



ANNUAL REPORT

WILDLIFE CONSERVATION SOCIETY
FIJI COUNTRY PROGRAM 2011



EXECUTIVE SUMMARY

This report highlights the Wildlife Conservation Society (WCS) Fiji Country Program's achievements from January to December 2011. 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:

- Using innovative tools to design resilient marine protected area (MPA) networks
- Designing a methodology to prioritize actions to improve coral reef health that simultaneously considers land and sea impacts
- Testing a framework to establish multiple use zones across the Vatu-i-Ra Seascape
- Assessing the capability of community-based actions within the FLMMA network to achieve the Fiji Government's target to effectively protect 30% of inshore waters by 2020
- Identifying factors influencing distributions of freshwater fishes
- Developing a prioritization scheme to increase terrestrial and freshwater protection across the Mt. Navotuvotu-Mt. Kasi corridor
- Evaluating mechanisms by which bacteria is transferred between people in near-pristine and degraded landscapes
- Identifying hotspots of cetacean activity and priorities for their management in the Vatu-i-Ra Seascape
- Assessing baseline conditions of Totoya's Sacred Reef to develop a holistic island-scale management plan

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

- Helped the communities of Wailevu, Wainunu, Nadi and Solevu establish resource management committees
- Facilitated ecosystem-based management planning processes with stakeholders from Wainunu, Nadi and Solevu districts
- Facilitated an adaptive management workshop in Kubulau District to review monitoring data and evaluate where the existing EBM plan could be strengthened
- Provided management support to the Kubulau Resource Management Committee through Community Educator Network trainings and focuses discussions on barriers to implementation
- Improved capacity to assess local fisheries resource conditions through production of fish rulers and CPUE trainings

- Led discussions with stakeholders from the four provinces in the Vatu-i-Ra Seascape to discuss integrating protected areas into broader provincial-level integrated coastal management plans

In 2011, WCS Fiji disseminated several communications tools to help spread awareness of ecosystem-based management/adaptation and guidance for implementation. These tools include: (1) *Ecotales from Kubulau: A Guide to the Cultural and Natural Heritage of Kubulau*; (2) a case study on *Implementing Ecosystem-Based Management at the District and Seascape Scale in Fiji* in the Global Coral Reef Monitoring Network guide on best practices for catchment management; (3) a case study on *Fiji's National Protected Area Committee's Approach to Achieving National Conservation Goals* in a SPREP published guide to best practices for marine management in the Pacific; and (4) a case study on *Adaptive Ecosystem Management to Improve Resilience to Climate Change in Fiji* in a guide on draft principles for Ecosystem-Based Adaptation published by Centro Agronomico Tropical de Investigacion y Ensenanza and distributed at the UNFCCC COP16 in Durban, South Africa. In addition, WCS Fiji hosted the 2nd Fiji Conservation Science Forum to highlight ongoing research from all across Fiji. Due to excellent advertising on TV and in the paper, we had over 200 participants from 65 organizations.

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, 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 2011.

The WCS Fiji office had a highly productive year, beginning with socioeconomic surveys of Wainunu (Bua) and Wailevu (Cakaudrove) districts in February, followed by 5 weeks of coral reef resilience surveys spanning across Solevu, Nadi, Wainunu, Kubulau and Wailevu districts in March and April. In May, WCS Fiji staff Rebecca Weeks, Naushad Yakub and Fiji Director Stacy Jupiter gave presentations on our work in Fiji at the 2nd International Marine Conservation Congress in Victoria, Canada.

In June, WCS Fiji staff Akuila Cakacaka, Waisea Naisilisili, Sirilo Dulunaqio and Stacy Jupiter had a unique opportunity to conduct baseline surveys of reef condition and fish populations at the Sacred Reef of Totoya Island in Southern Lau. This work was a collaboration between the Pacific Blue Foundation, the Waitt Institute, WCS Fiji and Wetlands International. The initial data collected was presented back to the Lau Provincial Council and will hopefully form the framework for development of an island-scale management plan.

In July, WCS Fiji facilitated an adaptive management workshop in Kubulau District. This provided an opportunity for the communities to review and evaluate the results of ongoing monitoring of coral reef and freshwater habitats and adapt their ecosystem-based management plan in response to new information and changes in environmental condition and resource pressures. The outcomes included proposals to place 500 m buffer zones around the existing district marine protected areas, add and extend several tabu areas, and add additional terrestrial and freshwater protection.

In August, WCS Ocean Giants staff Brian Smith joined some of the WCS Fiji team to participate in the annual cetacean survey training, led by Department of Fisheries and the Whale and Dolphin Conservation Society. Brian then led WCS Fiji staff Margaret Fox, Waisea Naisilisili and Sirilio Dulunaqio to conduct boat and land-based cetacean surveys around Vatu-i-Ra Island and Reef, which had been identified as a hotspot of cetacean activity through surveys of local fishermen around the Vatu-i-Ra Seascape. The team located breeding individuals of the Oceania sub-population of humpback whales, as well as confirmed the common bottlenose dolphin to be the species *Tursiops truncatus*.

September was a busy month for the WCS Fiji staff. From 8-9 September, we facilitated a Vatu-i-Ra Seascape Stakeholder workshop at Nadave, bringing together teams of government and community members from the four provinces of Ra, Tailevu, Lomaiviti and Bua to discuss how to integrate management and sustainable development into the framework of provincial-level integrated coastal management plans. From 14-16, WCS Fiji hosted the 2nd Fiji Conservation Science Forum, bringing together over 200 participants from 65 organizations for three days to hear the latest findings from the environment, management, disaster response and health sectors.

In November, WCS Fiji facilitated a large ecosystem-based management workshop for the districts of Wainunu, Nadi and Solevu in Bua Province, to adapt the Kubulau EBM model to their own local conditions. Results of the socioeconomic and biological surveys were presented back so that the communities could identify the main threats to their local resources and devise strategies to sustainably manage them for the future.

In December, WCS Fiji staff Rebecca Week, Margaret Fox and Stacy Jupiter presented on our Fiji work at the 25th International Congress for Conservation Biology in Auckland, New Zealand. And at our holiday party on December 22, WCS Fiji, in partnership with the Coral Reef Alliance, was proud to launch its new book: *Ecotales of Kubulau: A Guide to the Cultural and Natural Heritage of the Vatu-i-Ra Seascape*, by Natalie Askew, Margaret Fox and Stacy Jupiter. Proceeds from the sale of the guide will go to support management efforts in Kubulau District.

Once again, our program has experienced staff turnover. During our second quarter, we bid farewell to our Government Liaison officer Mr. Naushad Yakub, who took up a new position with the Pacific Centre for Environment and Sustainable Development at USP. Our Program Manager, Ms. Janette Kaipio, departed in November to begin a new role as hotel manager on Wakaya Island. In the meantime, our team has benefited from the skills and experience of Mrs. Natalie Askew and Mr. Ged Acton, who both began as volunteers with our program and now are undertaking contracts to assist with our management and conservation planning.

Although there were fewer opportunities for WCS Fiji staff to receive or offer external training in 2011, our staff have still grown in their leadership and management abilities. In July, Ms. Yashika Nand participated in a Reef Resilience Training-of-Trainers workshop in Palau, led by The Nature Conservancy. Yashika will now pass on this knowledge to partners within the FLMMA network by leading a comparable training within Fiji in early 2012. In the meantime, Mr. Akuila Cakacaka provided leadership and mentoring support to the WCS Papua New Guinea field team during their surveys in the middle of the year.

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 focused early this year on presenting chapters from *Marine Conservation Biology*, an edited text, and later in the year on practicing presentations for various workshops and conferences. WCS Fiji also provided training to external partners in use of Marxan, a decision-support software tool for conservation planning.

This report focuses on WCS Fiji's achievements during 2011 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 2012, 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 2011.

Conservation Planning

Designing Resilient MPA Networks

STATUS: Complete

FUNDING: David and Lucile Packard Foundation (2009-34839), US National Oceanic and Atmospheric Administration (NA10NOS4630052)

PARTNER ORGANISATIONS: N/A

OUTPUTS:

- *Newsletter Article:* Jupiter SD, Weeks R (2011) Adaptive Management in Fiji to Strengthen Community-based Protected Areas. Science Digest, WCS Institute, Oct 2011: 23-25.
- *Conference Presentations:* Weeks R, Jupiter S (2011) Incorporating coral reef resilience in the design of community-managed MPA networks in Fiji. 2nd International Marine Conservation Congress, Victoria, Canada, 14-18 May. Weeks R, Jupiter S (2011) Adaptive marine protected area management to improve reef resilience. 2nd Fiji Conservation Science Forum, Suva, Fiji, 14-16 September
- *Journal Article:* in prep

RESEARCH HIGHLIGHTS:

The initial design of the Kubulau MPA network was informed by both socioeconomic and biological information collected by local managers and their conservation partners, with the primary goal of increasing the size and abundance of food fish within the qoliqoli to ensure food security for local communities. Whilst climate change was also recognised by community members as a threat to coral reef ecosystems, at the time the Kubulau EBM Plan was developed no data were available to explicitly incorporate reef resilience into the MPA network design. More recently, as further research has improved our understanding of climate-change impacts on coral reef ecosystems, guidelines and tools for identifying reef resilience and designing resilient MPA networks have emerged.

Table 1 outlines general principles for resilient MPA network design and the measures that WCS has taken to apply these across qoliqoli for Kubulau, Solevu, Nadi and Wainunu districts (Bua Province) and Wailevu District (Cakaudrove Province). Below, we provide further details on how recommendations were formulated for two key principles: (1) representation of habitat types, and (2) protection for critical areas that have high natural resistance or resilience to bleaching events.

Resilience principle	Strategy for Kubulau
Size: “Bigger is better” – MPAs should be large enough to protect the full range of marine habitat types and the ecological processes on which they depend	Encourage communities to increase the size of small tabu areas, e.g. Yamotu Lase, which may be smaller than the home range of targeted fish species.
Shape: Simple shapes should be used to minimize edge effects while maximizing interior protected area	Recommend that MPA boundaries follow the reef edge, especially where confusion over boundaries has led to reduced management effectiveness (e.g. Nasue MPA).
Risk spreading: Protect at least 20–30% of each habitat type overall, with replicates spread out to reduce the chances they will all be affected by the same disturbance event	Establish target 30% of each coral reef habitat type within the qoliqoli; Marxan outputs provide priority maps for achieving this goal. Highlight underrepresented habitats and where they might be protected to communities.
Critical areas: Protect critical areas that are most likely to survive the threat of climate change	Sites with high natural resilience to climate change-induced bleaching events identified through analysis of WCS survey data and prioritised for inclusion in MPA reconfigurations.
Connectivity: MPAs should be spaced a maximum distance of 15–20 km apart to allow for replenishment via larval dispersal	Marine reserves and tabu areas in the Kubulau qoliqoli already meet this recommendation.
Maintain ecosystem function: Maintain healthy populations of key functional groups, particularly herbivorous fishes	Communicate the importance of herbivores to reef resilience to communities through workshop presentations; “Fish Rulers” distributed to communities include recommended size limits for parrotfishes.
Ecosystem-based management: Embed MPAs in broader management frameworks that address other threats external to their boundaries	Hold adaptive management workshop to review the existing Kubulau EBM Plan, revising management rules where necessary.

Acquisition of high-resolution habitat maps in 2011 from the Millennium Coral Reef Mapping Project has greatly improved our ability to assess and plan for habitat representation in the Kubulau MPA network. Following the Fiji Government commitment to protect and effectively managed 30% of its inshore and offshore marine habitat by 2020, we proposed a representation target of 30% of each coral reef habitat type within our design recommendations for the Kubulau qoliqoli and our broader design recommendations expanding between Solevu district in the west and Wailevu district in the east. Gap analysis (Figure 1) indicates that at present some reef types are much more extensively protected than others in Kubulau. Forereef, reef flat and shallow terrace reefs types and passes are well represented within the MPA network, exceeding the 30% target. Other reef types are less well represented, and would clearly benefit from increased protection.

We used the conservation-planning software Marxan to explore how the Kubulau MPA network might be expanded or reconfigured to improve habitat representation. Marxan is a decision-support tool that assists users to identify MPA networks that achieve specified biodiversity objectives while minimizing socioeconomic impacts. When provided information on the amount

of each biodiversity feature (in this case reef habitat types) in each “planning unit”, Marxan identifies sets of planning units that achieve biodiversity targets in an efficient manner. For this analysis we did not consider spatially heterogeneous costs: the purpose of the output maps was to communicate conservation priorities to community decision-makers, who would themselves have much better knowledge of socioeconomic costs and implementation feasibility than any dataset could provide. For both design exercises, existing MPAs were “locked in” to the Marxan solutions, so that new sites were prioritised on the basis the conservation value that they contributed to the existing system.

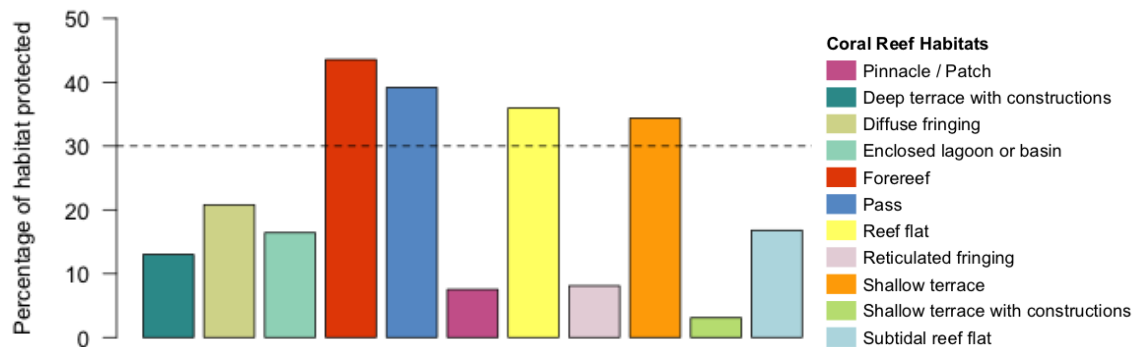


Figure 1. Representation of coral reef habitat types within the existing MPA network in Kubulau. The dashed line indicates the representation target of 30%.

In the context of improving resilience to climate change, critical areas for inclusion in MPA networks are those that have naturally high resistance or resilience to mass coral bleaching events. Indicators of coral reef resilience that were identified as relevant to the Fiji qoliqoli include:

- Sites with a high abundance of mature coral colonies and evidence of strong coral recruitment
- Sites that have a high availability of suitable substrates
- Sites that have a high abundance and functional diversity of herbivores
- Sites with high fish and coral diversity and functional diversity
- Sites that are dominated by bleaching-resistant or bleaching-tolerant coral taxa
- Sites where fishing pressure is low
- Sites that are influenced by upwelling or are exposed to strong currents
- Sites that are shaded by high, steep-sided islands or reef topography

Other potential resilience indicators were disregarded, either because they are not applicable at this spatial scale, because they are not scientifically robust, or due to lack of available data. Using an adapted version of the Reef Resilience (R^2) Toolkit, reef resilience data were collected at 53 sites in the Kubulau qoliqoli during March 2010 and an addition 143 sites across Solevu, Nadi, Wainunu and Wailevu qoliqoli between March-April 2011. Data were collected on reef fish biomass and diversity; coral population structure, benthic cover and site physical

characteristics, such as flushing and shading. These data were analysed to rate each site against the resilience indices shown in Table 2. Indices were rescaled and summed to give a single resilience score for each site. Overall resilience was scored relative to other sites within the planning regions (Figure 2).

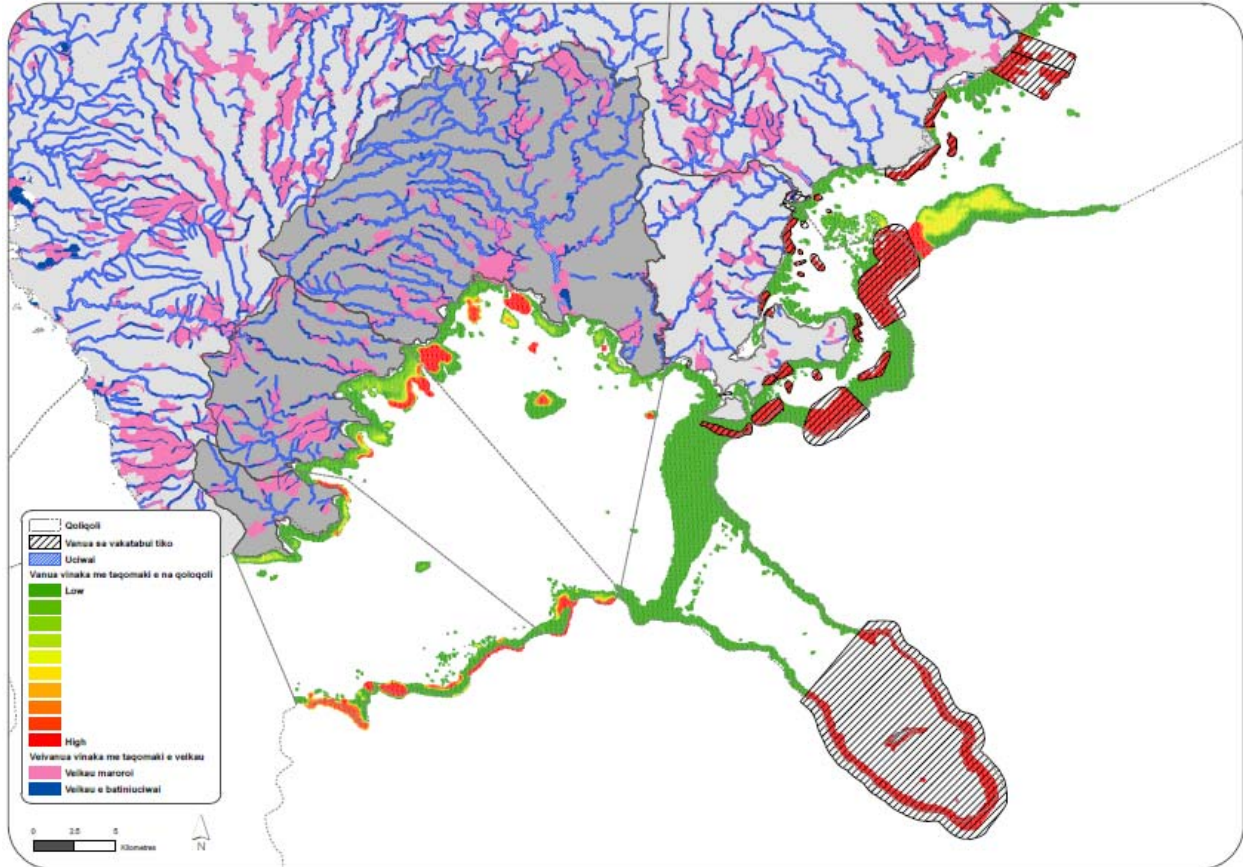


Figure 2. Map of recommended areas for establishment of marine and terrestrial/freshwater protected areas across Solevu, Nadi, Wainunu, Kubulau, and Wailevu districts to meet representation and resilience targets.

