

An Analysis of Issues Affecting the Management of Coral Reefs and the Associated Capacity Building Needs in Puerto Rico

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Coral Reef Management Network in Puerto Rico & NOAA's Coral Reef Conservation Program

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The concepts and methods described in this document have evolved over many years and benefited from the ideas, experience and wisdom of many people, from scientists to spiritual leaders, from policy makers to practitioners. This document is a product of continued learning, based upon the art of convening and listening. Our goal is to improve our collective understanding and practice of the ecosystem approach by creating authentic engagement in meetings, gatherings and conversations to address the pressing issues of our time. Since the ultimate objective of this capacity needs assessment is to increase capacity for stewardship of coral reefs, we firmly believe the approach must integrate across sectors, social structures, and disciplines and take on a systems view that incorporates biophysical and social dimensions. We call this integrated approach the ecosystem approach. It is neither easy nor inexpensive to practice and requires continued investments in capacity building. The methods applied in this document draw from the work of Stephen B. Olsen, Director Emeritus of the Coastal Resources Center at the University of Rhode Island, a key author of [Increasing Capacity for Stewardship of Oceans and Coasts: A Priority for the 21st Century](#) (National Research Council, 2008) and the lead advisor of our consultant team. We have integrated methods and lessons learned from the fields of needs assessment for social interventions, innovations in interdisciplinary scholarship, developmental evaluation, capacity assessment practice and theory in the context of international development as well as complexity concepts drawn from ecosystem science. Because the methods are a composite of elements from a wide range of disciplines, they are experimental, and will be customized for each jurisdiction to match the context and capacity of the situation. This capacity assessment process has been designed in close consultation with the NOAA Coral Reef Conservation Program.

Cover Photo: Ridge to reef perspective from the peak of El Yunque National Forest to the reefs of the North East Reserves. (Photo credit: Glenn Page, SustainaMetricx.)

Summary of Major Findings and Recommendations

The objective of this assessment is to present an analysis of the issues that affect capacity to implement Puerto Rico's Coral Reef Management Priorities (NOAA, 2010) and Local Action Strategies (LAS) for Coral Reef Conservation 2011-2015 Puerto Rico (NOAA, 2011), and an associated set of recommendations that could lead to an action strategy to build adaptive capacity to address current management objectives. Commissioned by NOAA's Coral Reef Conservation Program, the consultant team facilitated a qualitative, collaborative and participatory approach to gain perspectives of resource users, managers and funders, and upper level administrators who fund coral reef management.

Much of what we have found regarding capacity to manage coral reefs in Puerto Rico is positive and serves as a base upon which increased adaptive capacity can be built. Over roughly the past 40 years, capacity to manage coral reefs has been building as evidenced by the range of activities featured in a coral reef management timeline developed as part of this assessment (Appendix C). Currently, with new leadership in the Puerto Rico Department of Natural and Environmental Resources (DNER), there is a revived sense of hope within the Commonwealth to build capacity for improved management of natural systems. The Puerto Rico DNER Ranger Corps (hereafter DNER Ranger Corps) is an enforcement unit that provides an outstanding basis for building enforcement capacity, and the efficacy of the DNER Ranger Corps to successfully implement its mandate to enforce DNER rules and regulations would be enhanced through an external assessment and reform. There are increasing numbers of natural and social scientists covering a variety of disciplines in Puerto Rico, growing academic and research capacity, exploring interdisciplinary research and becoming capable of generating transformative research. There is a growing number of NGOs, coalitions and informal groups of resource users that are working at multiple scales, growing a civil society capacity base. Federal agency investments to improve management of coral reefs have increased over the past 10 years, adding significant capacity for improved management. However, as described in this report, there are clear gaps, barriers and impediments to building adaptive capacity for improved management, the context of which is increasingly complex, dynamic, uncertain and emergent, and there is no clear path forward. There are highly significant actions that we believe, if accomplished, would have a major and visible impact signaling clearly that there is momentum for improved coral reef management in Puerto Rico.

Recommendations within this report are divided into three groups. The first group involves decisions that are highly political in nature. The ultimate timing, control and direction needs to be decided from the highest levels of government within the Commonwealth. We believe these actions are the most critical to build long-term adaptive capacity to manage coral reefs and promote Ecosystem-based Management in Puerto Rico. The second group requires increasing collaboration among implementing and funding partners in select priority sites to more fully realize the goals of Ecosystem-based Management at the sites. The third group are a range of actions that can be done at the scale of committees, task forces, within organizations, and by groups of individuals. These are important, but their overall impact will only be realized if there is significant progress with capacity building in the other two groups.

This first group begins with critical recommendations aimed at accomplishing true reform of the DNER Ranger Corps program. If enforcement does not function effectively, voluntary compliance is undermined and the entire management system becomes ineffective. Addressing the DNER Ranger Corps system must be done in a clear-headed

recognition of the dangers, pressures, and threats of the drug trade and other pressing issues that serve to limit effective enforcement.

Linked to improved enforcement is the enactment of a recreational fishing license program (Recommendation 1.2), and the use of associated funds to support fishing data acquisition, habitat restoration and other measures to improve marine resource conservation. Completing the license program is related to the larger issue of completing formal rulemaking for Law #147, making the law truly operational (Recommendation 1.3). If the new leadership felt that the political timing for taking these steps is appropriate and they were completed, it could have a huge impact. All of this requires formal commitment and must fit into a larger political landscape. This first group of recommendations are the most critical as they would signal clear support for building capacity to manage coral reefs in Puerto Rico. This group is also the most complex because they feature difficult political decisions that need to be made by senior officials in Puerto Rico who must factor in a wide range of extenuating circumstances, yet their adoption would support tourism and fisheries sectors and underscore the ecosystem services of coral reefs including coastal protection, property values, educational, cultural, recreational and research use.

