AND RESOURCES 2010

Journal Articles

- Jupiter SD, Egli DP** (2011) Ecosystem-based management in Fiji: successes and challenges after five years of implementation. *Journal of Marine Biology*. doi:10.1155/2011/940765
- Adams VM, Mills M, **Jupiter SD**, Pressey RL (2010) Improving social acceptability of marine protected area networks: a method for estimating opportunity costs to multiple gear types in both fished and currently unfished areas. *Biological Conservation*. doi:10.1016/j.biocon.2010.1009.1012
- Clarke P, Jupiter SD** (2010) Law, custom and community-based natural resource management in Kubulau District (Fiji). *Environmental Conservation* 37:98-106
- Jenkins AP, **Jupiter SD, Qauqau I**, Atherton J (2010) The importance of ecosystem-based management for conserving aquatic migratory pathways on tropical high islands: A case study from Fiji. *Aquatic Conservation: Marine and Freshwater Ecology* 20:224-238
- Prouty NG, Field ME, Stock JD, **Jupiter SD**, McCulloch M (2010) Coral Ba/Ca records of sediment input to the fringing reef of the southshore of Moloka'a, Hawai'i over the last several decades. *Marine Pollution Bulletin* 60:1822-1835
- Weeks R**, Russ GR, Alcala AC, White AT (2010) The effectiveness of marine protected areas in the Philippines for biodiversity conservation. *Conservation Biology* 24:531-540
- Weeks R**, Russ GR, Bucol AA, Alcala AC (2010) Incorporating local tenure in the systematic design of marine protected area networks. *Conservation Letters* doi: 10.1111/j.1755-263X.2010.00131.x.
- Weeks R**, Russ GR, Bucol AA, Alcala AC (2010) Shortcuts for marine conservation planning: the effectiveness of socioeconomic data surrogates. *Biological Conservation* 143:1236-1244
- Wilson SK, Fisher R, Pratchett MS, Graham MH, Dulvy NK, Turner RA, **Cakacaka A**, Polunin NVC (2010) Habitat degradation and fishing effects on the size structure of coral reef fish communities. *Ecological Applications* 20:442-451

Conference Proceedings

- Roelfsema C, Phinn S, **Jupiter S**, Comley J, Beger M, Peterson E (2010) The application of object based analysis of high spatial resolution imagery for mapping large coral reef systems in the west Pacific at geomorphic and benthic community scales. *Proceedings of the 30th IEEE International Geoscience and Remote Sensing Symposium*. Honolulu, HI, 25-30 July

Reports

- Jupiter S**, Mills M, **Weeks R**, Adams V, **Qauqau I**, Tora K (in prep) Filling the gaps: identifying candidate sites to expand Fiji's national protected area network: Outcomes report from provincial planning meeting, 20-21 September 2010. Wildlife Conservation Society, Suva, Fiji.
- Jupiter S**, Mills M, Comley J, Batibasaga A, Jenkins A (2010) Fiji marine ecological gap assessment: interim progress report. Wildlife Conservation Society, Suva, Fiji, 26 pp.

- Adams VM, Mills M, **Jupiter SD**, Pressey RL (2010) Marine opportunity costs: a method for calculating opportunity costs to multiple stakeholder groups. Wildlife Conservation Society-Fiji Technical Report no. 01/10, Suva, Fiji, 34 pp.
- Jupiter SD, Tui T, Shah S, Cakacaka A, Moy W, Naisilisili W, Dulunaqio S, Patrick A, Qauqau I, Yakub N, Caginitoba A** (2010) Integrating EBM science to assess marine protected area effectiveness: clues from coral proxies of land disturbance, ecological assessments and socioeconomic surveys. Wildlife Conservation Society-Fiji Technical Report no. 02/10. Suva, Fiji, 24 pp.
- Jupiter SD, Egli DP, Jenkins AP, Yakub N, Hartley F, Cakacaka A, Tui T, Moy W, Naisilisili W, Dulunaqio S, Qauqau I, Prasad S** (2010) Effectiveness of marine protected area networks in traditional fishing grounds of Vanua Levu, Fiji, for sustainable management of inshore fisheries. Wildlife Conservation Society-Fiji and Wetlands International-Oceania Technical Report no. 03/10. Suva, Fiji, 59 pp.
- Jupiter SD, Clarke P, Prasad SR, Egli DP, Tui T, Caginitoba A, Qauqau I** (2010) Non-compliance with management rules and its implications for traditional fisheries in Fiji. Wildlife Conservation Society-Fiji Technical Report no. 04/10. Suva, Fiji, 29 pp.
- Egli DP, Moy W, Naisilisili W** (2010) Fish movement in MPAs on coral reefs in Kubulau, Fiji. Wildlife Conservation Society-Fiji. Technical Report no. 05/10. Suva, Fiji, 16 pp.
- Cakacaka A, Jupiter SD, Egli DP, Moy W** (2010) Status of fin fisheries in a Fijian traditional fishing ground, Kubulau District, Vanua Levu. Wildlife Conservation Society - Fiji, Technical Report no. 06/10, Suva, Fiji, 21 pp.
- Egli DP, Tui T, Jupiter SD, Caginitoba A** (2010) Perception surveys of coastal resource use and changes following establishment of a marine protected area network in Kubulau, Fiji. Wildlife Conservation Society - Fiji Technical Report no. 07/10. Suva, Fiji, 16 pp.