Sites predicted to have high resilience to coral bleaching, and those whose resilience might be improved by management (e.g. those with low herbivore abundance as a result of fishing pressure but rate highly against other resilience criteria) were shown on the map of conservation priorities (Figure 2) used as the primary input for discussions with community decision makers on how the MPA network might be established or reconfigured to improve resilience to climate change impacts.

Resilience indices	Measure
Coral community dominated by bleaching-'resistant' or 'tolerant' taxa	Site susceptibility index, derived from coral genera susceptibility to bleaching (from the literature) and dominance at site
Substrate availability	Proportional cover of coral and crustose coralline algae to other substrate types
Coral population structure	Number of coral recruits (to 10cm) per 100m ²
Herbivore abundance and functional diversity	Total herbivore biomass, as proportion of highest site; proportion of herbivore functional groups present
Fishing pressure	Total fish biomass, as proportion of highest site
Shading from high, steep-sided islands or reef topography	Site observations of physical shading (e.g. from overhangs) and canopy shading (e.g. from tabulate corals), scored 1-5
Proximity to upwelling or exposure to strong currents	Site observations of current strength and flushing, scored 1-5
Reef exposure at low tide	Site observations / local knowledge of reef exposure at low tide, scored 1-5

NEXT STEPS:

- Predictive modeling from satellite data of factors related to resistance to and recovery from climate change disturbance
- Preparation of peer-reviewed journal article(s)

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. The project supports the following strategies from the draft **National Climate Change Policy: Adaptation Strategy 2:** Include vulnerability assessment and climate change impact projections into resource management planning, such as integrated coastal and watershed management plans; **Adaptation Strategy 5:** Support the ecosystem based management approach throughout Fiji, recognizing that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience; and **Adaptation Strategy 6:** Develop and make accessible hazard maps of coastal, riverine, urban and inland areas in Fiji, utilizing the Comprehensive Hazard Assessment and Risk Management tool to guide all development planning.

Land-Sea Prioritization to Maximize Coral Reef Health

STATUS: Complete

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

PARTNER ORGANISATIONS: ARC Centre of Excellence for Environmental Decisions (CEED), University of Queensland; National Center for Ecological Analysis and Synthesis (NCEAS) Working Group on decision making in the Coral Triangle

OUTPUTS:

- *Journal Article:* Klein CJ, Jupiter SD, Selig ER, Watts M, Halpern BS, Kamal M, Roelfsema C, Possingham HP (in press) Forest conservation delivers highly variable coral reef conservation outcomes. *Ecological Applications*
- *Conference Presentations:* Klein CJ, Jupiter SD, Selig ER, Watts M, Halpern BS, Kamal M, Roelfsema C, Possingham HP (2011) Prioritizing land and sea conservation investments to protect coral reefs. 2nd Fiji Islands Conservation Science Forum, Suva, Fiji, 14-16 September. Klein CJ, Possingham HP (2011) Balancing decisions between land- and sea-based conservation management actions to increase the resilience of coral. 25th International Congress for Conservation Biology, Auckland, New Zealand, 5-9 December

RESEARCH HIGHLIGHTS:

Coral reefs are threatened by multiple human activities on both the land and the sea. However, planning for the conservation of coral reefs is usually only focused on implementing marine protected areas without also implementing land management. To address this, we aimed to develop a new model with an integrated land-sea planning approach to determine where the protection of coastal forest can deliver the greatest return on investment for coral reef health.

Our objective was to maximize coral reef condition through investment in terrestrial protected areas across Fiji's coastal watersheds, focused on the three main islands of Viti Levu, Vanua Levu and Taveuni. We created a simple model to estimate coral reef condition as influenced by watershed-based pollution and fishing impacts, as no other suitable models were available to address our objective. These stressors were chosen as they are the only stressors for which we have consistent data across the whole study region that can be mitigated through implementation of a protected area.

We modeled the condition, C , of each 1 km² coral reef, i ($i=1\dots,7759$), as a function of watershed-based pollution and fishing pressure:

$$C_i = [(e^{-\alpha p_i})[(e^{-\beta f_i})(1 - \delta) + \delta]],$$

where p_i and f_i are variables that quantify the amount of watershed-based pollution and fishing pressure at each reef, assuming no conservation strategies are implemented. The remaining parameters are constants, where α indicates the rate of coral reef degradation with increasing watershed-based pollution, β indicates the rate of coral reef degradation towards a condition of δ with increasing fishing pressure, and $0 \leq \delta \leq 1$ is the expected condition of a heavily overfished coral reef with no watershed-based pollution. We populated the model variables (p_i , f_i) using

existing spatial data, whereas the constants (α , β , δ) were derived from the literature, where possible, and varied to determine the sensitivity of the prioritisation outcome to their value.

We first ran the model under the scenario that all remaining forest had been cleared in Fiji to see how much relative pollution would come out of each catchment. Figure 3a shows the relative amount of land-based pollution which we modeled would be delivered from each catchment and Figure 3b indicates which reefs are likely to be affected by the sediments and nutrients coming off the land using a basic flood dispersion model. We then ran the model assuming that all forests were protected to look at how much improvement to coral reef condition we could expect if we protected all forests and where would the benefit to coral reefs be the greatest.

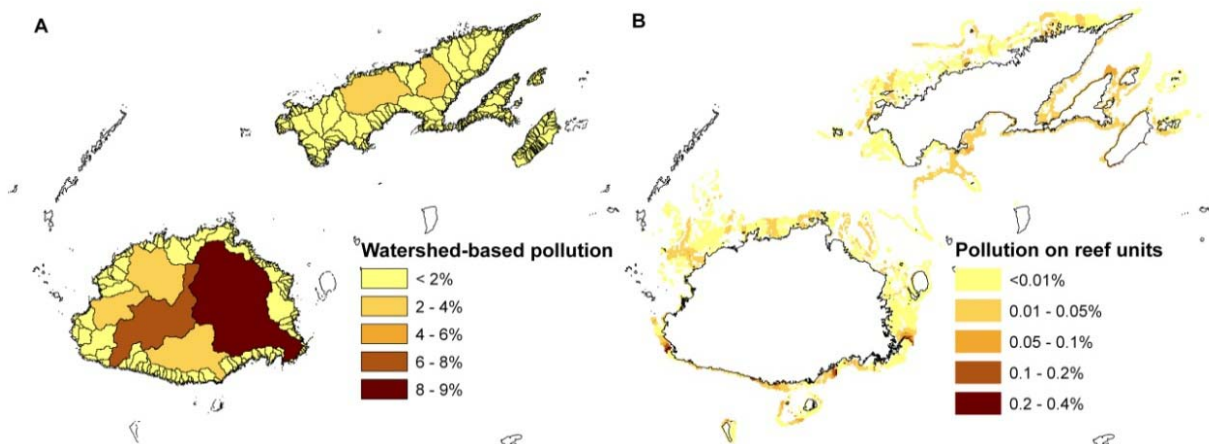


Figure 3. Modeled amount of watershed-based pollution in each watershed (a) and on each reef pixel (b), assuming all forest has been cleared. Amounts are expressed as percent of total pollution to entire study region.

We found that depending on values chosen for levels of impact of watershed pollution (α) and fishing (β) and initial reef state due to fishing impact alone (δ), total coral reef condition would be 8-58% improved when all forests are protected rather than cleared. The most cost-effective forest to protect is in watersheds that are heavily forested and influence a large area of coral reefs, thus contributing most to increasing coral reef health (Figure 4). We also found that coral reefs influenced by heavily cleared watersheds are a low priority for implementing protected areas regardless of fishing pressure.

These findings have been presented back to the national Protected Area Committee to guide the development "rules of thumb" guidelines for implementing cost-effective management to improve coral reef condition. During the presentation, the caveats were also made that because the models only look at maximizing return on investment for improvements to coral reef condition, the guidelines must be considered in conjunction with other conservation planning principles for terrestrial protection (e.g. complementarity, representativeness, risk

spreading, and adequacy) when the PAC selects specific terrestrial sites for allocation of resources for management.

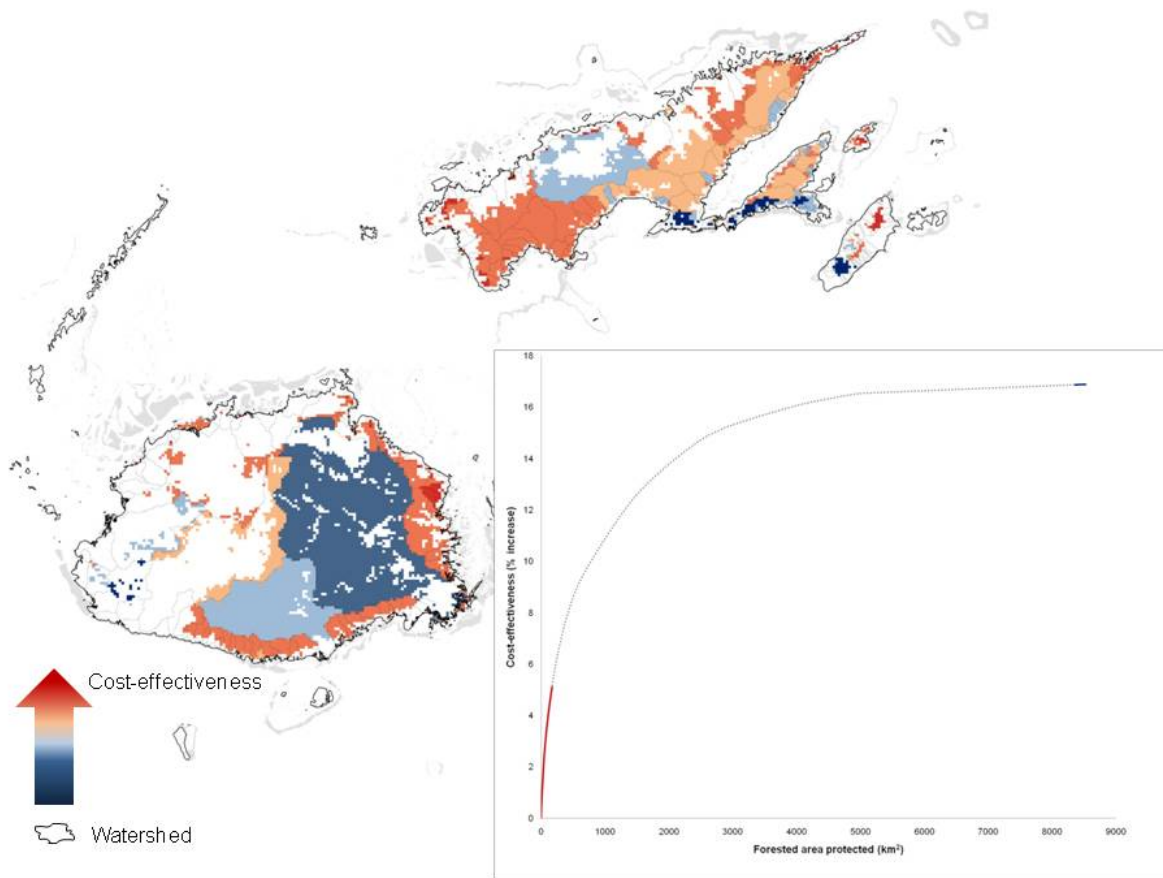


Figure 4. Cost effectiveness of protecting forests and cumulative benefits of protecting each forest pixel, highlighting the most (red, top 2%) and least (dark blue, bottom 2%) cost-effective areas for conservation. Cost-effectiveness of implementing a terrestrial protected area was defined as the improvement in relative condition across all reefs, divided by the cost of implementing the action at the forest pixel.

NEXT STEPS:

- Use information in conjunction with other priorities for terrestrial conservation to select sites with the PAC for enhanced on expanded management

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.

Marine Zoning Across the Vatu-i-Ra Seascape

STATUS: In progress

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

PARTNER ORGANISATIONS: ARC Centre of Excellence for Environmental Decisions (CEED), University of Queensland; National Center for Ecological Analysis and Synthesis (NCEAS) Working Group on decision making in the Coral Triangle

OUTPUTS:

- *Conference Presentations:* Makino A, Klein C, Beger M, Jupiter S, Selig E, Watts M, Possingham H (2011) Marine zoning of the Vatu-i-Ra ecoscape incorporating marine zone effectiveness and socioeconomics. 2nd Fiji Islands Conservation Science Forum, Suva, Fiji, 14-16 September. Makino A, Klein CJ, Beger M, Jupiter S, Possingham HP (2011) Incorporating zone effectiveness into marine zoning in Fiji. 25th International Congress for Conservation Biology, Auckland, New Zealand, 5-9 December
- *Masters Thesis:* by UQ student Azusa Makino, in prep

RESEARCH HIGHLIGHTS:

In September 2011, WCS Fiji has taken the first steps in discussing with teams from the four provinces of Ra, Tailevu, Lomaiviti and Bua how they might think about planning for multiple activities that take place in the coastal zones of the Vatu-i-Ra Seascape (*see **Vatu-i-Ra Seascape Stakeholders Workshop** below*). Once further consultations are made, part of this process might consider a zoning scheme that applies different types of management actions across the planning space. Because not all of these management actions are equally effective for protection of biodiversity, we worked with researchers at the University of Queensland to ask how differential zone effectiveness could affect the selection of priority areas for management and how would the selection priorities change if we want to distribute costs equitably across the qoliqoli so that no one district has the burden of setting aside more than 10% of their qoliqoli area?

The analysis was conducted by Azusa Makino, Masters student at the University of Queensland. She used all of the habitat data that was available for the national marine gap analysis (Mills et al. 2011), with the targets of 30% representation for mangroves, intertidal mudflats, non-fringing reefs and fringing reefs, and 10% representation for other benthic habitats. For management costs, she considered the costs associated with patrolling the qoliqoli, whereby total cost = distance from village (km) x fuel cost (FJ\$1.29/km). Permanent no-take areas were considered 100% effective for biodiversity protection, while areas open to fishing were considered ineffective. The effectiveness of partial protection areas (periodically harvested closures) varied across habitats depending on whether the measure was taken as an average of the effectiveness values for the different species groups considered in Mills et al. (2011), the lowest values or the highest values (Table 3). These zone effectiveness scores were incorporated into a decision-support software tool, Marxan with Zones, to compare different

configurations of zones designed to meet the targets for "effective" representation of each habitat.

The amount of overall area required to meet the target varied depending on which effectiveness scores were used, with the most habitat area required when then lowest scores were used (Figure 5). Although the amount of area required to meet the target of equitably distributing closures across all of the Vatu-i-Ra Seascape qoliqoli was less, it required a much higher overall management cost.

Table 3. Ecological effectiveness scores of partial protected areas across each habitat type

Conservation Features	Average	Lowest	Highest
Fringing reefs	53%	20%	100%
Non-fringing reefs	58%	20%	100%
Mangrove	41%	25%	100%
Intertidal	31%	20%	45%
Other benthic less than 10m	54%	20%	100%

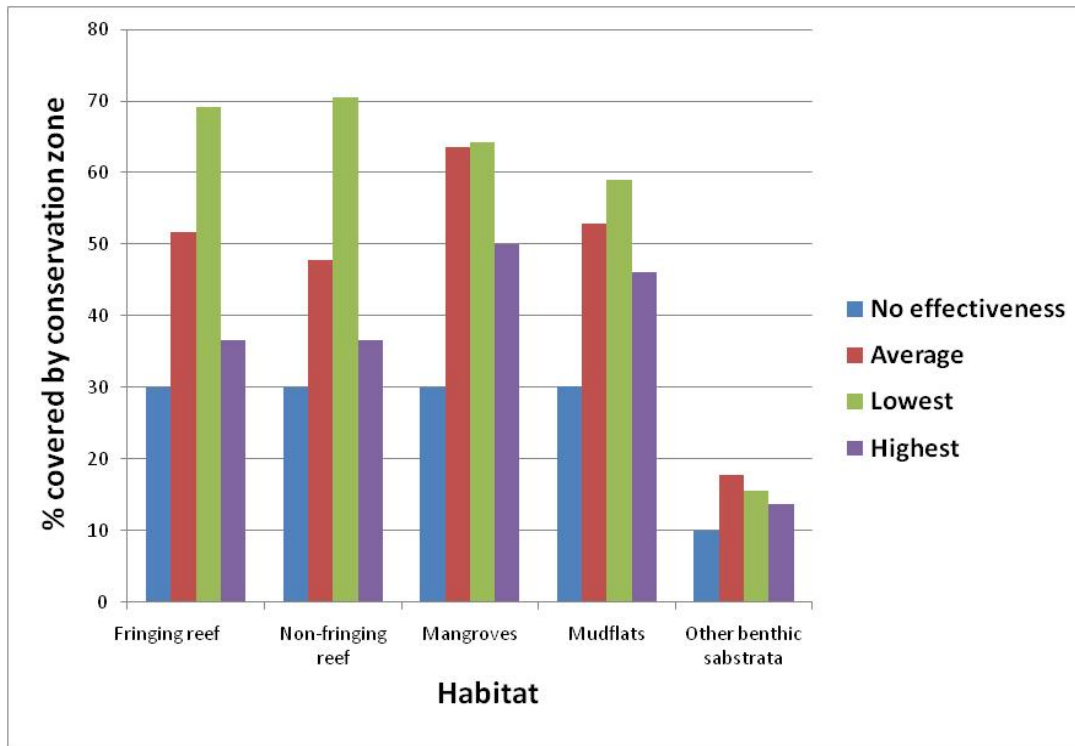


Figure 5. Comparison of outcomes of Marxan with Zones trials for the amount of area required to achieve 30% effective protection of fringing reefs, non-fringing reefs, mangroves and mudflats, and 10% effective protection of other benthic substrata in scenarios where different effectiveness scores for each habitat type are used.