The second group of recommendations involves a series of collaborative actions that can be done within a relatively small segment of the coral management network and focused in select geographies. Together, the recommendations in this group promote the collaborative use of a common management framework to sequence and prioritize implementation in select priority areas. To be effective, this would require commitment by all actors within a system including resource users, managers and funders. For example, funding partners would provide clear guidance and training for those who are preparing proposals, implementing actions and reporting on project performance to follow a clearly defined management cycle, to track progress along the way, changing contexts and adapt as needed. As a pilot demonstration, we suggest initiating this effort in one or two of the priority areas where there is already an established collaborative process such as in Guánica and the North East Reserves/Culebra.

The third group of recommendations includes actions that contribute to building adaptive capacity, yet their implementation can be controlled by a small group of people, an organization or a network of organizations. This group includes programs, trainings etc. that focus on building a range of technical, financial, social, institutional and political capacities. While this group is more commonly associated with traditional building of knowledge, skills and competencies, all forms of capacity, we believe investment here will have far greater return as long as attention is paid to implementing the two groups described above.

Key findings and recommendations of our work in Puerto Rico include:

- For reef conservation to truly succeed, it is imperative to build an understanding among decision makers and the general public that the economic and cultural value of the Commonwealth's reefs is very high in terms of tourism, fisheries, recreation, coastal protection and that the window of opportunity for "capturing" the benefits is limited and closing fast. There is no island system on the planet that has the luxury to wait and see if preserving reefs and coastal ocean health is important to the long term health and well-being of its inhabitants. It will not be easy, inexpensive or politically expedient, but the time for Puerto Rico to act to build capacity to improve the management of coral reefs is now.
- There are several politically challenging recommendations that can only be achieved with broad political support and formal, high level commitment. These include completing the final rulemaking for PR Law

#147 and commissioning a thorough external evaluation of the DNER Ranger Program leading to the wide-ranging reform of the troubled program.

- The DNER Ranger Corps was widely cited by our interviewees as a major impediment to effective management and is in need of significant reform. Without reform, both enforcement of, and compliance with, natural resource protection regulations will be undermined, further reducing the effectiveness of measures designed to enhance and protect the Commonwealth's natural heritage.
- Staff capacity for coral reef protection is very low within DNER. Significantly improving the efficacy of coral conservation within DNER will require the commitment of additional personnel resources. Unfortunately, simply allocating financial resources in this direction is not enough. The process whereby job openings in DNER are listed, advertised and filled is problematic, and often results in candidates that are not the most highly qualified, and not the first choice of managers, being hired. The reasons are often cited as being “political” in nature, impossible to remedy, and a persistent source of inefficiency and frustration within the natural resource management community. Addressing this problem will take commitment within very high levels of the Puerto Rico government.
- The natural resource managers across Puerto Rico have increasing responsibilities and often shrinking resources and would benefit from a common management framework that can more effectively sequence, prioritize and guide action toward clear goals. Ideally, such a common framework would be accepted across funders to maximize management and minimize administration. Pursuing a concerted program to train managers in, and promote the use of, the language and tools of ecosystem management can bear great fruits in improving management efficacy and adaptive learning. The common language and tools should be actively used at one or two priority coral conservation sites to complete a single “generation of management” by progressing through the five identified steps of the management cycle at the sites, thereby providing a pilot example for other sites.
- While there is a growing, albeit small conservation community, overall the general public in Puerto Rico is not highly attuned to marine conservation issues. One person, well-familiar with public attitudes noted that many Puerto Ricans “turn their back to the sea” when it comes to stewardship. Paradoxically, the local community benefits from coral reefs in many ways such as cultural and recreational attachment and coastal protection. As a result, we believe an opportunity exists to articulate and evaluate alternative social-ecological futures and uncertainties, and help support planning, decision-making, and social learning to build capacity for adaptation to ecosystem change.

This report examines issues related to capacity to implement priority management strategies and improve management effectiveness. An action plan is needed to move from recommendations to implementation. If a capacity building action strategy is implemented well, it positions DNER, and the wide range of implementing partners in government, civil society and market forces to more effectively capture the benefits of coral reefs. If results are not acted upon in some manner, inertia and status-quo will likely lead to declines in economic drivers of reef related tourism, recreation, reef related real-estate transactions, coastal protection, and support to commercial and recreational fisheries. A well-conceived action strategy that sets forth implementation of capacity building strategies is strongly recommended that features participation across resources management agencies from Commonwealth to Federal, from small to large NGOs, coalitions, and features the participation of funding partners and upper level administrators to gain support

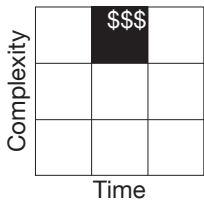
from resource users who depend on the coral reefs of Puerto Rico for their livelihoods. It will require contributions from all stakeholders.

Table of Recommendations

LEGEND

TIME SCALE	COMPLEXITY SCALE	MONETARY SCALE
Short = <1 year	Low = Somewhat context independent recommendations such as “best practices” and “standard operating procedures” that have fairly high certainty of building capacity.	\$ - Less than \$5,000
Medium = 1 to 2 years	Medium = Context is more important and the recommendation may require either coordination of technical expertise that may or may not be present in the system, or may require a degree of social engagement and relationship building that creates a common ground; i.e. either socially or technically complicated.	\$\$ - Between \$5,000 and \$20,000
Long = >2 years	High = Context is highly dependent and the recommendation may require strategies that are adaptively implemented and address dynamic, emergent, non-linear and complex conditions.	\$\$\$ - Between \$20,000 and \$100,000 \$\$\$\$ - Greater than \$100,000

EXAMPLE



This graphic shows project time scale of 1 to 2 years (**Medium**) with complexity scale equal to **High** and monetary scale between \$20,000 and \$100,000 (**\$\$\$**).