Guides

- Clarke P, Jupiter S** (2010) Principles and practice of ecosystem based management: A guide for conservation practitioners in the tropical Western Pacific. Wildlife Conservation Society, Suva, Fiji, 80 pp.
- WCS** (2010) WCS-Fiji marine biological monitoring handbook. Version 3.1. Wildlife Conservation Society-Fiji, Suva, Fiji, 34 pp

Conference Presentations

- Fox M, Tokota'a M, Dulunaqio S, Williams H, Jupiter S** (2010) Using local knowledge of traditional management practices from Kubulau District to inform current actions to maintain livelihoods through future uncertain climate change. Presented at the Future Challenges, Ancient Solutions conference, Suva, Fiji, 29 November - 3 December 2010.
- Jupiter S, Jenkins A** (2010) Challenges and opportunities for catchment management in Fiji to conserve biodiversity and improve human health. Presented at the Fiji Islands EcoHealth Forum, Suva, Fiji, 25-26 November.
- Jenkins A, **Jupiter S** (2010) Seasonal patterns in fish abundance and diversity in Vanua Levu catchments. Presented at the Fiji Islands EcoHealth Forum, Suva, Fiji, 25-26 November.
- Roelfsema C, **Jupiter S**, Knudby A, Lyons M, Phinn S (2010) Object based analysis of high spatial resolution imagery for mapping large coral reef systems to estimate fish resources in

Kubulau, Fiji. Presented at the Australian Coral Reef Symposium, Coffs Harbour, Australia, 11-13 September. (also presented at Fiji Islands EcoHealth Forum, Suva, Fiji, 25-26 November).

Roelfsema C, Phinn S, **Jupiter S**, Wendt H, Comley J (2010) Object based analysis of high spatial resolution imagery for mapping large coral reef systems in Fiji. Presented at the Pacific Island GIS/Remote Sensing User Forum, Suva, Fiji, 22-26 November.

Roelfsema C, Phinn S, **Jupiter S**, Comley J, Beger M, Peterson E (2010) Object based analysis of high spatial resolution imagery for mapping large coral reef systems in the West Pacific at geomorphic and benthic community spatial scales. Presented at the 30th International Geoscience and Remote Sensing Symposium. Honolulu, HI. July.

Mills M, Adams V, **Jupiter S**, Pressey B, Singh P (2010) Planning for action: Tackling the mismatch of scales between regional planning and local implementation in Fiji. Presented at the 24th Annual Meeting of the Society for Conservation Biology, Edmonton, Alberta. 3-7 July.

Prasad S, Jupiter S, Clarke P (2010) Designing culturally appropriate tools to communicate and implement ecosystem based management (EBM) in the tropical Western Pacific. Presented at the International Pacific Marine Educators Network Conference, Sigatoka, Fiji, 6-9 July

Jupiter SD (2010) The importance of ecosystem-based management for preserving biodiversity and human livelihoods in Fiji. Invited presenter at the Fairfield Osborn Memorial Lecture, New York, USA, 14 April.

PROJECTED ACTIVITIES FOR 2011

The following sub-sections present a brief list of confirmed and pending projects for 2010 and their link to National Priorities.