NEXT STEPS:

- Prepare manuscript for submission to peer-reviewed journal

- Use Marxan with Zones in combination with extensive community and provincial-level consultation to develop zoning plans in support of ICM plans for the four provinces within the Vatu-i-Ra Seascape

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. It additionally supports **NBSAP Implementation Plan Thematic Group 4 (Coastal Development) Strategy 1:** Strengthen national guidelines for inter-sectoral coastal development, **Objective 1.3:** By 2014, a national coastal development plan to be developed to regulate/monitor coastal development activities; **Action 1.3b:** ICMC will collate and develop the coastal development plan with relevant stakeholders targeted to mainstream all current and planned development activities. The project also supports the following strategies from the draft **National Climate Change Policy: Adaptation Strategy 2:** Include vulnerability assessment and climate change impact projections into resource management planning, such as integrated coastal and watershed management plans.

FLMMA Future Scenarios

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

OUTPUTS:

- *Journal Article:* Mills M, Adams VA, Pressey RL, Ban NC, Jupiter SD (in review) Where do national and local conservation actions meet? Simulating the expansion of ad hoc and systematic approaches to conservation into the future. Conservation Letters.
- *Technical Report:* Mills M, Jupiter S, Adams V, Ban N, Pressey B (2011) Can management actions within the Fiji Locally Managed Marine Area Network serve to meet Fiji's national goal to protect 30% of inshore marine areas by 2020? Wildlife Conservation Society and ARC Centre of Excellence for Coral Reef Studies, Suva, Fiji, 16 pp.
- *Conference Presentations:* Mills M, Adams VM, Pressey RL, Jupiter SD (2011) Where do regional and local conservation actions meet? Modelling the differences between local implementation and regional conservation planning in Fiji. 2nd International Marine Conservation Congress, Victoria, Canada, 14-18 May

RESEARCH HIGHLIGHTS:

In 2005 at the review of the Barbados Plan of Action in Mauritius, the Fiji Government made a commitment to effectively manage and finance at least 30% of Fiji's inshore marine areas by 2020. Given that much of the planning for inshore marine management is undertaken by partners of the Fiji Locally Managed Marine Area (FLMMA) network, this study was undertaken to evaluate whether the expansion through the FLMMA network could achieve national conservation objectives by 2020. Led by Morena Mills at the ARC Centre of Excellence for COral Reef Studies at James Cook University, a model was developed simulating expansion of the FLMMA network to 2020 using data collected from key informant interviews to identify factors that influence opportunities for and constraints on implementing closures in Fiji. We additionally compared this model to results obtained through systematic conservation planning techniques.

Details of the development of the model can be found in a technical report (Mills et al. 2011) that was presented to the national Protected Area Committee, participants at the Vatu-i-Ra Seascape Stakeholders workshop, and distributed to the Fiji Department of Environment. The main outcome of this work was that under our opportunistic scenario, where conditions were designed to reflect an optimistic continuation of the business as usual conditions by which new sites are added to the FLMMA network, the network will achieve a good portion of the national objectives, but will fall considerably short of the 2020 objectives (Figure 6). Furthermore, given the current weak status of the global economy, it may not be realistic to assume that donor investment to the FLMMA network and FLMMA partners will be at the same level when expansion peaked in 2002-2004. Therefore, these simulations may under-represent what can actually be achieved should funding be reduced over the next 10 years.

Although a systematic approach came closer to achieving the national 2020 objectives, we do not recommend abandoning the FLMMA approach in favour of systematic conservation planning. However, systematic assessments can be useful in Fiji to help scale up where FLMMA partners and government could additionally allocate resources to fill important gaps to achieve national objectives. This is already being done in several parts of Fiji such as Kubulau and Kadavu. As an example, a community may want to establish a small, periodically harvested marine closure with the local aim of increasing fisheries resources so that they are available for an annual feast. Systematic assessments may help identify mangrove and mudflat areas that will help achieve local fisheries objectives and that are of high importance for meeting national representation objectives for mangrove and mudflat protection. With the guidance of systematic assessments, FLMMA partners and other government organizations may be able to provide incentives to the community to expand the boundaries of its tabu so that it will contribute to both local and national objectives. Such incentives could include both financial and/or non-monetary benefits (e.g. payment of school fees, national public recognition), which may be a necessary step as we recognize that local communities are unlikely to be willing to take on the cost burden of contributing to national objectives for free.

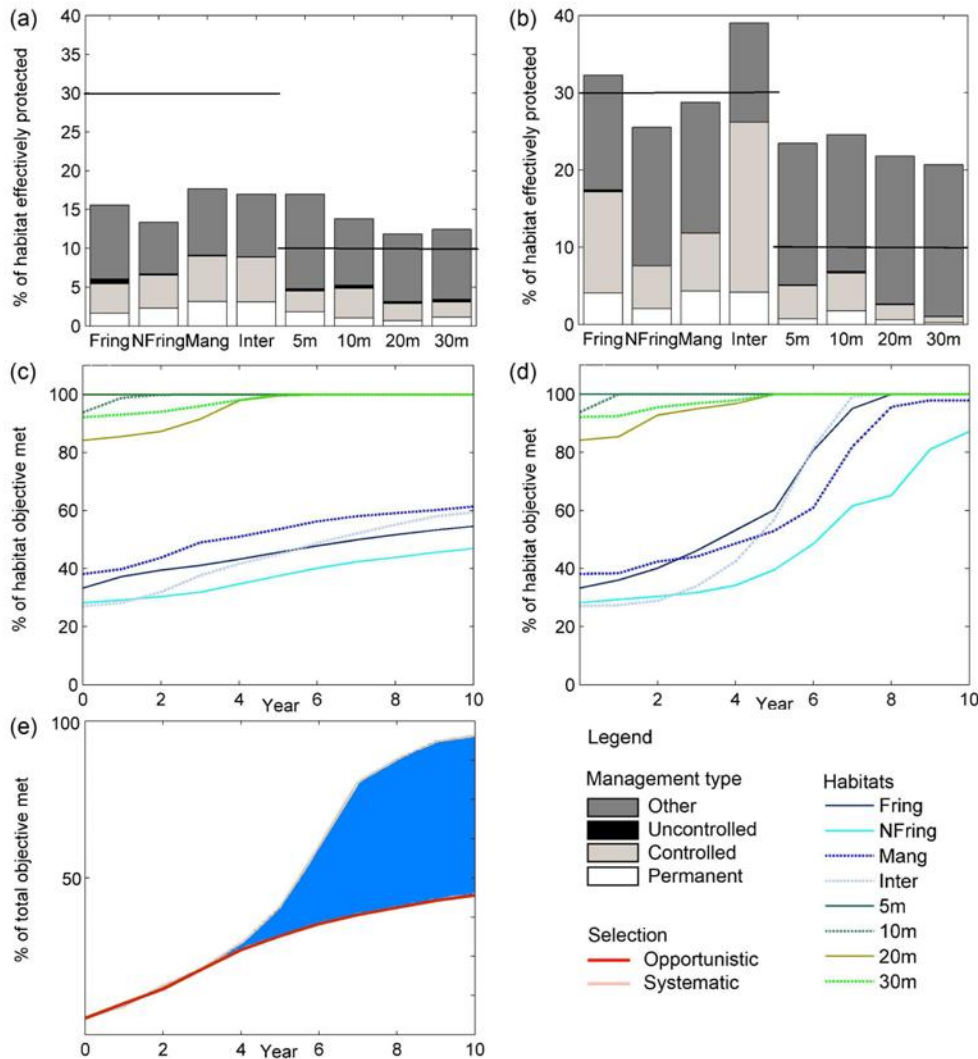


Figure 6. Achievement of national 2020 objectives by the opportunistic and systematic scenarios. (a) Percent representation of each habitat by 2020 in the simulated FLMMA network under the opportunistic scenario. Horizontal lines indicate national objectives. (b) Percent representation of each habitat by 2020 of all MPAs in the modeled systematic scenario. Horizontal lines indicate national objectives. (c) For the opportunistic scenario, the per-year increase in representation of each habitat over the ten years to 2020, averaged across 100 simulations. (d) For the systematic scenario, the per-year increase in representation of each habitat over the ten years to 2020, averaged across 100 runs. (e) Achievement of national overall objective over the ten years to 2020 in the opportunistic and systematic scenarios, averaged across 100 selection processes and across all habitats.

NEXT STEPS:

- Initiate discussions with PAC and FLMMA to develop incentives for encouraging communities to establish larger closures over sites that have high national value for biodiversity conservation and would help the Fiji Government achieve their target to effectively manage 30% of inshore and offshore water by 2020.

LINKS TO NATIONAL PRIORITIES:

The work was completed as part of a prioritized action for quarter 3 of 2011 under Fiji's **National Biodiversity Strategy and Action Plan (NBSAP) Implementation Plan 2010-2014** thematic section for Inshore Fisheries. 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.

Catchment to Reef Processes and Human Livelihoods

Factors Influencing Freshwater Fish Assemblages

STATUS: Complete

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

PARTNER ORGANISATIONS: Wetlands International-Oceania

OUTPUTS:

- *Journal Article:* Jenkins AP, Jupiter SD (2011) Spatial and seasonal patterns in freshwater ichthyofaunal communities of Vanua Levu, Fiji. *Environmental Biology of Fishes* 91:261-274
- *Conference Presentations:* Jupiter S, Jenkins A, Askew N, Qauqau I, Weeks R, Mailautoka K (2011) Conservation of highly migratory ichthyofauna using ecosystem-based management principles at local and national scales in Fiji. 25th International Congress for Conservation Biology, Auckland, New Zealand, 5-9 December. Mailautoka K, Jupiter S, Jenkins A (2011) Human and climate impacts on decline of Fiji's freshwater fishes. 2nd Fiji Islands Conservation Science Forum, Suva, Fiji, 14-16 September

RESEARCH HIGHLIGHTS:

In the WCS Fiji 2010 Annual Report, we presented an overview of the training methodology and research surveys methods for a collaborative project by WCS Fiji and WIO to answer the question: "How does catchment land cover and riparian forest width influence in-stream fish communities and biophysical characteristics of streams?"

A total of 32 sites were selected from 4 districts; these included 14 sites from Wainunu, 9 from Kubulau, 4 from Sasa and 7 from Macuata. The different sites were selected based on the amount of forest cover which they contain: we used a stratified sampling design to attempt to select sites with > or <50% forest cover, and > or <30 m riparian buffer zones. Water quality was measured; fish species were identified for its diversity and counted for their abundance. Likewise the forest buffer zone was measured to around 30 meters from the river bank and the different trees within the 30 meters buffer were identified in family and species and their diameter measured.

Both fish species richness (Figure 7) and abundance were affected by the environmental condition and the presence of downstream hanging culverts.

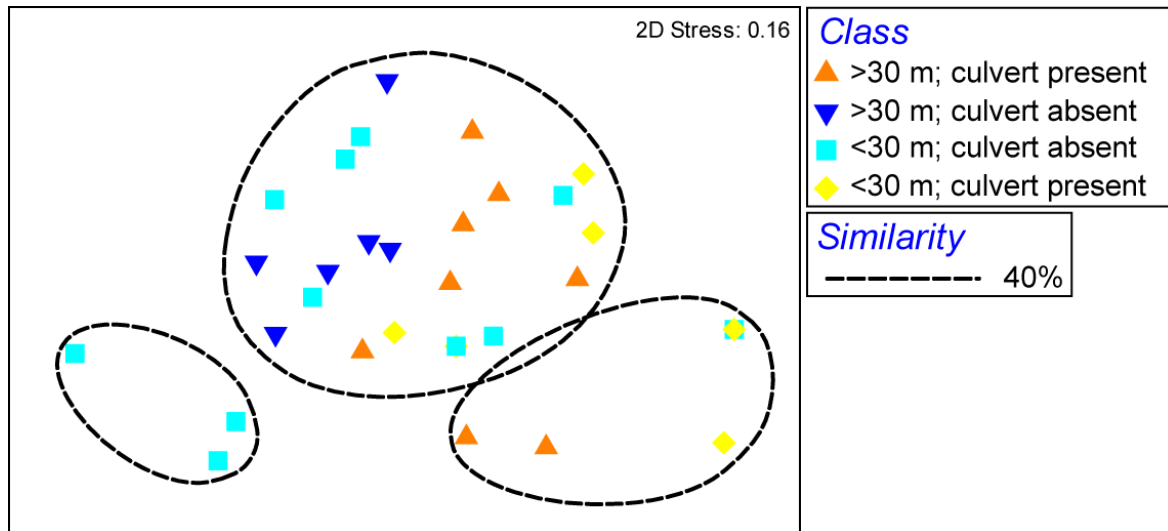


Figure 7. A non-metric multidimensional scaling plot of the similarity between fish species composition at each survey site. Sites to the left generally have higher richness and sites to the right have lower richness. Blue triangles = >30 m riparian zone, no culvert; turquoise squares = <30 m riparian zone, no culvert; orange triangle = >30 m riparian zone, culvert present; yellow diamonds = <30 m riparian zone, culvert present.

The sites in the cluster on the right, which are significantly different from the other two clusters, represent a mixture of different conditions that all had few to no species. This cluster included sites with good forest cover and wide riparian zones, but because of large, steep culverts, the only fish that were found were those that were able to physically climb up the barrier (e.g. *Anguilla marmorata*, *Giuris margaritacea*). The other sites in the cluster either had no fish or only the most hardy species (e.g. *Sicyopterus lagocephalus*) due to the presence of clusters and/or heavy land clearing adjacent to the stream.

Fish communities are determined by many ecological, biophysical and geographic variables. This study may not have had power to detect all significant factors because we sampled in very small streams, therefore many of the differences may be determined by chance alone. Across all of research findings to date, the three major factors that all may serve as barriers to fish migration include: (1) catchment/riparian zone degradation; (2) presence of non-native species; and (3) presence of overhanging culverts.

Based on these lessons, we have developed the following management recommendations:

- For catchment and riparian zone degradation, people should protect intact forests and riparian zones where they exist and restore riparian vegetation where it has been cleared.
- For non-native species, people should prevent introduction of non-native species in areas where they presently are not found. However, in areas where they are

widespread, because they are so hard to eradicate, it is okay to continue with aquaculture projects

- For dams, culverts or weirs, there should be consideration during the design process to assess whether fish will be able to pass. In cases where they cannot, designs should be modified with fish passageways and ladders.

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 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 5 (Threatened and Endangered Species) Strategy 1:** Increase access to expertise/increased efforts made in the fields of quality research, **Objective 1.1:** By 2012, resource inventories are compiled for at least 10 target species; **Action 1.1b:** Undertake a comprehensive terrestrial and freshwater/marine biodiversity resource inventory; and **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.

Increasing Protection Across the Mt. Navotuvotu-Mt. Kasi Corridor

STATUS: Ongoing

FUNDING: Disney Friends for Change Initiative

PARTNER ORGANISATIONS: N/A

OUTPUTS:

- *Conference Presentations:* Jupiter S, Jenkins A, Askew N, Qauqau I, Weeks R, Mailautoka K (2011) Conservation of highly migratory ichthyofauna using ecosystem-based management principles at local and national scales in Fiji. 25th International Congress for Conservation Biology, Auckland, New Zealand, 5-9 December.

RESEARCH HIGHLIGHTS:

The forests within and surrounding the KBAs of Mt. Navotuvotu and Mt. Kasi in Fiji are recognized as critical for conservation both because they contain globally threatened species

and because they are sites of national significance for biodiversity conservation. The forests surrounding Mt. Kasi have the highest known single-site species richness on Vanua Levu. They include the IUCN red-listed critically endangered *Astronidium kasiense* and *Gardenia anapetes*, and the vulnerable *Metrosideros ochrantha*, all of which are endemic plants to Fiji. *A. kasiense* and *G. anapetes* are additionally found in the Mt. Navotuvotu KBA. While the biodiversity of freshwater fauna from the KBAs is currently unknown, streams within the relatively pristine forests of adjacent districts (Kubulau and Wainunu) in the corridor between Mt. Navotuvotu and Mt. Kasi contain at least 5 species of endemic freshwater fish (*Redigobius leveri*, *Glossogobius sp.*, *Stenogobius sp.*, and two species of *Stiphodon*). The streams also support sensitive species, such as *Eleotris melanosoma*, *Butis amboinensis*, *Kuhlia munda*, *Giurus hoedti* and *Redigobius bikolanus*, that are conspicuously absent from other Fiji catchment streams where forests have been cleared and non-native tilapia introduced.

The forests and freshwater areas of the Mt. Navotuvotu-Mt. Kasi forest corridor are under imminent threat from logging, mining and invasive species. Fifty-nine percent of the Mt. Navotuvotu KBA is currently allocated as logging concessions, while 80% of the Mt. Kasi KBA is under mining tenement. Without management, there is a high risk that: (1) IUCN red-listed plant species will be lost through direct clearing; (2) endemic and vulnerable freshwater fish species will be lost through direct and indirect effects of sedimentation; and (3) there will be irreconcilable damage to downstream coastal and marine ecosystems.