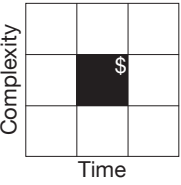
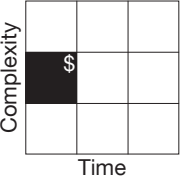
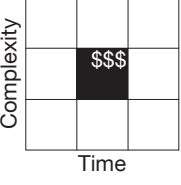
GROUPING AND PRIORITIZATION

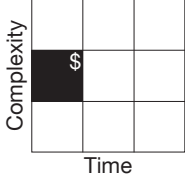
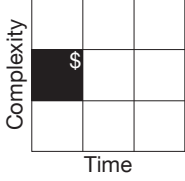
As noted above, the recommendations in the following tables have been divided into three groups based upon their tractability, scale, practicality and the degree of control over their implementation. The first group is highly political in nature, will require high-level governmental action, and in many respects lies beyond the direct reach of the coral management network. The second group will require a collaborative and coordinated approach to management at select priority areas and involve interconnected systems and engagement with multiple resource users, government entities, NGOs and funders. The third and final group is designed to build capacity at an organizational scale where leadership and control over implementation is relatively high. The recommendations in Group 1 are presented in simple priority order, from highest to lowest, incorporating guidance from the Puerto Rico Jurisdictional Capacity Assessment Committee (J-CAT) and our best professional judgement. The recommendations in Group 2 are organized into a logical sequence that will aid their implementation at one or two priority sites in Puerto Rico and were not subject to prioritization. The recommendations in Group 3 are grouped according to sub-theme, with the highest priority sub-themes presented first, and the recommendations within each sub-theme also presented in general priority order, again incorporating the guidance of the J-CAT and our best professional judgement.

Group 1 Recommendations: Politically Challenging Goals to Improve Formal Commitment to Coral Reef Conservation

This group of recommendations is highly political in nature, will require high-level governmental action, and in many respects lies beyond the direct reach of the coral reef management network.

Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
46	PR 1.1	Reform the DNER Ranger Corps	
48	A	<p>External Review of DNER Ranger Corps: The DNER Ranger Corps, and coral reef management generally, could benefit from a thorough, external evaluation by professional evaluators with expressed expertise in evaluating natural resource regulatory enforcement programs. This recommendation is essential because without supportive and effective enforcement, compliance will be low and reef health will continue to decline. High-level leadership within DNER supports the idea of an external review of the DNER Ranger Corps, creating a window of opportunity to both perform the external review and then effectively implement the proposed recommendations. One potential organization that has conducted such reviews is MPA Enforcement International.</p> <p>Associated PSD Goals: A3 and B2 Recommended Lead: DNER Secretary Potential Partners: DNER Ranger Corps, MPA Enforcement International</p>	
49	B	<p>Specific DNER Ranger Corps Reforms: The following specific potential reforms do not remove the necessity of a professional evaluation, but can provide a reform agenda while pursuing an evaluation and can provide background for it.</p> <ul style="list-style-type: none"> • The sanction-based system should be completely redesigned. • Performance reviews and merit-based advancement should be instituted, and successful collaborations should be rewarded. • A certification program based on both performance and knowledge could improve the efficacy of the DNER Ranger Corps. • Marine Rangers should be a dedicated unit and receive specific training relevant to marine enforcement responsibilities and should not be transferred between marine and terrestrial responsibilities. • Ranger patrols should be unpredictable and scheduled to work in areas and at times when violations are known to be likely. • Rangers should be trained in avoiding and resolving conflicts of interest and their advancement should be based on successfully navigating these issues while achieving strong enforcement and compliance. <p>Associated PSD Goals: A3, B2, B3, and C1 Recommended Lead: DNER Secretary Potential Partners: DNER Ranger Corps</p>	
49	C	<p>Limited External Investment in DNER Ranger Corps Until Review Complete: Lax enforcement and weak compliance are so problematic across the Commonwealth that only limited further external investments in the Corps should be made until an external evaluation is complete and reforms have been initiated.</p> <p>Associated PSD Goal: B2 Recommended Lead: DNER Secretary Potential Partners: NOAA CRCP, NOAA CZM, NOAA NMFS Office of Law Enforcement</p>	