Ecosystem-Based Science in Fiji: Closing the Knowledge Gaps

STATUS: Confirmed

NATIONAL PRIORITIES:

The activities under this grant support the following objectives:

- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 4:** Design new ecologically relevant inshore MPAs, **Objective 4.4:** By mid-2012, options for MPA networks are produced and consulted on by all external stakeholders, specifically **Action 4.4a:** Use spatial modeling tools to identify optimum areas for a representative, resilient network of inshore MPAs.
- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 3:** Maintain existing MPAs, **Objective 3.2:** By 2014, biodiversity surveys show no decline in numbers related to 2010 levels and there is a 15% increase (which must be a significant difference) in biomass of targeted species inside MPA compared with outside, **Action 3.2a:** Monitor core set of existing MPAs for biodiversity and fisheries resources compared with unmanaged sites.
- **NBSAP Implementation Plan Thematic Group 1 (Forest Conversion), Strategy 2:** Promote research and awareness on forests and terrestrial resources, **Objective 2.2:** By 2012, promote at least 2 case studies on the relationship between forests cover and ecosystem services, **Action 2.2h:** Undertake a survey on current status of biological resources, specifically those of subsistence and economic importance and those that are threatened or need attention for protection
- **NBSAP Implementation Plan Thematic Group 7 (Inland Waters), Strategy 1:** Improve and update information on status of wetlands and wetland biodiversity, **Objective 1.1:** By end 2011, national wetland inventory of habitats (as well as their flora and fauna) produced as baseline for national planning, **Action 1.1b:** Collate and update information into spatially registered database.

2011 OUTPUTS:

- MPA network reconfigured to take into account coral reef areas with greatest resilience to climate disturbance
- Assessment of links between upstream riparian stream condition and downstream community health
- Second Fiji Islands Conservation Science Forum

LOCATION: Kubulau District and Macuata Province, Vanua Levu

PARTNERS: Wetlands International-Oceania

DONOR: David and Lucile Packard Foundation (2009-34839)

TIMELINE: February 2010 – January 2012

INVESTMENT: USD\$200,000

Incorporating Reef Resilience to Climate Change in Ecosystem-Based MPA Management Plans for Two Fijian Traditional Fishing Grounds

STATUS: Confirmed

NATIONAL PRIORITIES:

The activities under this grant support the following objectives:

- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 4:** Design new ecologically relevant inshore MPAs, **Objective 4.4:** By mid-2012, options for MPA networks are produced and consulted on by all external stakeholders, specifically **Action 4.4a:** Use spatial modeling tools to identify optimum areas for a representative, resilient network of inshore MPAs.
- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 3:** Maintain existing MPAs, **Objective 3.2:** By 2014, biodiversity surveys show no decline in numbers related to 2010 levels and there is a 15% increase (which must be a significant difference) in biomass of targeted species inside MPA compared with outside, **Action 3.2a:** Monitor core set of existing MPAs for biodiversity and fisheries resources compared with unmanaged sites.

2011 OUTPUTS:

- Kubulau EBM plan adapted to take into consideration MPA network reconfiguration to improve resilience to climate disturbance
- New climate-ready EBM plan established for MPA network in Wainunu District
- Management rules posters in Fijian
- Short guide in Fijian on recommendations for designing resilient MPA networks

LOCATION: Kubulau and Wainunu districts, Bua Province

PARTNERS: Kubulau Resource Management Committee

DONOR: US National Oceanic and Atmospheric Administration (NA10NOS4630052)

TIMELINE: October 2010 - March 2012

INVESTMENT: USD\$77,400

An Ecosystem Approach to Fiji's Vatu-i-Ra Seascape: Integrating Science Into Site Management and National Planning Processes

STATUS: Confirmed

NATIONAL PRIORITIES:

This project supports:

- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 4:** Design new ecologically relevant inshore MPAs, **Objective 4.4:** By mid-2012, options for MPA networks are produced and consulted on by all external stakeholders, specifically **Action 4.4a:** Use spatial modeling tools to identify optimum areas for a representative, resilient network of inshore MPAs.
- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 3:** Maintain existing MPAs, **Objective 3.2:** By 2014, biodiversity surveys show no decline in numbers related to 2010 levels and there is a 15% increase (which must be a significant difference) in biomass of targeted species inside MPA compared with outside, **Action 3.2a:** Monitor core set of existing MPAs for biodiversity and fisheries resources compared with unmanaged sites.
- **NBSAP Implementation Plan Thematic Group 6 (Protected Areas), Strategy 1:** Identify gaps in biodiversity protection against national targets, **Objective 1.1:** By end 2010, initial iteration of terrestrial and marine gap analyses complete, specifically **Actions 1.1a-d**
- **NBSAP Implementation Plan Thematic Group 6 (Protected Areas), Strategy 2:** Expand protected area network in priority sites at the national level and provincial level to achieve national targets, **Objective 2.1:** By end 2011, complete list of priority terrestrial and marine sites developed, **Actions 2.1a-c**

2011 OUTPUTS:

- Biological and socioeconomic database for Wainunu and Wailevu districts
- Resource management committees established in Wainunu and Wailevu districts
- Feasibility report/journal publication detailing the extent to which scaling up through FLMMMA can meet national biodiversity targets
- Eco-Guide to Flora and Fauna of Kubulau

LOCATION: Kubulau and Wainunu districts, Bua Province; Wailevu District, Cakaudrove Province

PARTNERS: N/A

.

DONOR: John D. and Catherine T. MacArthur Foundation (10-94985-000-GSS)

TIMELINE: July 2010 - June 2012

INVESTMENT: USD\$250,000

Building Success into Marine Protected Area Management in Fiji and Indonesia

STATUS: Confirmed

NATIONAL PRIORITIES:

This project supports:

- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 5:** Strengthen natural resource leadership, management and governance, **Objective 5.1:** By 2014, 50% increase in number of villages and management units that have undergone leadership training, **Action 5.1a:** Provide leadership training to managers of marine biodiversity and fisheries resources
- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 5:** Strengthen natural resource leadership, management and governance, **Objective 5.2:** By 2014, all inshore MMAs will have been trained in financial literacy and have access to financial mechanisms, **Action 5.2a:** Train all inshore marine management structures in financial literacy
- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 5:** Strengthen natural resource leadership, management and governance, **Objective 5.3:** By 2014, all inshore MMAs will have a management plan that is adaptively managed, **Action 5.3a:** Provide all MMA sites with a management plan template and assistance developing management actions
- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 5:** Strengthen natural resource leadership, management and governance, **Objective 5.4:** By 2010, resource managers at 50 selected sites are recording incidents of destructive fishing and by 2014, multi-sectoral enforcement plans developed for all MMA sites, **Action 5.4a:** Develop strategic, multi-sectoral enforcement plans.

OUTPUTS:

- Marine and terrestrial enforcement protocols for Kubulau, Wainunu and Wailevu
- EBM plans for Wainunu and Wailevu created
- Report describing vulnerabilities to climate change across the Vatu-i-Ra Seascape

LOCATION: Kubulau and Wainunu districts, Bua Province; Wailevu District, Cakaudrove Province

PARTNERS: The Coral Reef Alliance

DONOR: David and Lucile Packard Foundation (2010-35664)

TIMELINE: July 2010 - June 2012

INVESTMENT: USD\$350,000 to WCS Fiji

Expanding networks of resilient marine protected areas in Bua Province, Fiji

STATUS: Pending

NATIONAL PRIORITIES:

This project supports:

- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 5:** Strengthen natural resource leadership, management and governance, **Objective 5.3:** By 2014, all inshore MMAs will have a management plan that is adaptively managed, **Action 5.3a:** Provide all MMA sites with a management plan template and assistance developing management actions
- **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 4:** Design new ecologically relevant inshore MPAs, **Objective 4.4:** By mid-2012, options for MPA networks are produced and consulted on by all external stakeholders, specifically **Action 4.4a:** Use spatial modeling tools to identify optimum areas for a representative, resilient network of inshore MPAs.

2011 OUTPUTS:

- MPA networks established for Nadi and Solevu districts
- Biological and socioeconomic database for Nadi and Solevu districts
- Resource management committees established in Nadi and Solevu districts

LOCATION: Nadi and Solevu districts, Bua Province

PARTNERS: Kubulau Resource Management Committee

DONOR: US National Fish and Wildlife Foundation

TIMELINE: April 2011 - September 2012

INVESTMENT: USD\$70,000