Community members and provincial administrators have expressed concern over these threats. At a recent Protected Area Committee (PAC) planning workshop with provincial administrators organized and facilitated by WCS, representatives from the Cakaudrove provincial office and NGOs identified the Mt. Kasi region as a candidate site for a forest reserve. Representatives from the Bua provincial office proposed conservation sites around Wainunu and Kilaka rivers as well as forest management around the Mt. Navotuvotu and Kilaka forests. The terrestrial working group of the PAC has named the Mt. Navotuvotu KBA as one of its top 10 priority locations to increase the current level of terrestrial area under protection in Fiji from 2.9% closer to the 20% target by 2020 set under Fiji's Programme of Work on Protected Areas.

We conducted a spatial prioritization exercise using Marxan decision-support software to identify areas for protection and management across all of Bua Province that considered the following targets:

- 30% of unfragmented rivers, plus an additional 30% of *unobstructed* and unfragmented rivers
- 20% of dense forest in KBAs based on the draft national target
- 10% of dense forest outside KBAs (We used a reduction of the draft national target because of increased activity in this area to be able to preserve more arable land)

Options for zones included: Community Forest Park, Riparian Buffer Zones, and Open. Unobstructed and unfragmented rivers were nested within unfragmented rivers, with the aim that Marxan will preferentially select unobstructed and unfragmented rivers because this contributes towards two targets, but with the option to select simply unfragmented rivers if

this is necessary to meet the targets. Conversely, the two forest features are spatially exclusive, because we want different targets for forest outside KBAs and inside KBAs, and by definition these forests can either be one zone or the other.

To calculate costs, we used costs for the overall amount of area selected and penalties for selecting arable lands and lands already under forest concession (Figure 8). For open areas, all costs were zero by definition because they are not being selected for management. We assigned the same arable land costs for Community Forest Parks and Riparian Buffer Zones because farming can occur equally in both areas. We assigned a higher logging cost for Community Forest Parks than Riparian Buffer Zones because the Fiji Logging Code of Practice already prohibits logging in river buffer zones at variable distances depending on stream width.

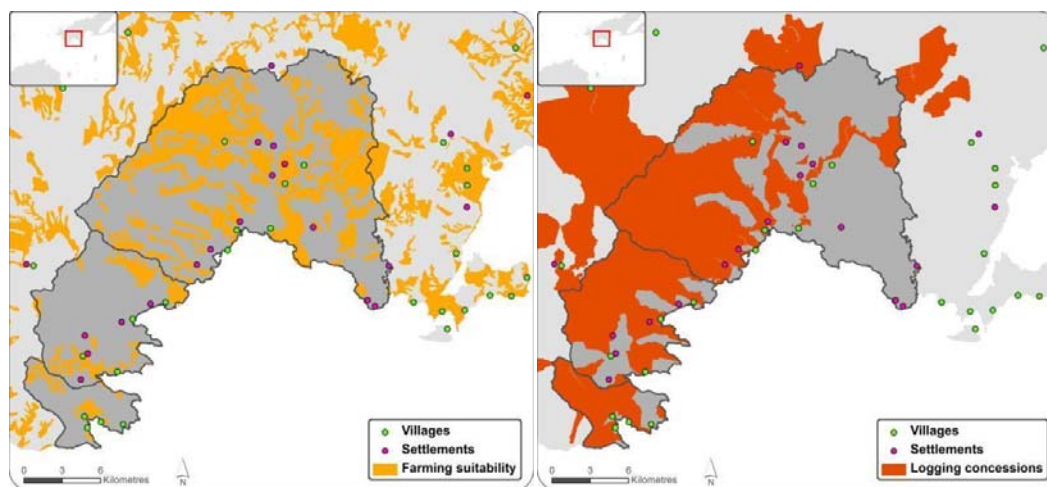


Figure 8. Cost layers were defined by (LEFT) suitable lands for farming as defined by land use classification categories I-IV; and (RIGHT) logging concessions. Maps are subset to Wainunu, Nadi and Solevu districts.

The best solution that met all of the targets with minimal cost is shown in Figure 2. These maps were presented to community stakeholders at the Wainunu, Nadi, Solevu ecosystem-based management planning workshop in November (*see below*). The next step is to consult with landowners to identify which mataqali are will to establish protection on their lands.

NEXT STEPS:

- Consultations with mataqali to discuss establishment of Community Forest Parks and Riparian Buffer Zones
- Work through the national Protected Area Committee to develop new Protected Area legislation that would legally recognize local authority to manage Community Forest Parks and Riparian Buffer Zones.

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; and **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: Massachusetts Institute of Technology (Dr. Ilana Brito - lead), Wetlands International-Oceania, Ministry of Health, Fiji National University

OUTPUTS:

- *Proposal developed:* Understanding common drivers of waterborne bacterial disease transmission and impacts to downstream ecosystem services to design relevant catchment management initiatives for Fiji

RESEARCH HIGHLIGHTS:

In 2010, Fiji declared a national health emergency due to a widespread, severe typhoid epidemic; and in 2011, several districts were quarantined due to focal typhoid outbreaks. Identifying the sources of infections is of utmost importance to healthcare providers throughout Fiji. Since waterborne diseases appear to peak after flooding events, identifying environmental determinants which contribute to flooding (and therefore cases of typhoid) may help to prevent future epidemics. In January 2011, a pilot study was launched to identify the major routes by which bacteria are transferred in order to better understand how typhoid is spread across districts in Fiji. The pilot study had three main goals: a) to validate a technique used to investigate bacterial transmission; b) to use this technique to evaluate the transfer of bacteria based on individuals' behaviors, demographics and locations and c) to identify potential sources of latent (asymptomatic) transmission or environmental reservoirs of *Salmonella typhi*, the cause of typhoid, and *Leptospira* bacteria. Participants in four villages and one settlement were included in this study. This study will provide the foundation from which to launch a broader study into the environmental determinants that may influence typhoid and other waterborne bacterial disease transmission in Fiji.

The study site included villages within the Wainunu and Macuata districts. Specifically, participants volunteered from Nakawakawa, Daria, Saolo and Navuevu (settlement) from Wainunu, and from Tabia in Macuata. These communities vary with respect to their access to potable water sources and sewage and drainage systems, microclimate, proximity to highly populated areas, land management, isolation and environmental degradation . These villages

have access to tapped spring water, although the Navuevu settlement did not: Saolo and Navuevu and settlements outside of Tabia use well-water. Navuevu uses river water in addition to well-water for drinking. The environment surrounding villages within Wainunu is much more preserved than the part of the Macuata district surrounding Tabia. This area has been subject to heavy deforestation, road-building, and cane farming.

Four endemic bacterial diseases are of interest to this study: typhoid, salmonella and shigella (all fecal-oral transmitted diseases) and leptospirosis (a disease of animal origin transmitted through contact with urine.) Within the previous 5 years, there have only a handful of typhoid cases within the selected villages. There were two deaths in Nakawaka due to shigellosis. There have been no confirmed cases of leptospirosis although several individuals reported sickness within their livestock (specifically pigs). They were not tested nor confirmed for presence of *Leptospira* bacteria. Neighboring districts succumbed to a severe typhoid epidemic in early to mid- 2011 that required quarantining villages and bans on communal grog drinking. Our study did not involve these villages although future studies that we are planning aim to identify sources of active infections targeting populations during epidemics. These projects currently await funding.

Study Participants and Sample Analysis

Participants answered a short questionnaire and providing biological samples. In addition to basic demographic data, individuals were queried with regard to behaviors and aspects potentially important in the spread of pathogenic bacteria: their social networks, occupation, diet and food storage, interactions with animals, general hygiene, health status including any recent history of illness and selected treatments, household income, and recent travel within and outside of the community.

We wanted to test human microbial communities that had the highest exposure to exogenous bacteria and thus the greatest probability of transmission: the mouth, the gut and the skin. At the time of the questionnaire, participants provided saliva samples and swabs were taken of their palms. Individuals were trained in how to collect a stool sample. Participation was voluntary and consent was obtained from all participants prior to their participation. Ethics review boards at the Fiji Ministry of Health, the Fiji National University, Columbia University and the Massachusetts Institute of Technology reviewed and approved the questionnaires, privacy protection measures and sample collection. In total, there were 298 participants in this study. Although the exact population of each village could not be determined, we estimate coverage of each village to be between 40 and 70% (Table 3), of which 83% provided stool samples. Safety measures (soap, latex gloves, alcohol swabs) were provided to individuals to prevent any adverse health effects from contamination due to stool. Environmental samples were taken to identify sources for human-associated microbes including: livestock stool, soil from areas surrounding households and potable water sources (Table 3).

Table 4. Samples collected from individuals and the environment at study locations in Wainunu and Macuata.

Location	Num. people surveyed / est. village pop. (%)	Number of samples from individuals	Num. of environmental samples
Daria	45/67 (67%)	122 Saliva and Hand swabs, Gut samples	12 Water, animal, soil samples
Saolo & Navuevu	54/203 (27%)	146 Saliva and Hand swabs, Gut samples	18 Water, animal, soil samples
Nakawakawa	81/240 (34%)	153 Saliva and Hand swabs, Gut samples	27 Water, animal, soil samples
Tabia	143/250 (57%)	378 Saliva and Hand swabs, Gut samples	31 Water, animal, soil samples

The number of total households surveyed was 73 with an average number of 6 per household. Among the study participants, there were 143 males and 155 females. Their ages ranged from 8 to 78 mean of 41.8 and median of 40.5. 11% tended animals, of which cows, horses and pigs are most common. In the past year, amongst the study participants, there were three cases of typhoid, 60 of influenza, 4 of pneumonia, 2 of meningitis, 2 of shigella, 2 of dengue virus. Forty-eight individuals had serious bouts of diarrhea. At the time of the study, eleven individuals were experiencing severe diarrhea; 19 had fever (unconfirmed), and 161 had dental pain. At the time of the study, 30 individuals were taking paracetamol, a painkiller and fifteen individuals taking an antibiotic: penicillin, amoxicillin or flucloxacillin. Since only a few types of antibiotics are being used in this area, antibiotic resistance may be a concern. Our data will also provide information on whether antibiotic resistant bacteria exist in this area. Based on the questionnaire results and observational data, we were able to reconstruct families and social networks of individuals in the study to assess the pathways that bacteria are transmitted from person-to-person.

For each sample to be processed, genetic material (bacterial DNA only) must be extracted and sequenced. DNA has been extracted from almost all of the samples and sequencing is currently underway, with expected dates of completion around February-March (subject to change). Analysis will be completed shortly thereafter. A presentation to both the Fijian Ministry of Medicine and Environment and study villages will follow thereafter so as to communicate all study results. Individuals with asymptomatic infections of typhoid will be notified so they can receive treatment to prevent further transmission.

NEXT STEPS:

A study to explore the environmental determinants of transmission is being planned between the Wildlife Conservation Society, Wetlands International-Oceania, the Massachusetts Institute of Technology and James Cook University. This study will determine whether environmental degradation due to land conversion surrounding catchments results in increased transmission of waterborne bacterial disease and loss of biodiversity in catchment and the near-shore environments. We hypothesize that flooding in areas that have undergone land conversion for

agriculture, forestry or mining, has resulted in increased bacterial carriage due to excessive runoff and sedimentation. We propose performing two types of studies: first, epidemiological cohort studies to identify associated factors with mild and severe cases of diarrheal disease; and second, a national-scale retrospective investigation into village origins of confirmed cases of typhoid and bacterial diseases to assess correlations of incidence with landscape-level environmental variables.

LINKS TO NATIONAL PRIORITIES:

The project supports the draft **National Climate Change Policy Adaptation Strategy 9**: Build the capacity of the health and agriculture sectors to respond effectively to climate sensitive diseases, including the strengthening of disease surveillance and control systems, and early warning mechanisms for climate sensitive human and livestock diseases

Conserving Biodiversity

Cetacean Surveys of Vatu-i-Ra Seascape

STATUS: Complete

FUNDING: Marisla Foundation

PARTNER ORGANISATIONS: Whale and Dolphin Conservation Society, Department of Fisheries

OUTPUTS:

- *Technical Report:* Smith B, Fox M, Naisilisili W, Dulunaqio S, Jupiter S (2011) Status of cetaceans in the Vatu-i-Ra Seascape and the development of local capacity for their research and conservation. Wildlife Conservation Society, Suva, Fiji, 23 pp.

RESEARCH HIGHLIGHTS:

Iconic species, such as cetaceans, resonate with local people and international supporters and can be effective conservation tools for anchoring protective measures in marine ecosystems. The charismatic quality of these animals may also provide opportunities for cetacean-watching tourism, which can provide a sustainable source of local income and increase community support for marine conservation. Marine waters in Fiji include breeding and nursery sites for an “endangered” population of humpback whales *Megaptera novaeangliae* and reef-edge habitat for a variety of other tropical cetaceans whose status are largely unknown in the South Pacific. Fiji is strongly committed to conserving cetaceans as evidenced by its declaration in March 2003 of its Exclusive Economic Zone as a Whale Sanctuary, providing protection from directed hunts for cetaceans over 1.3 million km², and its signing in September 2006 of the Memorandum of Understanding for the Conservation of Cetaceans and their Habitats in the Pacific Islands Region, negotiated under the United Nations Environmental Program’s Convention on Migratory Species.

Since early 2010, WCS has expanded its work across the Vatu-i-Ra seascape in support of a United Nations World Heritage nomination. Through rigorous scientific studies and extensive consultations, WCS is working with local communities to develop proactive, ecosystem-based conservation plans with specific provisions made for protecting threatened species. The focus of this project in the Vatu-i-Ra seascape is to preliminarily assess the status of cetacean populations, strengthen local capacity to conduct research, and develop effective strategies for their conservation.

The objectives of this project are to: (1) increase the capacity of local scientists and resource managers to conduct research on cetaceans and implement effective strategies for their conservation; (2) preliminarily assess the conservation status of cetacean populations in the proposed World Heritage Seascape; and (3) raise awareness among local people about cetaceans in Fijian waters and on efforts to conserve them in other areas of the world. Accomplishing these objectives will form the basis to consider conducting a more comprehensive assessment and integrating of cetacean conservation needs into protected area planning and management.

Given the lack of information on cetaceans in Fiji waters, interview surveys were conducted to provide preliminary information on these mammals. A total of 90 systematic interviews were conducted in 30 coastal villages distributed around the perimeter of the Vatu-i-Ra seascape within the province of Bua, Ra and Tailevu, to identify areas of cetacean activities and the types of cetaceans that are sighted there.

Interviewees were familiar with cetaceans based on personal observations (88.9%), local stories (63.3%), and television (51.1%). All reported positive feelings about whales (Tovuto) and 93.3% reported positive feelings about dolphins (Babale), with the rest being indifferent. The interviewees were shown a nautical chart of the Vatu-i-Ra seascape and asked to point out the sighting locations of each species they reported. Four areas were identified as potential cetacean hotspots, with a strong caveat being that these results may have been affected by the distribution of interview effort (Figure 9). These were the waters (1) surrounding Vatu-i-Ra Reef, especially near Vatu-i-Ra Island at its northern head, the 700 m deep Vatu-i-Ra Passage, in the lee of the reef's southern tip and western margin facing Viti Levu, and inclusive of Moon Reef or Makalati, a small crescent-shaped atoll located close to the southern tip of Vati-i-Ra Reef; (2) along the southwestern coast of Vanua Levu inclusive of Kubulau; (3) adjacent to the northern sides and between Ovalau and Makogai islands; and (4) inside and near Monkey Passage located between Monkey Face Island and Vanua Levu.

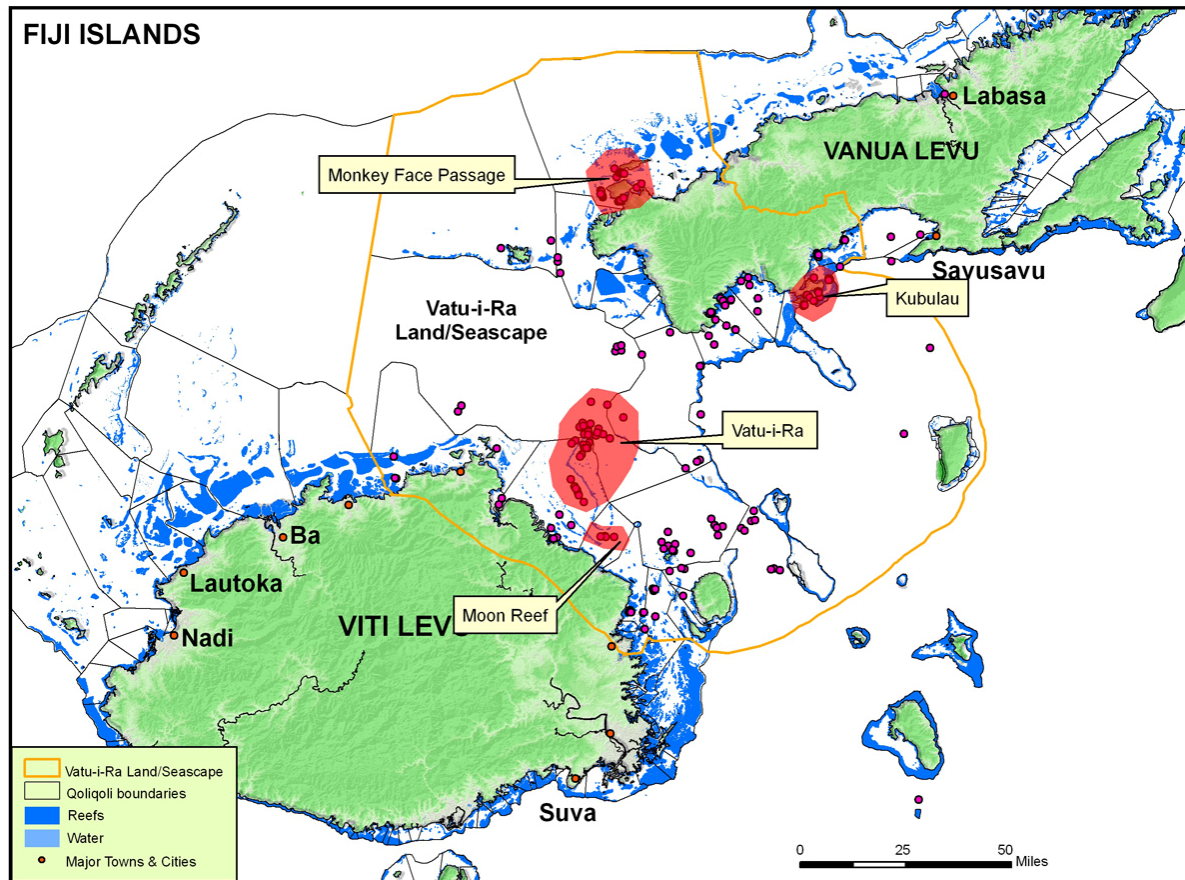


Figure 9. Anecdotal reports of cetacean sightings across the Vatu-i-Ra Seascape.