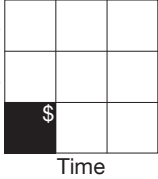
Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
50	PR 1.2	<p>Complete Recreational Fishing License Program and Invest Proceeds in Coral Conservation Activities:</p> <p>Revenues generated by the recreational fishing licensing program should be invested in improving fisheries management and undertaking activities that sustain fish populations and the coral habitats upon which they depend, including improved recreational fishing effort and catch data acquisition and analysis, and fish nursery habitat restoration, among others (as outlined in the fisheries regulations).</p> <p>Associated PSD Goals: B1, B2, B3, and C1 Recommended Lead: DNER Secretary Potential Partners: DNER Fish and Wildlife Bureau, DNER Ranger Corps, Office of Permits and Licenses</p>	
50	PR 1.3	<p>Finalize Regulations for PR Law #147</p>	
51	A	<p>Create Strategic Plan to Complete A New Regulation for PR Law #147:</p> <p>The new DNER Secretary should quickly assign a DNER staff member to review the present status of the law and prepare a time-bound strategic plan to bring the final rulemaking for the law to completion.</p> <p>Associated PSD Goals: Promotes formal commitment to support all PSD goals Recommended Lead: DNER Coral Reef Committee Potential Partners: DNER Secretary</p>	
51	B	<p>Complete New Regulation for PR Law #147:</p> <p>After the creation of the strategic plan, the plan should be expeditiously put into action and aggressively pursued as both a substantive and symbolic expression of formal commitment to coral conservation in Puerto Rico. While Law #147 could be a strong asset for improved reef management, its language could be updated in the future to make it stronger. For example, the Act could include measures such as one or more additional Commonwealth-funded full-time equivalents (FTEs) within DNER devoted to coral conservation. With the current political climate, there could be a window of opportunity to amend the law, otherwise amendments should be considered in future action plans.</p> <p>Associated PSD Goals: Promotes formal commitment to support all PSD goals Recommended Lead: DNER Secretary Potential Partners: DNER Office of Legal Affairs, Puerto Rico State Department, DNER Coral Reef Committee</p>	
51	PR 1.4	<p>Increase Staff Capacity for Coral Management within DNER:</p> <p>One new staff position could be dedicated to increasing the quality of collaboration across partner agencies and organizations and a second new staff position could be focused on water issues and monitoring and evaluation. A strategic staffing plan, with well-written job descriptions, could prove valuable for justifying staff increases and securing funding. Adding coral-dedicated staff at DNER will also improve general capacity to manage the CRCP cooperative agreement, develop new projects and associated management plans, monitor ongoing projects, etc.</p> <p>Associated PSD Goals: A2, A3, and improves capacity in support of all PSD goals Recommended Lead: DNER Secretary Potential Partners: NOAA CRCP, DNER Coral Reef Committee</p>	

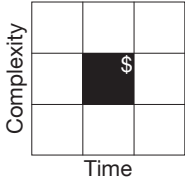
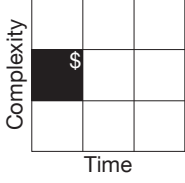
Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
51	PR 1.5	<p>Improve Coordination with Environmental Quality Board:</p> <p>DNER should work to improve coordination with the EQB. An annual briefing to the EQB on watershed activities such as emerging trends on agricultural best management practices and sediment and erosion control structures could begin to improve coordination and collaboration. A liaison from EQB should be invited and encouraged to participate in regular meetings, seminars, and annual events associated with Ridge to Reef activities.</p> <p>Associated PSD Goals: A1, A2, A3, and C2 Recommended Lead: DNER Secretary Potential Partners: Environmental Quality Board</p>	
52	PR 1.6	<p>Create Hiring Practices Briefing for New DNER Secretary:</p> <p>The problems affecting the job listing and hiring process within DNER will require concerted effort from the highest level of the Department and perhaps within even higher levels of government to solve, and lie beyond the scope of this capacity assessment. A thorough briefing, with well-documented examples, should be prepared and presented to the new Secretary that alert her to these problems and will enable her to begin to craft an appropriate course of action. Ideally, this would include a “process flow chart” that shows how the key steps that a hiring manager would need to take flows through the DNER system, including securing resumés, selecting candidates for interviews, and completing the final selection process. The Human Resources Office (<i>Oficina de Recursos Humanos</i>) should lead the implementation of this recommendation by briefing the new DNER Secretary about future plans to develop standard operating procedures to formalize uniformed protocols for hiring candidates based on merit. Additional standards should be developed that base job retainment and pay increases on performance of duties. High-level support of this reform could bolster the confidence of DNER supervisors by ensuring that only quality candidates with appropriate credentials fill vacancies and retain high performance over time. Such a briefing on hiring practices should be re-assessed and repeated with each incoming Secretary at DNER.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: DNER Secretary Potential Partners: DNER Human Resources Office</p>	

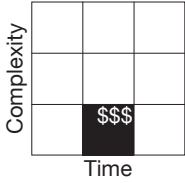
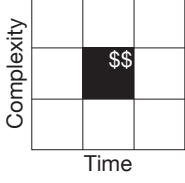
Group 2 Recommendations: Using a Common Management Framework to Pursue Ecosystem-based Management at Priority Site

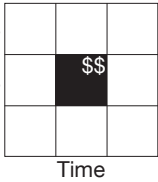
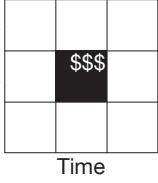

This group of recommendations will require a collaborative and coordinated approach to management at select priority areas, and involve interconnected systems and engagement with multiple resource users, government entities, NGOs and funders.

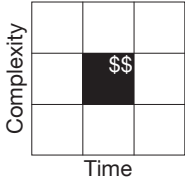
Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
54	PR 2.1	Build Capacity Through the Application of a Common Management Framework	
54	A	<p>Promote the Use of a Common Language and Management Analysis Tools Through Management Training: Select an institution of known competence in training on the practice of ecosystem governance (e.g. Coastal Resources Center at the University of Rhode Island) to offer an annual course (or courses) designed in partnership with a selected university unit that would address the principles and the practice of the ecosystem approach and core competencies required to build adaptive capacity for effective coral reef management. The expectation would be that once the curriculum has been developed and the course established, the university would assume full responsibility for the program and incorporate it into its curriculum. The curriculum should emphasize lessons learned from Puerto Rico and other jurisdictions and address in particular the transition from issue analysis and planning (Steps 1 and 2) to commitment to, and implementation of, a management plan of action (Steps 3 and 4). A central theme should be recognition of how the contributions of the natural and social sciences shift with each step. Such courses should strive to attract a diversified participant mix so that each class is exposed to the views and experiences of natural and social scientists, managers, lawyers, educators, the NGO community and enforcement personnel. Such a capacity building curriculum could be adapted to feature short courses or seminars for senior administrators, judges, journalists and educators. Sample modules are suggested in Appendix E.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: NOAA CRCP Potential Partners: DNER Coral Reef Committee, an organization of known competence in training on the practice of ecosystem governance, Puerto Rican Public and Private Universities</p>	<p>Complexity</p> <p>Time</p>

Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
	PR 2.1 (cont.)	Build Capacity Through the Application of a Common Management Framework	
55	B	<p>Case Study Curriculum:</p> <p>Natural resource managers, funders and practitioners could benefit from improved documenting and sharing of case studies of management success stories and lessons learned through a case study curriculum. This curriculum of coral reef management would emphasize case studies from Puerto Rico and other jurisdictions and address in particular the transition from issue analysis and planning (Steps 1 and 2) to commitment to, and implementation of, a management plan of action (Steps 3 and 4). A central theme should be recognition of how the contributions of the natural and social sciences shift with each step. Such courses should strive to attract a diversified participant mix so that each class is exposed to the views and experience of natural and social scientists, managers, lawyers, educators, the NGO community and enforcement personnel. Such a curriculum would have multiple uses as:</p> <ul style="list-style-type: none"> • An information sharing database amongst natural resources managers, funders and practitioners; • Ideally, Puerto Rico could share such a curricular base with other US jurisdictions through the All Islands Committee of the US Coral Reef Task Force. A pilot set of case studies to begin the establishment of a broader library of case study curricula to be housed at the Caribbean Landscape Conservation Cooperative (CLCC) to improve systems-learning across the conservation community; • Lessons plans of curriculum from junior high schools through PhD-level; • Short courses for senior administrators, judges, journalists and educators after adaptation (Recommendation 2.1A); and, • Public education and outreach materials, after necessary re-tooling. <p>Creating a Puerto Rico-specific knowledge base and then sharing the information through multiple avenues through quality documentation and distribution would foment continued learning within the Puerto Rico conservation network and beyond.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: DNER Potential Partners: An organization of known competence in training on the practice of ecosystem governance, CLCC, USFWS, coral reef management network of Puerto Rico, Puerto Rican Public and Private Universities</p>	<p>Complexity</p>  <p>Time</p>
56	C	<p>Tie CRCP Funding to Steps in Management Cycle:</p> <p>To be successful and truly build capacity to manage coral reefs it is important to use a “common management framework” that is widely distributed across the entire coral management community, including among funders (i.e. CRCP and NGOs). This would be enhanced by encouraging (and ideally requiring) grantees to propose their projects in relation to the steps in the management cycle (a key component of the framework) as an organizing principal for grant requests. Funding decisions, tracking of progress and reporting would also fit well into this organizing framework. Specifically, we recommend that projects funded by CRCP and other funders such as National Fish and Wildlife Foundation (NFWF) involved at the priority sites link the proposed activity to the appropriate step or steps in the coral reef management process at the site or sites where the activity is to be conducted. The CAP process already encompasses some of the goals of employing a common management framework and can form a foundation from which to build and adopt this recommendation.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: DNER Coral Reef Committee Potential Partners: TNC, NFWF, NOAA CRCP, Guánica Bay Watershed Initiative, NRCS, USFWS, USDA, USGS, CLCC</p>	<p>Complexity</p>  <p>Time</p>

Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
	PR 2.1 (cont.)	Build Capacity Through the Application of a Common Management Framework	
56	D	<p>Link Funding of Research and Monitoring to Management Outcomes: We recommend that future research and monitoring projects funded by CRCP link the proposed activity to the appropriate step or steps in the coral reef management process at the site or sites where the activity is to be conducted. Research and monitoring proposals should explicitly link the proposed activity to the issues addressed by management and identify how the activity will inform the management process.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: NOAA CRCP Potential Partners: DNER Coral Reef Committee, Guánica Bay Watershed Initiative, North East Reserves management teams, USFWS, CLCC</p>	
56	PR 2.2	Pursue Ecosystem-based Management at Two Priority Sites	
57	A	<p>Focus Efforts at One or Two Areas: We recommend that in the short term, DNER and NOAA work together to identify one or two of the existing priority sites upon which the program will focus its efforts and target investments in order to successfully make the transition to effective implementation of a management plan for those areas. By focusing on one or two sites (specifically Guánica and North East Reserves/Culebra), this provides the opportunity for implementation partners to focus their efforts and pilot new approaches for increased quality linkages across their programs. Piloting this approach at one or two priority sites will create the opportunity for deep learning about how such quality collaboration could function. It is important to note while concerted effort will be made at these one or two sites, other protected areas will not be abandoned. Such management plans should specify the rules and incentives by which specific goals for both the condition of the corals and how the desired types and intensities of human activity will be achieved. Dissemination of these plans and an overall coral reef strategy is essential. NOAA CRCP's MPA Management Assessment Checklist could be a model for outlining the assessment structure for increasing the level of accountability and setting criteria for improved engagement and fostering more unified efforts at the selected site or sites (MPA Management Assessment Checklist). Current managers of the protected areas will be key partners for the implementation of this recommendation along with DNER and NOAA spearheading the effort.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: DNER Coral Reef Committee and DNER Secretary Potential Partners: NOAA CRCP and Caribbean Field Office, Guánica Bay Watershed Initiative, North East Reserves management teams</p>	

Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
	PR 2.2 (cont.)	Pursue Ecosystem-based Management at Two Priority Sites	
57	B	<p>Ridge to Reef Summit:</p> <p>We recommend a regular summit on ridge to reef management approximately every two years at Guánica and other sites. This would allow participants employing the conceptual frameworks for management process and outcomes to further learn from experiences at priority sites and elsewhere so as to report out on the priority site investments and learn from what is going on elsewhere. The use of the management cycle and orders framework can show how highly integrated and coordinated site-specific management actions at the scale of a watershed will further increase adaptive learning. Audiences should include field operations staff, managers and policy/decision makers as well as students and educators interested in this topic.</p> <p>Associated PSD Goals: A1, A2, A3, C1, and C2 Recommended Lead: USCRTF (as part of their Watersheds Initiative) Potential Partners: All relevant partners involved in coral reef management including DNER Coral Reef Committee, Guánica Bay Watershed Initiative, North East Reserves management teams, USFWS, NOAA CRCP and Caribbean Field Office, EPA, NRCS</p>	
59	PR 2.3	<p>Create and Adopt Improved Plans:</p> <p>While formal plans exist for the priority areas and other sites across the Commonwealth, the plans generally do not present a clear and operational sequence of actions to be followed. By linking the creation and adoption of new plans, as well as the review, revision and implementation of existing plans, to the management training suggested in Recommendation 2.1, managers can evaluate their plans and create a more operational, logical and sequenced implementation plan for their sites that can guide funding decisions for CRCP and beyond. Improved plans should feature:</p> <ul style="list-style-type: none"> • The regulations by which the goals are to be achieved; • Positive incentives to encourage desired behavior change; • Broad-based stakeholder support before implementation; and • Support across the DNER hierarchy prior to program implementation. <p>Such plans will gain further strength if they can build on improved formal commitment to conservation, as evidenced by completed rulemaking for Law #147 and reforms to the DNER Ranger Corps (Recommendations 1.1 and 1.2).</p> <p>Associated PSD Goals: A1, A2, A3, B1, B2, B3, C1, C2, and C3 Recommended Lead: DNER Potential Partners: Guánica Bay Watershed Initiative, North East Reserves management teams, NOAA CRCP and Caribbean Field Office</p>	

Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
60	PR 2.4	<p>Enhance Collaboration and Employ Collaboration Frameworks: DNER and the larger coral management network should take concrete steps to improve collaboration across the network. By promoting the use of a common management framework and language and employing management training, as suggested in Recommendation 2.1, managers will be better equipped to communicate and collaborate. If DNER and CRCP seek a common framework to improve the quality of collaboration, we recommend that it investigates employing the Collaboration Evaluation and Improvement Framework (CEIF) high quality collaboration methodology, or similar collaboration framework, as a means to improve collaboration across the Puerto Rico coral reef management system. To make such a framework operational, it would be best applied as part of the common language for improved ecosystem management.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: NOAA CRCP Potential Partners: An organization of known competence in training on the practice of ecosystem governance, Guánica Bay Watershed Initiative, North East Reserves management teams, USFWS, USGS, NRCS, EPA, NOAA Caribbean Field Office, CLCC, Puerto Rican Public and Private Universities</p>	
61	PR 2.5	<p>Strategies to Improve the Use of Monitoring and Evaluation to Enhance Adaptive Management</p>	
61	A	<p>Institutionalize Monitoring and Evaluation (M&E): M&E should be built into the management process, not conducted as an “afterthought.” Starting with one or two target priority areas, programs should undergo semi-annual self-assessments, bringing together an experienced, interdisciplinary team, including high-level administrators. Programs should use simple scorecards to prepare baselines of both environmental and social conditions against which progress can be measured. This should be scaled up to multiple sites after being successfully piloted.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: NOAA CRCP, NFWF Potential Partners: Local implementing partners, USFWS, USGS, NRCS, EPA, CLCC</p>	
62	B	<p>Revise Primary Management Documents: Both the PSD and the LAS documents should be revised and updated as an expression of adaptive management by 2016. A primary focus of updating the LAS should be to create a clear sequence of priority actions for each management area.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: DNER Coral Reef Committee Potential Partners: All relevant stakeholders and partners</p>	

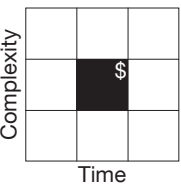
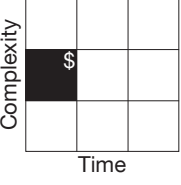
Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
	PR 2.5 (cont.)	Strategies to Improve the Use of Monitoring and Evaluation to Enhance Adaptive Management	
62	C	<p>Use Scorecards to Track Evidence of Enabling Conditions for Improved Coral Reef Management:</p> <p>Finally, experience suggests that use of a simplifying scorecarding tool can be extremely useful to track the ongoing assembly and maintenance of the enabling conditions as part of implementation of a coral reef management initiative. A simple scorecard can track all four of the following conditions and the degree that they are present:</p> <ul style="list-style-type: none"> • A core group of well-informed and supportive constituencies supports the program; • Sufficient capacity is present within the institutions responsible for the program to implement its policies and plan of action; • Governmental commitment to the policies of a program has been expressed by the delegation of the necessary authorities and the allocation of the financial resources required for long-term program implementation; • Unambiguous goals define both the societal and the environmental conditions against which the efforts of the program can be measured. <p>Each of these enabling conditions as well as steps through the management cycle can be measured using simplifying scorecarding tools. It is our recommendation that the coral reef initiative in Puerto Rico pilot test these tools in the two priority areas to guide adaptive management and continued learning.</p> <p>While picking and applying scorecards such as those recommended here may be unfamiliar and many managers lack training in their application, they are quite simple to use and trainings in their use are available by organizations familiar with the practice of ecosystem governance.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals</p> <p>Recommended Lead: DNER</p> <p>Potential Partners: NFWF, an organization of known competence in training on the practice of ecosystem governance, local implementing partners such as Guánica Bay Watershed Initiative, North East Reserves management teams, USFWS, USGS, NRCS, EPA, CLCC</p>	