Under the guidance of WCS (Asia Program) cetacean specialist, Brian Smith, field surveys were conducted around Vatu-i-Ra waters from 15th to 20th August.

Boat-based surveys: Survey conditions were generally poor and this made detecting and identifying cetaceans extremely difficult, especially from a small open boat. Altogether we made 10 cetacean sightings including humpback whales (six groups of 1-6 individuals), spinner dolphins (one group of 5-8 individuals), common bottlenose dolphins; one group 45-60 individuals), and unidentified small-medium cetaceans (two groups of one individual). Seven of these sightings (one medium-sized cetacean - possibly a pygmy or dwarf sperm whale, the bottlenose dolphins and five humpback whale groups) were made in during the morning of our last day of the boat-based survey (18 August) in an arc-shaped path located about 12-17 km offshore of Vatu-i-Ra Island offshore from the southeast to the northeast (Figure 10).

Land-based surveys: Following permission from the owners of Vatu-i-Ra Island (Nagilogilo Tribe), we conducted land-based surveys on 20th August on top the highest peak (38m above sea level) of Vatu-i-Ra Island, on a cement platform from a lighthouse that has now been removed. We observed four groups of large baleen whales (1, 1, 2 and 5 individuals) that were almost certainly humpbacks based on their medium height bushy blows and breaching behaviour. The whales were calculated as being 4-8 km west and north of the whale groups we

recorded during the boat-based surveys. The locations of the whales observed during the land-based surveys were in deep waters of the Vatu-i-Ra. The combined area of occurrence of humpback dolphins groups, using the locations of five groups observed on the last day of the boat-based survey and the locations of the four groups observed during the land-based surveys, was 28.9 km².

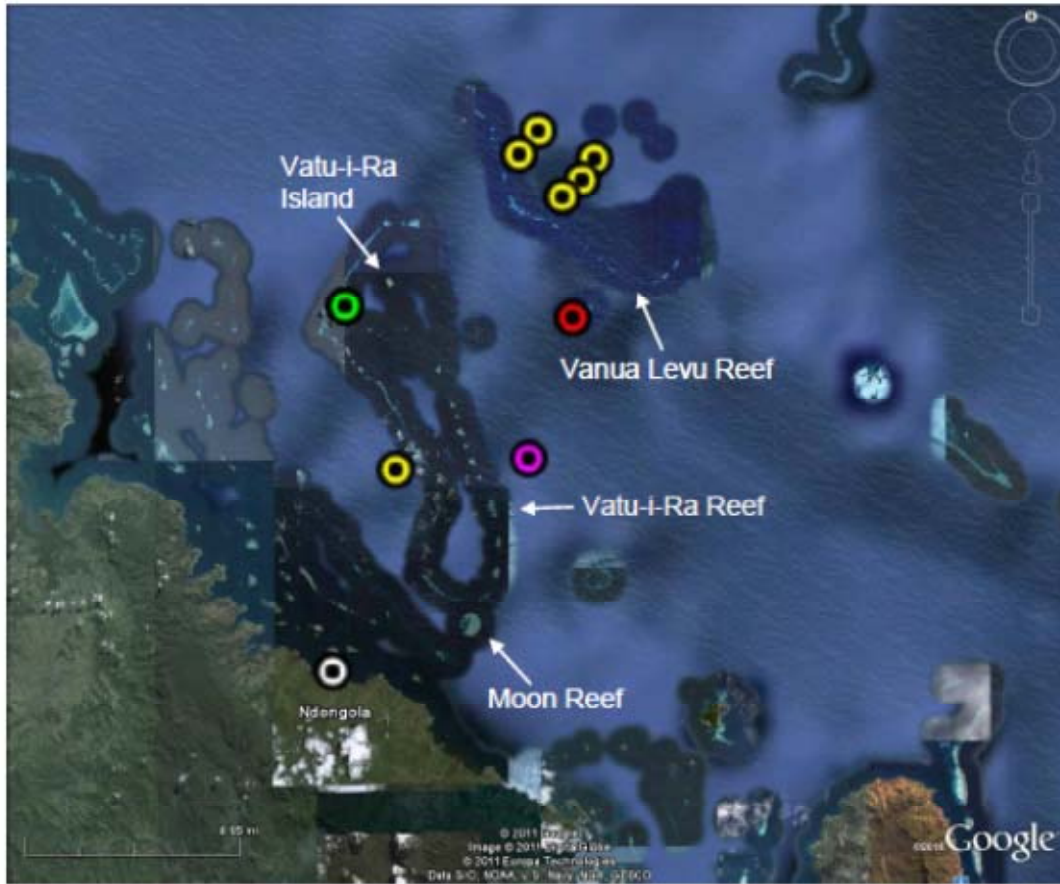


Figure 10. Satellite image of Vatu-i-Ra, Vanua Levu, and Moon reefs and Vatu-i-Ra Island, with the locations of cetacean sighting. Yellow = humpback whale; purple = unidentified large delphid/small whale; red = common bottlenose dolphin; green = spinner dolphin.

During both the interview and boat-based surveys, we found no evidence of major threats to cetaceans in Fiji. Although there may be some isolated cases of fishing gear entanglement, fishing pressure in the nearshore waters where we surveyed was extremely low (although a partial explanation may also be the poor sea-state conditions during our visit) and most effort was spear fishing along local reefs. Spear fishing may threaten large reef fish but does not directly threaten cetaceans. We received few reports of directed kills of cetaceans by spear but these were isolated cases versus an organized activity.

NEXT STEPS:

- Increase capacity of WCS Fiji staff to conduct boat-based cetacean surveys and collect data on cetacean species

LINKS TO NATIONAL PRIORITIES:

This project supports the **NBSAP Implementation Plan Thematic Group 5 (Threatened and Endangered Species) Strategy 1**: Increase access to expertise/increased efforts made in the fields of quality research, **Objective 1.1**: By 2012, resource inventories are compiled for at least 10 target species; **Action 1.1b**: Undertake a comprehensive terrestrial and freshwater/marine biodiversity resource inventory.

Expedition to Totoya's Sacred Reef

STATUS: Ongoing

FUNDING: Pacific Blue Foundation, Waitt Institute

PARTNER ORGANISATIONS: Pacific Blue Foundation, Scripps Institute of Oceanography, Waitt Institute, Wetlands International-Oceania

OUTPUTS:

- *Media Coverage:* National Geographic's Newswatch website (<http://newswatch.nationalgeographic.com/2011/06/08/expedition-to-the-sacred-reef-of-fiji-6/>); Fiji Times (<http://www.fijitimes.com/story.aspx?id=172732>); Fiji Sun (Expedition to the Sacred Reef, June 11, 2011); Long Island Press (<http://www.longislandpress.com/2011/06/21/fiji%E2%80%99s-totoya-island-coral-reefs-declared-sacred/>); Our Amazing Planet (<http://www.ouramazingplanet.com/coral-reef-fiji-totoya-expedition-1614/>); Animal House radio interview WAMU (<http://wamuanimalhouse.org/shows/2011-08-27/exploring-sacred-fiji-coral-reefs/transcript>)

RESEARCH HIGHLIGHTS:

The primary goal of this research trip was to document the marine and terrestrial biodiversity within and outside of the Totoya Island's Sacred Reef (Figure 11). The secondary goal was to document the integration of the Totoya community with their environment and help them further the development a management plan for the region, building on initial work by the Fiji Department of Fisheries.

Marine resource inventory

The Wildlife Conservation Society (WCS) collected information on fish size structure and abundance, as well as benthic condition, from four sites inside *Daveta Tabu* and four sites outside *Daveta Tabu*. The reefs were full of large top predators, including white tip sharks, great barracuda, giant trevally, dogtooth tuna, and large red snapper. The mean total fish biomass inside *Daveta Tabu* (4.7 T ha^{-1}) is comparable to the highest values of coral reef fish biomass recorded for the Pacific at Kingman Atoll (5.3 T ha^{-1}) The mean total fish biomass on the reefs outside *Daveta Tabu* was also extremely high (2.3 T ha^{-1}) and comparable to the

highest values recorded from Fiji's largest marine protected area, the Namena Marine Reserve, in Kubulau District, Bua Province. The exposed forereef both inside and adjacent to *Daveta Tabu* appeared to support the lowest fish density and biomass, likely due to the low topographic complexity. The forereef was dominated by coralline algae and low growing, hardy coral species (e.g. *Pocillopora*, *Favia*) which can withstand high wave energy. The leeward side of the barrier reef exhibited more diverse coral communities, with a high range of morphologies, offering hiding places for more prey species and thereby attracting higher numbers of predatory fish.



Figure 11. Aerial image of Totoya's sacred reef. Photograph (c) Keith Ellenbogen

Fish diversity

Recent fish genetic studies by researchers at Boston University indicate that there are strong evolutionary links between fish found in the Fiji-Tonga region, which are distinct from other nearby island nations. The Fiji-Tonga complex has the fifth highest record of number of endemic reef fishes of anywhere in the world. From Fiji alone, there are 22 endemic fish species from 12 separate families, of which blennies and gobies are the most represented. There are an additional 21 fish species shared by Fiji and Tonga.

This high level of regional endemism is particularly notable at Totoya, where Wetlands International-Oceania (WIO) located 11 of the 43 species unique to the Fiji-Tonga complex. These include four species of damselfish, including the big blue *Pomacentrus callainus*, as well as *Neoglyphidodon carlsoni*, a cave-dwelling damselfish. WIO also sighted the tiny and cryptic goby *Bryaninops dianneae*, as well as unusually high numbers of the endemic rabbitfish, *Siganus uspi*, named after the University of the South Pacific.

Community development and management planning

A delegation of community representatives, expedition members and government representatives visited the villages of Ketei, Udu, Dravuwalu and Tovu between June 1 to 4, 2011 to discuss community development initiatives and discuss progress on a Totoya-wide management plan. In addition, multiple interviews about resource use patterns and local knowledge of biodiversity were conducted with elders, fishers, and farmers in all four villages from May 31 to June 7, 2011. The major findings from these surveys included:

- Totoya is exceptionally rich in natural resources due to large size, low population density, and a lack of commercialization, however the island struggles with development and maintaining progress due to remoteness and poor transportation, a lack of manpower due to depopulation, and a lack of services such as a secondary school and hospital due to low population.
- The foundation of the local economy presently is based on subsistence farming and fishing, and the diet and nutrition of the community is excellent.
- The cash economy is presently dominated by the sale of dried sea cucumbers, the most valuable export, followed by copra. Fish is also exported but mostly in the form of gifts to relatives on Viti Levu, in exchange for remittances and goods.
- Should the problem of transportation be solved, the opportunity for small-scale, community-appropriate nature-based tourism “ecotourism” and cultural tourism exists, with a pristine environment and intact culture. Archaeological sites were identified and mapped that would add interest to the guest experience.
- Sea level rise and beach erosion is a developing and increasing problem, and rock seawalls are not the best long-term solution.

Declaration of marine protected area

On June 6, participants of the research cruise and government representatives from the Fiji Department of Fisheries and National Disaster Management Office joined Roko Sau, the church minister and more than a dozen leaders of the Totoya communities during the formal re-establishment of the no-take marine protected area (MPA) at *Daveta Tabu*, which now occupies approximately 4 km² of reef and waters surrounding the sacred passage. The minister led the blessing of the MPA, which was followed by the placement of boundary markers at the eastern- and western-most points of the MPA. The MPA declaration, in honor of World Oceans Day, was later celebrated in the village of Tovu with traditional meke performances.

NEXT STEPS:

- Present results back to communities of Totoya to develop holistic island-scale management plans

LINKS TO NATIONAL PRIORITIES:

This project supports **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 4:** Design new ecologically relevant inshore MPAs, **Objective 4.6:** By mid-2014, 25% of the communities will have established new management structures for new MPAs, **Action 4.6a:** Consult with communities at priority regions outside of existing MMAs to establish new MPA management structures.

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

Provincial-scale engagement

Vatu-i-Ra Seascape Stakeholders Workshop

STATUS: Complete

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

PARTNER ORGANISATIONS: large range of government, NGOs and private sector represented

OUTPUTS:

- *Technical Report:* Jupiter S, Cakacaka A, Caginitoba A, Fox M, Askew N, Qauqau I, Weeks R, Prasad S (in prep) Building Provincial-level Integrated Coastal Management Plans: Outcomes from the Vatu-i-Ra Seascape Stakeholders Workshop. Wildlife Conservation Society, Suva, Fiji

HIGHLIGHTS:

Between September 8-9, 2011, the Wildlife Conservation Society (WCS) hosted a Vatu-i-Ra Seascape Stakeholder management workshop held at the Centre for Appropriate Technology & Development in Nadave. The objective of the workshop was to bring together stakeholders and community members from the region to discuss moving forward on identifying important areas for management in the context of developing provincial-level integrated coastal management (ICM) plans for Ra, Lomaiviti, Tailevu and Bua.

The workshop was attended by over 65 participants from government (Fisheries, Forestry, Environment, provincial offices), NGOs (WCS, CORAL, IUCN, BirdLife International, Conservation International, Live and Learn, Whale and Dolphin Conservation Society), communities, the Fiji Locally Managed Marine Area (FLMMA) Network, academia (University of the South Pacific, University of Queensland), the Fiji Museum and the National Trust of Fiji (Figure 12).

As a starting point for discussions, on Day One participants reviewed the outputs of the successful Protected Area Committee workshop in September 2010, where provincial level administrators identified candidate sites for protection and expanded management. After presentations on how the FLMMA network is helping Fiji achieve its target to protect 30% of its waters by 2020, applications for marine zoning, and the framework for a national coastal plan, participants were asked to discuss how zoning could potentially be applied in their respective provinces to regulate activities affecting coastal zone.

On Day Two, participants heard presentations on: local initiatives to restore and manage terrestrial areas through tree planting and invasive species eradication; an overview of the

Environmental Impact Assessment (EIA) process, including guidelines on when and EIA is required; and lessons learned from case studies on eco-tourism developments within the Vatu-i-Ra Seascape. Participants were then asked to discuss and respond to the following questions: (1) What types of land management activities are needed in your province?; (2) How can we work with Primary Industries to foster best practice?; (3) What are opportunities for eco-tourism in your province?; and 4) What are the areas for development (especially tourism development) that need to be regulated?



Figure 12. Participants at the Vatu-i-Ra Seascape Stakeholder workshop.

Outputs from the workshop include draft maps of areas to zone for conservation and management, as well as specific activities that would require regulation under ICM plans for each province. WCS and other partners look forward to working closely with the four provinces of Bua, Ra, Lomaiviti and Tailevu to develop these ICM plans that are aligned with the national framework.

NEXT STEPS:

- Distribute outcomes report to all provincial offices
- Source finances to host stakeholder workshops and provincial-level ICM planning meetings

LINKS TO NATIONAL PRIORITIES:

This workshop was in support of **NBSAP Implementation Plan Thematic Group 4 (Coastal Development) Strategy 1: Strengthen national guidelines for inter-sectoral coastal development, Objective 1.3:** By 2014, a national coastal development plan to be developed to regulate/monitor coastal development activities; **Action 1.3b:** ICMC will collate and develop the coastal development plan with relevant stakeholders targeted to mainstream all current and planned development activities. The workshop also supported the following strategy from the

draft **National Climate Change Policy: Adaptation Strategy 2**: Include vulnerability assessment and climate change impact projections into resource management planning, such as integrated coastal and watershed management plans.

Spreading Ecosystem-Based Management

Adaptive Management in Kubulau District

STATUS: Ongoing

FUNDING: David and Lucile Packard Foundation (2010-35664), US National Oceanic and Atmospheric Administration (NA10NOS4630052)

PARTNER ORGANISATIONS: FLMMA, Kubulau Resource Management Committee (KRMC), the Coral Reef Alliance, Kubulau Business and Development Committee

HIGHLIGHTS:

Fiji, like many other Pacific islands, has a strong tradition of resource tenure and use rights. These present unique opportunities for adaptive management, as rules established by local decision-makers (e.g. high council of chiefs) can be modified promptly in response to new information. In contrast, making alterations to gazetted national protected areas is often a difficult and protracted process.

Since 2005, WCS has assisted communities in Kubulau District to establish a network of 3 large no-take marine protected areas (MPAs) and 17 smaller, periodically harvested closures (*tabu* areas). The initial network design was informed by both biological data and extensive consultation with communities. In 2009, management of these areas was formalised when village chiefs endorsed the Kubulau Ecosystem-Based Management (EBM) Plan, Fiji's first ridge-to-reef management plan that includes rules and regulations for all of the terrestrial and marine habitats in the district.

Two years on, in July 2011 WCS facilitated a workshop with the Kubulau Resource Management Committee and representatives from each village to discuss options for revising their EBM plan in response to new information, including: (1) data demonstrating the variable effectiveness of current MPAs in Kubulau (Jupiter and Egli 2011); and (2) improved understanding of, and data on coral reef resilience to climate change impacts.

Prior to discussing possible options for adaptive management, WCS presented information on climate change and ecosystem resilience, and facilitated small group discussions using the Community-Based Risk Screening - Adaptation and Livelihoods (CRiSTAL) tool. Climate hazards identified to be of greatest threat to Kubulau resources included recent droughts, king tides, and unseasonable weather patterns. Where current strategies to deal with these impacts were not sustainable, community members suggested alternative strategies, such as planting

drought/salt tolerant varieties of crops and planting mangroves to prevent shoreline erosion. These actions will be incorporated into the revised EBM plan.

WCS then presented feedback on the effectiveness of the current MPA network with respect to both sustaining local fisheries and achieving conservation objectives set by the Fiji Government. The take home messages for participants were that *tabu* areas opened for fishing more than once per year were likely to be less effective, that some existing *tabu* areas are too small to produce fisheries benefits, and that the network does not yet adequately represent all reef habitat types in the district. Finally, recommendations for expanding the existing MPA network to improve habitat representation and include reefs identified to have high potential ability to resist and/or recover from climate-induced disturbance were presented.

Workshop participants were encouraged to consider the following options with respect to both community *tabu* areas and the three district MPAs: (1) add new protected areas; (2) change the boundaries of existing areas; (3) change management rules (e.g. frequency of *tabu* openings); or (4) move protected areas. Following the presentations and subsequent discussions, three villages proposed to increase the size of their existing *tabu* areas and one village proposed to establish a new *tabu* area. In addition, participants collectively agreed to place a 500 m no-fishing buffer zone around the three district MPAs. Despite previous conflict over fishing rights in the Namena Marine Reserve, no amendments to the boundaries of this reserve were proposed (Figure 13).

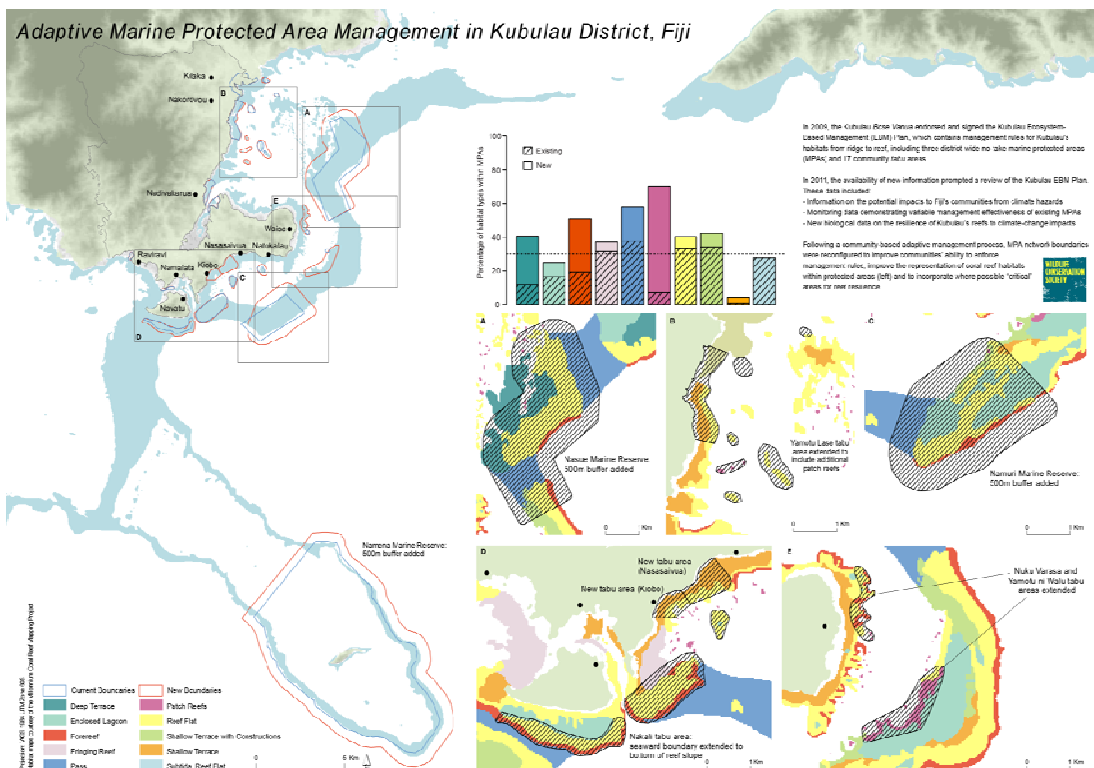


Figure 13. Proposed adapted configurations of the Kubulau MPA network, showing increases in habitat representation by addition of new sites and buffer zones.

Whilst the workshop was moderately successful in prompting adaptive management in response to new information, most changes to the MPA network appeared to be made with regard to short-sighted fisheries management objectives rather than a longer-term view of increasing reef resilience. Only in one case did community members directly indicate that they wanted to extend their *tabu* to include reefs identified as high priority for resilience. Despite best efforts to translate climate change concepts into Fijian context, language barriers may limit participants' understanding of climate impacts and their ability to manage them. For example, there is no equivalent expression in Fijian for "resilience" and the Fijian term "*draki*" means both climate and weather (Grantham et al. in press). By the conclusion of the workshop, less than 30% of participants could correctly identify three ways that climate hazards impact Kubulau's ecosystems and less than 45% could correctly identify two characteristics of resilient reefs.

NEXT STEPS:

- Confirmation of draft protected area boundaries and rules
- Collation of information into adapted EBM plans
- Endorsement of adapted EBM plan by Kubulau *Bose Vanua*
- Roadshow to each village to raise awareness of management rules and actions

LINKS TO NATIONAL PRIORITIES:

This work supports **NBSAP Implementation Plan Thematic Area 3 (Inshore Fisheries) Strategy 3: Maintain existing protected areas, Objective 3.2:** By 2014, biodiversity surveys show no decline in numbers related to 2010 levels and there is a 15% increase in biomass of targeted species inside MPA compared with outside, **Action 3.2ab:** Monitor core set of existing MPAs for biodiversity and fisheries resources compared with unmanaged sites; and **Strategy 4:** Design new ecologically relevant inshore MPAs, **Objective 4.5:** By mid-2014, 20% of communities with existing MMAs will have agreed to add additional MPAs, **Action 4.5a:** Consult with communities at existing MMA sites to determine willingness to add MPA sites to their MMA. This work also supports the draft **National Climate Change Policy Adaptation Strategy 4:** Support the development of adaptation technologies and systems that are sustainable, consider traditional knowledge and are culturally acceptable.

EBM Management Planning in Wainunu, Nadi and Solevu Districts

STATUS: Ongoing

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), Department of Fisheries, Department of Forestry, Native Lands and Fisheries Commission, Ministry of Agriculture

HIGHLIGHTS:

WCS Fiji held a Management Planning Workshop to support the districts of Wainunu, Nadi and Solevu (Bua Province) in the village of Daria (Wainunu District) from 24 - 26 November 2011. Representatives from Vuya District participated as observers. There was broad stakeholder participation from a number of organizations, namely: Department of Forestry, Department of Fisheries, Agriculture and Land Use Department, Department of Environment, Native Lands and Fisheries Commission, FLMMMA and WCS staff.

On the first day, WCS staff presented to the participants research findings from a range of studies carried out in the area, including results from: (i) riparian and freshwater surveys for Wainunu only (see **Factors Influencing Freshwater Fish Assemblages** above); (ii) focal group and household socioeconomic surveys for Wainunu only (see **Assessing Climate Hazard Risk to Improve Adaptation Strategies** below) ; (iii) marine ecological and reef resilience surveys for Wainunu, Nadi and Solevu (see **Designing Resilient MPA Networks** above); and (iv) cetacean field and anecdotal surveys (see **Cetacean Surveys of the Vatu-i-Ra Seascape** above). This was a very informative exercise for the communities as they get to know the different types of resources that are present in their environment.

On the second day, the participants split into different separate groups by habitat type (terrestrial, freshwater, coastal, marine) to identify management targets, direct and indirect threats and strategies to mitigate those threats (Figure 14). The process was highly participatory and actively encouraged the participants to provide ideas and thoughts on how they can protect and conserve their natural resources. One of the strategies that were common to all the groups was that they thought that the establishment of a protected area will help them immensely in achieving their targets and vision.

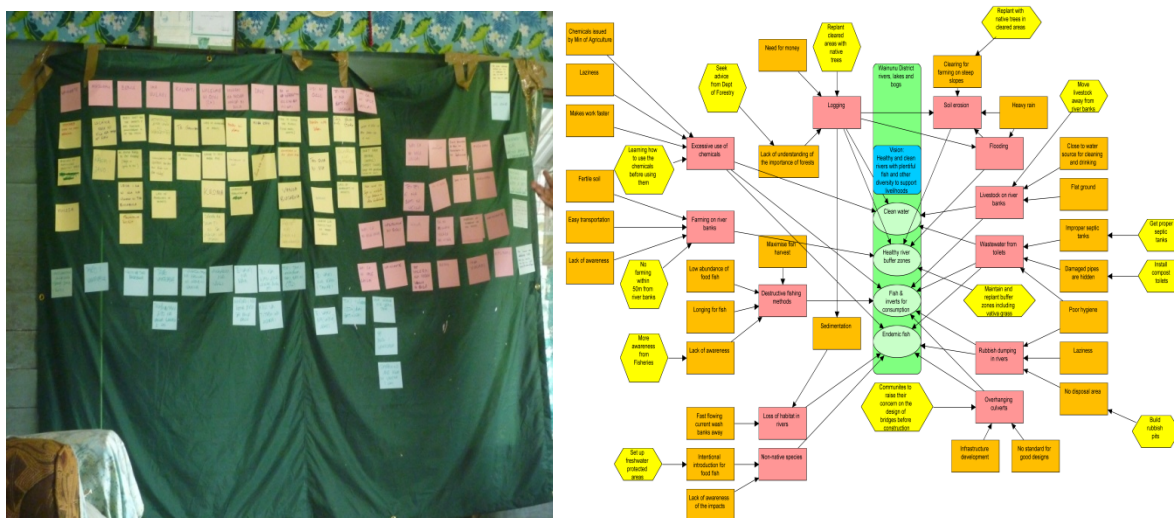


Figure 14. (LEFT) Photograph of management targets, direct and indirect threats, and management strategies for freshwater systems identified by community members from Wainunu, Nadi and Solevu districts. (RIGHT) Conceptual model of the identified targets, threats and strategies for freshwater systems.

On the third day, participants split into groups of their respective districts to formulate management rules for their action plans. Since most of the participants wanted the establishment of a protected areas, WCS distributed out maps on which indicated areas which recommended for protection to meet representation and resilience targets (see Figure 2). Nadi District set up protected areas since the last workshop that was held in November 2010, while the districts of Solevu and Wainunu finalised their proposed protected area locations at this workshop. These proposed areas and management rules will be presented back to their village meetings and 'Bose Vanua' before any final decision is approved.

NEXT STEPS:

- Confirmation of draft protected area boundaries and rules
- Collation of information into draft EBM plans
- Endorsement of EBM plans
- Roadshow to each village to raise awareness of management rules and actions

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;** and **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 4:** Design new ecologically relevant inshore MPAs, **Objective 4.6:** By mid-2014, 25% of the communities will have established new management structures for new MPAs, **Action 4.6a:** Consult with communities at priority regions outside of existing MMAs to establish new MPA management structures. This work also supports draft **National Climate Change Policy Adaptation Strategy 5:** Support the ecosystem based management approach throughout Fiji, recognizing that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience.

Building Capacity and Awareness

Assessing Climate Hazards to Improve Adaptation Strategies

STATUS: Ongoing

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: N/A

OUTPUTS:

- *Journal article:* Grantham HS, McLeod E, Brooks A, Jupiter SD, Hardcastle J, Richardson A, Poloczanska ES, Hills T, Mieszkowska N, Klein CJ, Watson JEM (2011) Ecosystem-based adaptation in marine ecosystems of tropical Oceania in response to climate change. *Pacific Conservation Biology* 17:241-258

HIGHLIGHTS:

Current local perceptions and interpretations of climate variability are diverse among communities and social groups, complicated by language barriers to communicating climate impacts and adaptation strategies. For example, there is no equivalent expression in Fijian for “resilience” and the Fijian term “draki” means both climate and weather. General and unbiased background information on global climate change needs to be framed in the Pacific context before any group discussion with communities to boost understanding. Using this approach, the WCS Fiji has successfully engaged local communities across the Vatu-i-Ra seascape in focal group interviews to identify climate hazards of greatest threats to local resources, using the Community-Based Risk Screening — Adaptation and Livelihoods (CRiSTAL) tool. Participants then consider the sustainability of current strategies for coping with climate hazards and, if they are inadequate, use facilitated group brainstorm activities to develop alternatives. These include income and food diversification, infrastructure development, and resource management actions.

For example, in Kubulau, the three major climate hazards identified by Kubulau communities were: (1) drought; (2) unseasonable weather patterns; and (3) damage from king tides linked to sea level rise. In general, Kubulau residents felt that their current coping strategies were sustainable for the most part, with the exception of strategies to deal with impacts to coastal resources, beach erosion and salt water intrusion from king tides (Table 4). The participants suggested planting mangroves and building stone seawalls in front of the villages, however, these strategies need to be undertaken with care. Seawalls can disrupt sediment transport, resulting in an increase in sedimentation in certain areas just upstream from the seawall and further erosion of beaches in downstream areas that no longer become replenished with sand. Secondly, mangroves will not establish in all coastal locations, particularly if they are exposed to high energy conditions. Therefore, they are not a universal solution for all environments and where they will not establish, residents may have to seriously consider moving village infrastructure back from beachfront areas.

NEXT STEPS:

- Incorporate sustainable strategies for coping with climate hazards into EBM plans

LINKS TO NATIONAL PRIORITIES:

This work supports draft **National Climate Change Policy Adaptation Strategy 5:** Support the ecosystem based management approach throughout Fiji, recognizing that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience; **Awareness Raising Strategy 1:** Conduct awareness raising workshops and sessions for policy makers, decision makers and local and national planners on climate change issues;

and Awareness Raising Strategy 2: Use a range of available communication technologies to conduct outreach activities related to climate change adaptation and mitigation.

Table 5. Outputs from focal group interviews in Kubulau of strategies to reduce vulnerabilities to climate hazards.

Hazard	Resources Impacted	Current Coping Strategies	Sustainability	Alternative Strategies	Villages
Drought	Crops (taro, cassava, kava, copra, fruit trees)	Reduce chemical usage in plantations	Yes, although crops will still suffer in extreme drought	Plant/request drought tolerant varieties. Establish nursery.	Group 2: (Nivatu, Namalea); Group 3: (Nadivakarua, Nikorovou, Kileka)
	Drinking water	Use water tanks	Yes	Find a secure, reliable water source	Group 1: (Kilobo, Nasesalua, Nacoklau, Walea); Group 2: (Nivatu, Namalea); Group 3: (Nadivakarua, Nikorovou, Kileka)
	Water source for crops	Planting trees in deforested areas	Partially, but still culture of introduced trees such as pine introduced to drying up of ponds.	Replant only native trees	Group 1: (Kilobo, Nasesalua, Nacoklau, Walea)
	Human health	Use of traditional medicines. Keep ecosystems healthy. Have a healthy diet	Yes	Seek advice from Ministry of Health on other practices. Document traditional knowledge and pass this knowledge to the younger generation.	Group 2: (Nivatu, Namalea)
Unseasonable weather systems	Crop damage and poor yields	Plant resistant crops. Replant trees. Try organic farming and permaculture. Plant nitrogen fixing trees (eg. clover).	Yes		Group 3: (Nadivakarua, Nikorovou, Kileka)
Sea level rise/ rising seas	Coconut and pandanus	Construct stone walls out to sea to reduce wave impact	No building stone sea walls is a traditional but not necessarily sustainable coping strategy.	Plant mangroves to provide physical protection	Group 1: (Kilobo, Nasesalua, Nacoklau, Walea)
	Water table through salt water intrusion	Construct stone walls out to sea to reduce wave impact	No building stone sea walls is a traditional but not necessarily sustainable coping strategy.	Plant mangroves to build land	Group 1: (Kilobo, Nasesalua, Nacoklau, Walea)
	Village infrastructure	Migrate to higher ground	No because there is a limited area to migrate to	Plant mangroves to reduce tide and wave impact	Group 2: (Nivatu, Namalea)
	Coastal resources through erosion	Establish catch areas and freshwatering regulations	Yes		Group 2: (Nivatu, Namalea)
	Crop damage	No suitable suggestions	N/A	Plant more salt tolerant varieties	Group 2: (Nivatu, Namalea)

Community Educators Network Training

STATUS: Ongoing

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

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

OUTPUTS:

- *Conference Presentation:* Tui T, Williams H, Dulunaqio S, Fox M, Jupiter SD, Nakeke A, Radway S, Tokata'a M (2011) Community Educators Network: Strengthening community leadership and conservation through effective communication. 2nd International Marine Conservation Congress, Victoria, Canada, 14-18 May

HIGHLIGHTS:

As part of the ongoing Community Educators Network Training that commenced in June 2010 , WCS Fiji and its collaborative partners, Coral Reef Alliance (CORAL) and Seaweb, and conducted 2 training modules this year with the members of the Kubulau Resource Management Committee (KRMC) on the following dates respectively: 21-25 February and 25-26 July. The purpose of this training is to empower members of the KRMC to become educators and train their respective villagers and peers on the importance of sustainably managing their ecosystems and natural resources.

The training conducted in February focused on: climate change, fish spawning aggregations, mangroves and their functions and environmental law. This training was strengthened with information supplemented by Conservation International (CI) on fish spawning aggregations, while a presentation on environmental laws was conducted by a representative from the Fiji Environmental Law Association (FELA). This module provided much needed information on the complex web of how an ecosystem is affected by climate change, and vital information on the functions of the mangrove ecosystem and fish spawning aggregations and the need to protect them, which can be mitigation tools in dealing with climate change and food security. Information on the environmental laws was enthusiastically received by the participants, as this was an area in which they were hungry for additional knowledge.

The module in July covered the importance of preserving riparian zones for preserving freshwater ecosystem function. At the workshop, the KRMC members were also informed of the results from the riparian survey conducted in the districts of Kubulau, Wainunu, Sasa and Macuata in September-October 2010 by WCS, Wetlands International-Oceania and Departments of Fisheries and Forestry. In addition, the participants conducted a visioning exercise to describe their vision for Kubulau in the next 10-20 years. Discussions on the challenges faced by these participants in effectively carrying out their community education were also discussed with the participants and facilitators suggesting solutions to these challenges.

Following these trainings, the KRMC reps have become confident community educators and have morphed from their previously quite characters to outspoken individuals. More importantly they are more informed and so have made their communities better aware. The information they have received and shared so far have made them better stewards for their environment.

NEXT STEPS:

- Work with SeaWeb to develop training materials for 4-6 key modules that can be replicated at sites across the FLMMA network

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**

Management Support Training with the Kubulau Resource Management Committee

STATUS: Complete

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

PARTNER ORGANISATIONS: The Coral Reef Alliance, Kubulau Business and Development Committee

HIGHLIGHTS:

To support the roles and responsibilities of the Kubulau Resource Management Committee (KRMC), WCS Fiji, in partnership with CORAL and Kubulau Business and Development Committee, conducted a follow up management support workshop. The main aims of this workshop were to:

- Get follow-up information on the decisions made on the protected area reconfiguration options that were presented during the Adaptive Management Workshop
- Help KRMC strengthen the areas of weakness/challenges so that they could better implement the Ecosystem Based Management plan for their district
- Re-assess the community management actions and re-prioritize and set new timelines for the remaining actions.

The KRMC members were initially elected in 2005 for a period of 3 years, and then another 3 years based on the approval from the Bose Vanua. Since the endorsement of the 2009 management plan, certain challenges have led to slight changes to the sub-committee membership. As part of strengthening the functions of KRMC, the members were asked to identify challenges to meeting its goals and recommendations for these challenges. Some of the major challenges that the committee was facing were:

- Members not attending the meeting/inactive members
- Miscommunication/lack of communication
- Lack of sub-committee meetings (lack of information on meetings)
- Lack of compliance by KRMC members

After reviewing the weaknesses of the committee, there was discussion on methods to strengthening KRMC. It was agreed that perhaps it would be better if KRMC could develop monthly action calendar so that the committee and its members could be better aware of the activities they are supposed to be implementing.

LINKS TO NATIONAL PRIORITIES:

This work 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 adaptive managed, **Action 5.3a:** Provide all MMA sites with a management plan template and assistance developing management actions; and **Objective 5.4:** By 2010, resource managers at 50 selected sites are recording incidents of destructive fishing and by 2014, multi-sectoral enforcement plans are developed for all MMA sites, **Action 5.4a:** Develop strategic, multi-sectoral enforcement plans.

Decision-Support Training with Marxan Software

STATUS: Complete

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

PARTNER ORGANISATIONS: N/A

HIGHLIGHTS:

Marxan is a freely available software package that provides decision support for a range of conservation planning problems, including the systematic design of protected area networks to achieve explicit biodiversity conservation and socioeconomic objectives. Marxan was developed during the rezoning of the Great Barrier Reef Marine Park in Australia, and has since been used to help design marine and terrestrial protected area networks worldwide.

At present there are few examples where Marxan has been used in a developing country context. However, this is changing, with recent applications in Indonesia, Philippines and the Solomon Islands. These examples demonstrate that such tools can be used in conjunction with community-based decision making and are able to work within the constraints of customary tenure. Nevertheless, obstacles to the use of decision-support tools in the Pacific remain. These include: uncertainty regarding the technological and data requirements of software packages; the perception that such software is difficult to use; that software is difficult to communicate with stakeholders; and the misconception that decision-support tools are only relevant to top-down, centralised planning. These issues were discussed at an Ecosystem-Based Management Tools discussion forum organised by IAS-USP in October 2011. The consensus amongst participants at this event was that Marxan could potentially support some aspects of conservation planning within Fiji, but further understanding of how the software works would be required to identify appropriate applications.

To increase capacity to use Marxan within Fiji, WCS hosted an “Introduction to Marxan” course in Suva, October 2011. The course was attended by 3 WCS staff and colleagues from the National Trust of Fiji and the University of the South Pacific. The course was led by Rebecca Weeks, currently a Postdoctoral Research Fellow with WCS, and consisted of presentations and hands-on exercises on:

- Key concepts in systematic conservation planning
- Creation of planning units
- Creating the essential Marxan input files
- Parameter setting in Marxan
- Understanding and using Marxan results
- An introduction to Marxan with Zones

WCS staff members are currently using Marxan to provide decision-support for the design of resilient MPA networks and to identify priority riparian and forest areas in Bua.

CPUE Training and Development of Fish Rulers

STATUS: Complete

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

PARTNER ORGANISATIONS: Department of Fisheries, FLMMA

HIGHLIGHTS:

WCS Fiji this year produced the first ever fish ruler that was distributed to the districts of Wailevu in the province of Cakaudrove and the districts of Kubulau and Wainunu in the province of Bua. This fish ruler shown in Figure 15 below contains pictures and information on some of the targeted food fish species that are commonly caught by communities. It includes their scientific names, Fijian names and maturity length of these targeted fish species. The ruler contains some of the protected and endangered fish species for Fiji that are in the IUCN red list. The ruler is 60 cm long and is in a form of a sticker. The sticker is peeled and pasted onto a plywood with a length of 70 cm and width of about 10 cm. The fish ruler sticker is water resistant and can be taken out by fishermen during fishing trips. The main reason for creating this fish ruler was to assist communities in enhancing proper management of their qoliqoli through sustainable catch.



Figure 15. Fish ruler distributed by WCS Fiji to community monitors conducting CPUE surveys to assess whether fish are smaller than minimum size at maturity.

Fish ruler stickers were distributed during catch-per-unit effort (CPUE) training sessions, delivered by WCS Fiji and the Department of Fisheries, with assistance from FLMMA in providing training materials. The CPUE training for Wailevu district was conducted on the June 30, where 20 households from Natuvu and 20 households from Naiqaqi were trained in how to conduct CPUE surveys. The training for Kubulau district was done on July 1, with 14 and 15 households trained respectively from Natokalau and Kiobo villages. In Wainunu, the villages of Nakawakawa and Saolo were chosen for this survey chosen because they were observed to be the ones using the sea more often than others. There were 20 households from each of the villages trained to do the survey and they were very enthusiastic about being involved in collecting data.

To date, the first round of data has been collected and is being entered by WCS Fiji staff for analysis. WCS Fiji staff will continue to collect data sheets will be done on the last week of every 3 months.

LINKS TO NATIONAL PRIORITIES:

This work supports **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries)**, **Strategy 8:** Reform fisheries legislation and management institutions, **Objective 8.2:** By 2014, size limit table will be updated with ecologically relevant minimum and maximum sizes for all target species, **Action 8.2a:** Perform stock assessment of inshore marine resources.

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.

2nd Fiji Conservation Science Forum and Public Panel Discussion

STATUS: Complete

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

PARTNER ORGANISATIONS: N/A

OUTPUTS:

- *Conference Proceedings:* Askew N, Prasad, SR (eds) (2011) Proceedings of the Second Fiji Conservation Science Forum 2011. Wildlife Conservation Society, Suva, Fiji. 117 pp.

HIGHLIGHTS:

In 2009 the Fiji Ecosystem-Based Management (EBM) partnership of the Wildlife Conservation Society (WCS), WWF South Pacific Programme, and Wetlands International-Oceania, hosted the inaugural Fiji Conservation Science Forum. The main goal of the Forum was to provide a

platform to consolidate and synthesize the science that has been conducted in Fiji. We were also very aware at the time that, due to few opportunities to present science locally, most of our good work was being presented overseas. Therefore, the Forum represented a unique opportunity, particularly for students, to showcase their work among their peers and colleagues.

Based on the positive feedback from the 1st Forum, WCS Fiji secured support from the David and Lucile Packard Foundation and the John D. and Catherine T. MacArthur Foundation to host a 2nd Fiji Conservation Science Forum between September 14-16, 2011 at Studio 6 in Suva. The Forum received additional local support from Fiji TV, Ricoh, Quality Print Ltd., Clariti (South Pacific) Ltd., Supreme Fuel, and Flour Mills of Fiji Ltd, to whom we are grateful.

The main theme of the 2nd Forum was "Confronting the Climate-Biodiversity Crisis" in recognition of the fact that climate change is an overarching threat that may be exacerbating impacts to species and habitats in Fiji and the region. As a lead-off to the event, Professor Ove Hoegh-Guldberg, Director of the Global Change Institute at the University of Queensland, highlighted the many ways that climate change is affecting biodiversity in the region and offered some thought-provoking solutions for managing the problems (Figure 16).

The keynote presentation was followed over the course of three days by seven thematic sessions on (1) Ecology and Management of Fiji's Watersheds, (2) Terrestrial Species, (3) Marine Species, (4) Results from Fiji's Locally Managed Marine Areas, (5) Scaling-up Local Management to Meet National Priorities, (6) Socio-Ecological Tools for Climate Change Adaptation, and (7) Adaptive Management. Due to the successful advertising campaign, the room at Studio 6 was consistently full with over 200 participants from 65 different organizations across academia, development, community, government, non-government, and the private sector.

During the first evening, WCS and SeaWeb hosted a public panel event on "Confronting the Climate-Biodiversity Crisis: Challenge or Opportunity?" The four panelists (Prof. Ove Hoegh-Guldberg of the University of Queensland, Prof. Bill Aalbersberg of the Institute of Applied Sciences at the University of the South Pacific (USP), Dr. Morgan Wairiu of the Pacific Centre for Sustainable Development at USP, and Ms. Kirti Chaya of the Department of Environment's Climate Change Unit) kept the audience engaged with responses to questions such as, "What are the opportunities to use climate change mitigation and adaptation funds to protect biodiversity?". Prior to the closing of the event, Mr. Bernard O'Callaghan of IUCN Oceania, facilitated a lively discussion on some of the main issues arising from the Forum that included debate on how we widen focus from marine to terrestrial and other areas and whether doing conservation science in Fiji is good value for to cost.

Overall, there was a strong feeling of camaraderie throughout the event, in support of the collective good work that is being conducted across Fiji. Further, by bringing together people from across the environment, planning, community, disaster risk management, health and development sectors, we were able to identify potential new partnerships for future

collaborations. WCS looks forward to the opportunity to host a potential 3rd Fiji Conservation Science Forum and we welcome other organizations to work with us to continue the tradition.



Figure 16. Professor Ove Hoegh-Guldberg delivering his keynote address on the topic of the conservation challenge for Pacific marine resources and people (above left). The staff of the WCS Fiji Program at the Forum (above right).

Conservation Connection: From the West Side to the West Pacific

STATUS: Complete

FUNDING: John D. and Catherine T. MacArthur Foundation Digital Learning Competition Winner

PARTNER ORGANISATIONS: The Field Museum (Chicago), FLMMA

OUTPUTS:

- *Conference Presentation:* Drew J, Sanzenbacher B, Caginitoba A (2011) Using Digital Education to teach coral reef biology and engage youth in marine conservation. 2nd Fiji Islands Conservation Science Forum, Suva, Fiji, 14-16 September
- *Letters to the Fiji Times:* "Shout out loud, Save the Reefs." Fiji Times newspaper. 14 August 2011 (VOISE Academy students); "Overfishing major threat to marine life." Fiji Times newspaper. 10 July 2011 (Marist Brothers students)

HIGHLIGHTS:

How do you engage students in coral reef conservation without getting them wet? Researchers and education specialists from the Field Museum of Chicago, the Wildlife Conservation Society (WCS) and the Fiji Locally Managed Marine Area (FLMMA) Network conducted a pilot interactive digital learning project called: "Conservation Connection: From the West Side to the West Pacific" between February and June 2011. The program, winner of the 2010 MacArthur Foundation Digital Media and Learning Competition, linked high school students from the VOISE Academy of inner city Chicago with students from the Marist Brothers School in Suva, Fiji.

Through WhyReef , an online virtual coral reef world, students learned how to identify coral reef species, build food webs, and evaluate the effects of different reef threats. In addition, the Chicago and Fiji students could directly interact with each other through online blogs and sharing photography and video projects about coral reef issues on FijiReef (<http://fijireef.ning.com/>), which operates much like the social networking site Facebook (Figure 17). This is a particularly exciting opportunity for Fiji students who may not have ever been previously exposed to technology such as digital cameras and video recorders which are nearly omnipresent in the United States.



Figure 17. (LEFT) Screen shot of FijiReef, the social networking site connecting teens from Suva and Chicago. (RIGHT) Scene from the educational online gaming platform WhyReef, which teaches students about coral reef processes and threats.

In the 21st century, learning how to communicate through digital media is an essential tool. Not only does this program teach students about coral reef conservation issues, they learn how to script, produce and film their own documentaries about reef species, threats and management strategies. At the end of the project, students from Marist Brothers and VOISE Academy both produced letters published in the Fiji Times to express their concerns about threats to the marine environment in Fiji.

LINKS TO NATIONAL PRIORITIES:

This work supports **NBSAP Implementation Plan Thematic Group 3 (Inshore Fisheries), Strategy 6:** Promote education and awareness in environmental science; **Objective 6.4:** By 2014, all primary and secondary schools' curriculum will include marine resource and biodiversity management, **Action 6.4a:** Develop curriculum for primary and secondary schools in marine resource and biodiversity management.

Launch of Ecotales of Kubulau

STATUS: Complete

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

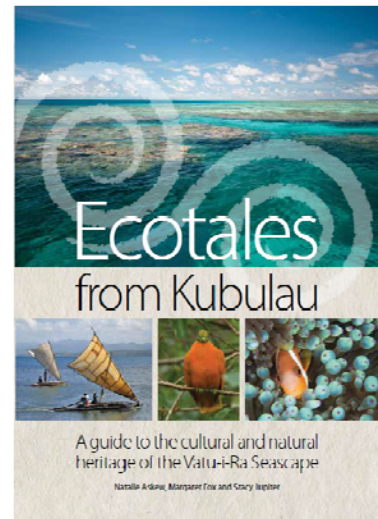
OUTPUTS:

- *Guide:* Askew N, Fox M, Jupiter S (2011) *Ecotales from Kubulau: A Guide to the Cultural & Natural Heritage of the Vatu-i-Ra Seascape*, Wildlife Conservation Society, Suva, Fiji, 100 pp
- *Conference Presentations:* Fox M, Tokota'a M, Dulunaqio S, Williams H, Jupiter S (2011) Using local knowledge of traditional management practices from Kubulau District (Fiji) to inform current actions to maintain sustainable livelihood practices through future uncertain climate change. 2nd Fiji Islands Conservation Science Forum, Suva, Fiji, 14-16 September; Fox M, Tokota'a M, Dulunaqio S, Williams H, Jupiter S (2011) Using Local Knowledge of Traditional Management Practices from Kubulau District (Fiji) to Inform Current Actions to Maintain Sustainable Livelihood Practices. 25th International Congress for Conservation Biology, Auckland, New Zealand, 5-9 December

HIGHLIGHTS:

In 2009, the high chief of Kubulau, Ratu Apenisa Vuki, made a request to the Coral Reef Alliance (CORAL) and the Wildlife Conservation Society (WCS) to find a way to showcase the distinctive species of the region. Two years later, *Ecotales from Kubulau* has been published, providing a glimpse into some of the plants and animals that have strong cultural and economic significance for the people of the Vatu-i-Ra Seascape. In addition, the guide introduces some of the species that are only found in this part of the world and discusses how we can conserve them for future generations.

It is our hope that the guide will raise awareness about the importance of the plants and animals to local livelihoods, cultures, and ecosystem functions. The stories in the pages come directly from the elders of Kubulau, who have described their associations with species for medicine, decorative arts, building materials, food, and totem spirits. By collecting these stories, the traditional knowledge that is rapidly fading away with modernisation can now be preserved for the youth of Kubulau and the Vatu-i-Ra Seascape.



The guide is being sold – with particular focus on tourists – to raise funds for Kubulau Resource Management Committee (KRMC), for their work implementing the Ecosystem-based Management Plan for Kubulau. It is expected that the sale of the book will raise around F\$8,000 in revenue for KRMC. These funds will be used for future re-prints of the guide and hence will become a sustainable source of financing for conservation in Kubulau.

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

The Adventures of Joji Goby: An Educational Comic Book

STATUS: In progress

FUNDING: Disney Friends for Change Initiative

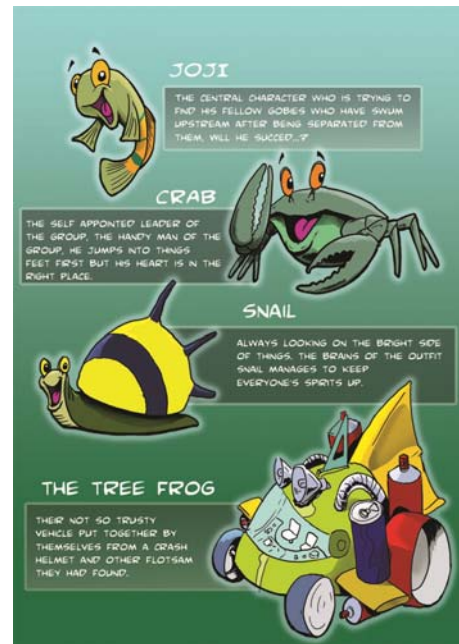
PARTNER ORGANISATIONS: N/A

OUTPUTS:

- *Comic Book:* Ledua T (in prep) The Adventures of Joji Goby. Wildlife Conservation Society, Suva, Fiji

HIGHLIGHTS:

With funding through the Disney Friends for Change Initiative, WCS Fiji is producing a comic book that chronicles the adventures of Joji Goby as he searches for his family. When he misses the mass migration upstream, he teams up with Crab and Snail to conquer the many challenges along their path due to human modification of the river system. The comic book is designed to teach children and adults alike about the threats to Fiji's waterways and how they can better look after their rivers. The hazards that Joji faces are based on factors identified through research by WCS and Wetlands International-Oceania to be substantial threats to native freshwater fish. The comic book will be launched in early 2012.



LINKS TO NATIONAL PRIORITIES:

This work supports **NBSAP Implementation Plan Thematic Group 7 (Inland Waters), Strategy 5:** Improve public awareness of the threats to wetland species and ecosystems and options for management, **Objective 5.1:** By 2012, the public will have a broader understanding of the specific threats to wetlands and the values of wetland services to public health, livelihoods and climate change adaptation, **Action 5.1b:** Launch social marketing campaign to raise awareness to threats to species and ecosystem services.

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. The communication focal points are volunteers who are responsible for distribution of the bulletin in their specific villages.



In 2011, articles in the bulletin covered:

- *Volume 16:* Introductory workshops in Wainunu/Wailevu on EBM principles; Outcomes from the September 2010 Protected Area Committee workshop with provincial administrators from across Fiji; WCS involvement with the Conservation Connection project (see **Conservation Connection** above) at the Marist Brothers high school; and the passing of the chief of Waisa in Kubulau
- *Volume 17:* overview of the socioeconomic and biological surveys in Wainunu/Wailevu; description of a pilot study on transmission of bacteria between people, animals and their environment being carried out in Wainunu and Macuata; story on leadership and management training held in Bua Province by iTaukei Affairs and Institute of Applied Sciences (USP); and overview of the most recent CEN training (see **Community Educators Network Training** above)
- *Volume 18:* Preliminary results of the biological surveys in Nadi, Solevu, Wainunu and Wailevu; overview of plans for upcoming cetacean surveys; description of catch-per-unit effort data collection training held in Wailevu, Kubulau and Wainunu; and presentations by WCS staff at the International Marine Conservation Congress in Victoria, Canada
- *Volume 19:* outcomes of the Kubulau Adaptive Management workshop (see **Adaptive Management in Kubulau District** above); results of the cetacean surveys around Vatu-i-Ra island and reef; and outcomes of the final CEN training.

- *Volume 20*: Special issue reviewing new information presented at the Fiji Conservation Science Forum (see **Fiji Conservation Science Forum** above)

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. Editions this year included:

- *Volume 3, Issue 1*: Community Educator Network Training module 3 (see **Community Educator Network Training** above); The COWRIE project funded by the CRISP initiative; Regional assessments of adaptive capacity of Pacific Island communities (submitted by IAS-USP); Conservation Connection project (see **Conservation Connection** above); Expansion of EBM in Bua Province; and an advertisement for the Fiji Conservation Science Forum
- *Volume 3, Issue 2*: Kubulau District Adaptive Management Workshop (see **Adaptive Management in Kubulau District** above); TNC Reef Resilience 'Training of Trainers' Workshop; EBM implementation in Gau by WWF; and program for the Fiji Conservation Science Forum
- *Volume 3, Issue 3*: Building healthy communities and ecosystems on the Coral Coast (submitted by Victor Bonito of Reef Explorer); 2nd Fiji Conservation Science Forum (see **2nd Fiji Conservation Science Forum** above); Vatu-i-Ra Seascape Stakeholders Workshop (see **Vatu-i-Ra Seascape Stakeholders Workshop** above); and Fiji Shark Sanctuary Campaign (submitted by the Coral Reef Alliance)



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.

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 2011, WCS Fiji produced a new look for our website as a resource and awareness tool for the public and interested stakeholders (Figure 18).

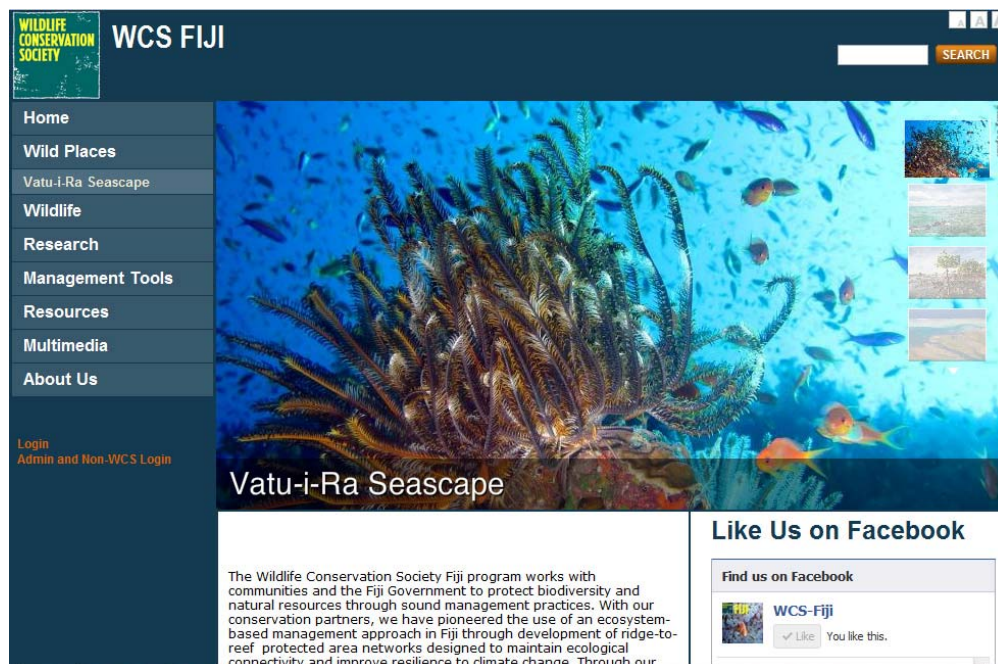


Figure 18. Homepage of WCS Fiji website (<http://www.wcsfiji.org/>)

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

- The Vatu-i-Ra Seascape
- Threatened species (humphead wrasse, bumphead parrotfish, humpback whales, sea turtles)
- Research projects
- Management tools that can be downloaded
- Resources for download (annual reports, community bulletins, conference proceedings, guides, journal articles, management plans, newsletters, WCS Fiji prospectus, reports, and theses)
- WCS Fiji mission, staff and where we work
- Photo gallery
- Media reports
- Contact information

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 2011.

Protected Area Committee and PoWPA

WCS Fiji, in partnership with staff from the National Trust of Fiji and the ARC Centre of Excellence for Coral Reef Studies, published the final results of the first iteration of the marine and terrestrial gap analyses as a technical report that included the outcomes of the Sep 2010 Protected Area Committee workshop with provincial administrators (Jupiter et al. 2011). The outcomes of the marine gap analysis have been published in *Conservation Biology* (Mills et al. 2011). The innovative techniques used to account for the ecological effectiveness of different community-based management strategies are currently being used by Fiji to report their overall level of marine protection to the CBD (1.2% EEZ, 12% inshore areas). WCS Fiji staff Rebecca Weeks and Stacy Jupiter, with staff from The Nature Conservancy (Alison Green) and the ARC Centre of Excellence for Coral Reef Studies at James Cook University (Bob Pressey) led a three day Think Tank in Auckland (Dec 2-4) with representatives from around the Coral Triangle-Oceania region to consider how the Fiji model might be applied more regionally to consider the effectiveness of a broader range of strategies currently being applied by communities to manage biodiversity and marine resources.

WCS Fiji Director Stacy Jupiter additionally participated in the CBD regional PoWPA workshop for the Pacific in Nadi between 3-7 October 2011, where she assisted the Fiji team to develop

an Action Plan for work under PoWPA for 2012-2020. The team first identified gaps in implementation, and then suggested focus actions for priority work, including:

- Integration of protected areas into wider land and seascapes to showcase mainstreaming of biodiversity with other sectors and ecosystem based approaches to adaptation to climate change adaptation and leading to mitigation through carbon sequestration
- Institutionalize management effectiveness assessment towards assessing 60% of the total areas by 2015 and ensure that the results of the assessments are implemented
- Diversification of governance types and recognition of ICCAs including through acknowledgement in national legislation or other effective means, formal inclusion in the national systems
- Development and implementation of sustainable finance plans for protected area systems
- Assessing the values and contribution of protected areas to the national and local economies and to achieving MDGs

Finally, WCS Fiji Director, as member of the PAC sub-committee on Protected Area legislation, worked with other committee members to produce a cabinet paper that was endorsed this year to allow for the development of new legislation. This has been nominated as a priority activity for 2012.

Integrated Coastal Management Committee

WCS Fiji Director Stacy Jupiter, as a member of the Integrated Coastal Management Committee, contributed information to and provided a strategic review of the Fiji Integrated Coastal Management Framework. In September 2011, WCS Fiji then facilitated the first stakeholder workshop, with the provinces of Ra, Tailevu, Lomaiviti and Bua, to discuss how to take integrate the candidate sites for management and protection nominated by provincial administrators at the September 2010 national PAC workshop into management across the broader Vatu-i-Ra land and seascape to account for multiple uses and objectives in the coastal zone (see ***Vatu-i-Ra Seascape Stakeholder Workshop*** above).

Regional EBSA Workshop

WCS Fiji Director Stacy Jupiter participated in the CBD's Pacific Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Areas (EBSA) held in Nadi from 22-25 November 2011. She provided scientific input into and led the nomination for a Vatu-i-Ra/Lomaiviti proposed EBSA. Additional information to support the nomination was contributed by BirdLife International, Whale and Dolphin Conservation Society, Department of Fisheries, plus information already collated by CSIRO by a range of data providers.

Fiji Locally Managed Marine Area Network

WCS Fiji continues to strongly support the FLMMA network through our participation on the Executive Committee and multiple working groups (Biological Working Group, Design and Administration Working Group). WCS Fiji staff contributed as participants and facilitators in

several FLMMA workshops held this year, including the Leadership and Management workshops in Bua (led by IAS and iTaukai Affairs) from 28 February – 4 March and 21-25 March, Sustainable Financing Workshop at Nataleira from 2-3 November, the Annual Lessons Learned and Annual General Meeting from 7-9 December.

Pacific Islands Roundtable for Nature Conservation

Although WCS Fiji staff were unable to attend the Pacific Islands Roundtable for Nature Conservation meeting in Fiji in July, WCS Fiji produced a monitoring template for organizations to report progress against the Fiji National Biodiversity Strategy and Action Plan Implementation Plan 2010-2014. WCS Fiji is still engaged on the Protected Area and Coral Triangle working groups of PIRT. WCS Fiji additionally supported the Fiji Department of Environment through participation at the annual NBSAP Strategy meeting in February 2011, by presenting the outcomes of the CBD COP10 negotiations, as well as the results of the marine national gap analysis. WCS Fiji Director facilitated the discussions to identify priority actions for the Inshore Fisheries thematic section of the NBSAP for 2011.

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- Grantham HS, McLeod E, Brooks A, **Jupiter SD**, Hardcastle J, Richardson A, Poloczanska ES, Hills T, Mieszkowska N, Klein CJ, Watson JEM (2011) Ecosystem-based adaptation in marine ecosystems of tropical Oceania in response to climate change. *Pacific Conservation Biology* 17:241-258
- Jenkins AP, **Jupiter SD** (2011) Spatial and seasonal patterns in freshwater ichthyofaunal communities of a tropical high island in Fiji. *Environmental Biology of Fishes* 91:261-274
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- Lewis SE, Brodie JE, McCulloch MT, Mallela JA, **Jupiter SD**, Williams HS, Lough JM, Matson EG (2011) An assessment of an environmental gradient using coral geochemical records, Whitsunday Islands, Great Barrier Reef, Australia. *Marine Pollution Bulletin*
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- Mills M, **Jupiter S**, Adams V, Ban N, Pressey B (2011) Can management actions within the Fiji Locally Managed Marine Area Network serve to meet Fiji's national goal to protect 30% of inshore marine areas by 2020? Wildlife Conservation Society and ARC Centre of Excellence for Coral Reef Studies, Suva, Fiji, 16 pp.
- Jupiter S**, Tora K, Mills M, **Weeks R**, Adams V, **Qauqau I**, Nakeke A, Tui T, **Nand Y**, **Yakub N** (2011) 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 Fiji, Suva, Fiji, 65 pp.
- Jupiter S**, **Cakacaka A**, **Caginitoba A**, **Fox M**, **Askew N**, **Qauqau I**, **Weeks R**, Prasad S (in prep) Building Provincial-level Integrated Coastal Management Plans: Outcomes from the Vatu-i-Ra Seascape Stakeholders Workshop. Wildlife Conservation Society, Suva, Fiji

Guides

Askew N, Fox M, Jupiter S (2011) *Ecotales from Kubulau: A Guide to the Cultural & Natural Heritage of the Vatu-i-Ra Seascape*, Wildlife Conservation Society, Suva, Fiji, 100 pp

Jupiter S (2011) Implementing ecosystem-based management and the district and seascape level in Fiji. In: Wilkinson C, Brodie J (eds) *Catchment Management and Coral Reef Conservation: A Practical Guide for Coastal Resource Managers to Reduce Damage from Catchment Areas Based on Best Practice Case Studies*. Global Coral Reef Monitoring Network and Reef and Rainforest Research Centre, Townsville, Australia, pp 74-75

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Conference Presentations

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- Jupiter S**, Mills M, Pressey R (2011) Complementing community-based marine management initiatives with strategic planning to meet local- and national-scale objectives in Fiji. 25th International Congress for Conservation Biology, Auckland, New Zealand, 5-9 December
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- Weeks R**, **Jupiter S** (2011) Adaptive marine protected area management to improve reef resilience. 2nd Fiji Conservation Science Forum, Suva, Fiji, 14-16 September
- Yakub NA**, **Jupiter SD** (2011) Rapid uptake of ecosystem-based management principles in community conservation initiatives in Fiji. 2nd International Marine Conservation Congress, Victoria, Canada, 14-18 May

PROJECTED ACTIVITIES FOR 2012

The following sub-sections present a brief list of confirmed and pending projects for 2012 and their links to National Priorities.

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.
- Draft **National Climate Change Policy: Adaptation Strategy 2:** Include vulnerability assessment and climate change impact projections into resource management planning, such as integrated coastal and watershed management plans; **Adaptation Strategy 5:** Support the ecosystem based management approach throughout Fiji, recognizing that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience; and **Adaptation Strategy 6:** Develop and make accessible hazard maps of coastal, riverine, urban and inland areas in Fiji, utilizing the Comprehensive Hazard Assessment and Risk Management tool to guide all development planning

2012 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**
- Draft **National Climate Change Policy Awareness Raising Strategy 2:** Use a range of available communication technologies to conduct outreach activities related to climate change adaptation and mitigation.

2012 OUTPUTS:

- New climate-ready EBM plans established for Wainunu, Nadi, Solevu and Wailevu districts
- Management support training conducted for Wainunu, Nadi, Solevu and Wailevu districts

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.
- Draft **National Climate Change Policy Adaptation Strategy 5:** Support the ecosystem based management approach throughout Fiji, recognizing that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience;

2012 OUTPUTS:

- Marine and terrestrial enforcement protocols for Kubulau, Wainunu and Wailevu
- EBM plans for Wainunu and Wailevu created
- CPUE data analyzed to assess fish stocks
- Report produced outlining recommendations for World Heritage nomination for Vatu-i-Ra.
- 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

Fiji's Goby Guarantee

STATUS: Confirmed

NATIONAL PRIORITIES:

The activities under this grant support the following objectives:

- **NBSAP Implementation Plan Thematic Group 7 (Inland Waters), Strategy 5:** Improve public awareness of the threats to wetland species and ecosystems and options for management, **Objective 5.1:** By 2012, the public will have a broader understanding of the specific threats to wetlands and the values of wetland services to public health, livelihoods and climate change adaptation, **Action 5.1b:** Launch social marketing campaign to raise awareness to threats to species and ecosystem services.

2012 OUTPUTS:

- *The Adventures of Joji Goby* comic book printed and distributed to youth in Kubulau and Wainunu
- Goby Youth Ambassadors and Forest Rangers established and actively monitoring
- Areas confirmed for establishment of Community Forest Parks and Riparian Buffer Zones

LOCATION: Kubulau and Wainunu Districts, Vanua Levu

PARTNERS: N/A

DONOR: Disney Friends for Change Initiative

TIMELINE: July 2011 - June 2012

INVESTMENT: USD\$25,000

Strengthening conservation and management across the Mt. Navotuvotu-Mt. Kasi forest corridor, Fiji

STATUS: Pending

NATIONAL PRIORITIES:

The activities under this grant support the following objectives:

- **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.
- **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**

2012 OUTPUTS:

- Terrestrial and freshwater biodiversity surveys of unexplored locations within the Mt. Navotuvotu-Mt. Kasi corridor, with focus on areas inside the KBAs
- Refined spatial prioritization to identify candidate sites for management
- Consultation with communities towards a goal of achieving 20% protection of land inside KBAs outside of active logging concessions and 10% protection of land and streams across the broader corridor
- Development of management support networks to ensure monitoring and enforcement

LOCATION: Mt. Navotuvotu - Mt. Kasi corridor, Vanua Levu

PARTNERS: N/A

DONOR: Critical Ecosystem Partnership Fund

TIMELINE: May 2012 - April 2013

INVESTMENT: USD\$98,248

Improving Management of Kia Island and Reef

STATUS: Pending

NATIONAL PRIORITIES:

The activities under this grant support the following objectives:

- **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.

2012 OUTPUTS:

- Presentation on findings of impacts of intensive harvest on fish populations
- Resurvey of Cakaulevu tabu and adjacent reefs to gauge recovery
- Community surveys to gauge socioeconomic impact of surf tourism development on the island

LOCATION: Kia Island and reef, Macuata

PARTNERS: N/A

DONOR: Quiksilver Foundation

TIMELINE: February 2012 - December 2012

INVESTMENT: USD\$10,000