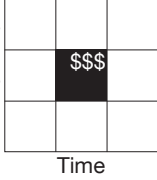

Group 3 Recommendations: Tractable Projects

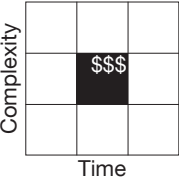

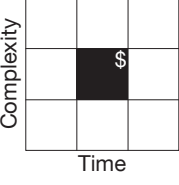
This group of recommendations can be controlled by a small group of people, an organization or a network of organizations. While some do involve improving coordination with other government agencies or non-governmental organizations, many can be pursued and led from within DNER or other implementing partners. This group of recommendations includes programs, trainings etc. that focus on building a range of technical, financial, social, institutional and political capacities.

Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost									
63	PR 3.1	Improve Aspects of DNER Function and Capacity										
63	A	<p>Sustainable Finance Plan:</p> <p>With over three million tourists visiting Puerto Rico each year, the Commonwealth has the opportunity to build capacity to take advantage of innovative potential funding sources, including tourism user fees, tourism and entry/exit fees, mooring user fees, as well as mechanisms for generating funding to encourage conservation activities, including cost and benefit sharing, using social media and “text to donate” services, investment and enterprise funds, and fiscal instruments and arrangements for private or community management of natural and marine reserves, protected areas and facilities. DNER could sponsor a “Philanthropy Roundtable” whereby members of foundations can meet to discuss funding priorities that match their mission, vision, and values. We believe such a forum could provide a unique opportunity to bring together both private and public funders, hear from those funders what is important to them, and let them hear from the people on the ground working in management about what is needed. This helps to foster a multi-party relationship for sustainable funding so that even if critical point-people move on, the roundtable can be sustained. The Puerto Rico Conservation Trust is a model organization that engages well with donors and may welcome an opportunity to share lessons learned for ways to engage philanthropy. NFWF could be another potential convener. These strategies and potential sources of income should be carefully studied and presented to both the new DNER Secretary and the new Governor with the goal of gaining formal commitment for raising funds dedicated directly to reef conservation and management programs. The management cycle would be an ideal organizing principle to guide adaptive action and reflection on this critical long-term need.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals</p> <p>Recommended Lead: DNER</p> <p>Potential Partners: Puerto Rico Conservation Trust, TNC, NFWF, and other interested philanthropies and representatives from the Puerto Rico coral network</p>	<p>Complexity</p> <table border="1"> <tr><td></td><td></td><td></td></tr> <tr><td></td><td></td><td>\$</td></tr> <tr><td></td><td></td><td></td></tr> </table> <p>Time</p>						\$			
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63	B	<p>Re-engage DNER Oversight of the Creation of Management Plans:</p> <p>Oversight of management plans can be improved by increasing the personnel devoted to coral reef management within DNER. The plans, and their likelihood of successful implementation, can be enhanced by ensuring that they have a strategic focus and a clear set of unified priorities, policies and desired outcomes. DNER needs to build capacity to improve central oversight of this process to reach a coordinated focus on what changes in the current environmental conditions and forms of human activity and use that implementation of management plans seeks to effect. This process should also improve and support enhanced coordination among site and area managers in the field. Improved DNER oversight is especially important when management plans are developed by contractors to help ensure the strategic focus of outsourced plans.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals</p> <p>Recommended Lead: DNER Secretary</p> <p>Potential Partners: All parties involved with the development of management plans.</p>	<p>Complexity</p> <table border="1"> <tr><td></td><td></td><td></td></tr> <tr><td></td><td>\$</td><td></td></tr> <tr><td></td><td></td><td></td></tr> </table> <p>Time</p>					\$				
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Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost									
	PR 3.1 (cont.)	Improve Aspects of DNER Function and Capacity										
64	C	<p>Strategies to Improve Grants Management: Strategies to improve grants management performance include:</p> <ul style="list-style-type: none"> • Maintain staff and funding to address administrative support for grants management within DNER. This is a case where training in grants management is needed for multiple people to create some level of redundancy in the event that key staff leave to avoid disruption in service; • Adding routine training for grants managers into the NOAA CRCP proposal on an annual basis, such as orientation workshops for the software used for grant applications, specific updates to accounting procedures that link with NOAA cooperative agreement accounting etc.; and, • Linking grants management lessons learned between Florida, the USVI and Puerto Rico such as how to increase efficiency with procurement, how to more effectively communicate with management staff, how to build redundancy into grants management system. <p>Associated PSD Goals: Improves capacity in support of all PSD goals depending on grant area Recommended Lead: NOAA CRCP Potential Partners: DNER and all parties involved in financial reporting/accounting</p>	<p>Complexity</p> <table border="1" data-bbox="1360 268 1516 422"> <tr><td></td><td></td><td></td></tr> <tr><td></td><td></td><td>\$\$\$</td></tr> <tr><td></td><td></td><td></td></tr> </table> <p>Time</p>						\$\$\$			
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64	PR 3.2	Enhance and Promote Linkage with EPA Region 2										
64	A	<p>Local Water Quality Standards: Through stronger partnerships with EQB and EPA, DNER should work to define a process for the adoption of water quality standards that are developed by EPA for use in a tropical context. While this is underway, tracking the progress including barriers and opportunities will help guide action that may be needed to complete this process.</p> <p>Associated PSD Goals: A1 and A2 Recommended Lead: DNER Potential Partners: EPA Region 2, EQB, NOAA CRCP</p>	<p>Complexity</p> <table border="1" data-bbox="1360 867 1516 1020"> <tr><td></td><td></td><td></td></tr> <tr><td></td><td></td><td>\$\$\$</td></tr> <tr><td></td><td></td><td></td></tr> </table> <p>Time</p>						\$\$\$			
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Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
	PR 3.2 (cont.)	Enhance and Promote Linkage with EPA Region 2	
65	B	<p>Link with EPA Region 2: Positive linkages with EPA should be pursued and made formal through an MOU with clear time bound and measurable milestones. Possible linkages between EPA Region 2 and NOAA CRCP and the Puerto Rico coral management community could include:</p> <ul style="list-style-type: none"> • Region 2 representation at United States Coral Reef Task Force; • Enhanced communication regarding on the ground planning associated with coral reef management between Region 2 and Region 4; • More communication between Region 2 and CRCP headquarters in Silver Spring; • Local integration with ongoing projects and stakeholders related to water quality and LBSP issues; • EQB integration into, and active participation, in coral efforts; • Integrating stakeholders in planning of efforts and activities on early stages in Steps 1 and 2 of the management cycle; • Identify an EPA person that is familiar with coral reef management efforts and circumstances in Puerto Rico that can serve as liaison to Region 2 and Region 4, as well as jurisdictional and federal agencies; • Improve communication between DNER and EPA regarding how funds will be spent to increase collaboration opportunities; • EPA integration in steering management committee for North East Reserve Management Plan Project (land and marine aspect); and, • Integration in Watershed Management Plan development for NE Reserves and Culebra. <p>Associated PSD Goals: A1 and A2 Recommended Lead: NOAA CRCP, DNER Potential Partners: EPA Region 2</p>	 <p>Complexity</p> <p>Time</p>
65	PR 3.3	Re-invigorate Working Groups, Committees and Regional Partnerships	
65	A	<p>Re-invigorate Coral Committees and Fisheries Working Group (Junta de Pesca): Coral committees, both within and external to DNER, should be re-invigorated to provide a forum for managers to continue to collaborate, coordinate and synergize their activities. While the intra-DNER coral committee works relatively well, it will be important to improve the coral committees external to DNER. An inventory and simple timeline of these collaborative groups as well as a scan of other effective collaborative strategies in other jurisdictions is needed to help inform the process of building task forces that generate meaningful results.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: DNER Potential Partners: All relevant partners</p>	 <p>Complexity</p> <p>Time</p>

Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
	PR 3.3 (cont.)	Re-invigorate Working Groups, Committees and Regional Partnerships	
66	B	<p>Link to Regional Initiatives: The Puerto Rico coral reef management system could benefit from linking to regional partnerships including the Caribbean Challenge, NOAA in the Caribbean, EPA Caribbean Coral Reef Protection Group, and the National Ocean Policy, and the Caribbean Landscape Conservation Cooperative (CLCC) among others. A regional perspective would encourage a broader analysis of issues related to coral reef management that includes fisheries, marine spatial planning, enforcement and compliance, supportive and informed constituencies, political will, etc. DNER could bring forth these issues in such a collaborative forum and that would allow the steering committee to decide what issues (Step 1) they will and will not address in their current management generation.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: DNER Potential Partners: Caribbean Challenge, EPA Caribbean Coral Reef Protection Group, NOAA in the Caribbean, CLCC, and the National Ocean Policy</p>	<p>Complexity</p>  <p>Time</p>
67	PR 3.4	<p>Valuation Studies: Inventory available, and conduct or update, as appropriate, studies that document the market and non-market value of healthy coral reefs. Values can include the revenue generating dimensions of enhanced reef tourism and revitalized recreational fisheries, as well as important non-market, ecosystem services of healthy reefs. Such studies could provide needed support to invest in programs such as addressing illegal gill-netting that catches juvenile fish and hampers fish population recoveries.</p> <p>Associated PSD Goals: Promotes formal commitment to support all PSD goals Recommended Lead: DNER, NOAA CRCP Potential Partners: TNC, World Resources Institute, IVM Institute for Environmental Studies, Stratus Consulting</p>	<p>Complexity</p>  <p>Time</p>
67	PR 3.5	Products and Events to Promote and Popularize Coral Conservation	
67	A	<p>Encourage Compliance: In addition to a strong and functional DNER Ranger Corps, investments should be made to engage the fishing community in a strong, participatory process to help fishers develop a specific and achievable vision of a sustainable future for fishing in Puerto Rico that includes measurable and time-bound interim goals. For example, the St. Thomas Fisherman's Association in the USVI has been involving fishers in the active process of conducting research and collecting data, both providing supplemental income to some fishers as well as bolstering communication and trust between the research and fishing communities. In Puerto Rico, such a process could be focused on an issue in a specific geography such as development pressure near the Northeast Reserves. An iterative process to engage fishers in selecting and refining closed areas and other geographic-based restrictions has proved successful elsewhere (Lopes et al. 2013). Ideally, leadership from a trusted organization such as the Caribbean Fisheries Management Council could serve to guide such an effort. Only with such an agreed-upon and mutual vision can the fishing community work collaboratively to ensure widespread compliance with rules.</p> <p>Associated PSD Goals: A3, B2, B3, C1, and C3 Recommended Lead: DNER Potential Partners: NOAA CRCP, Caribbean Fisheries Management Council, recreational and commercial fishers and their networks</p>	<p>Complexity</p>  <p>Time</p>

Page #	Capacity Building Strategy / Recommendation / Potential Partners		Complexity / Time / Cost
	PR 3.5 (cont.)	Products and Events to Promote and Popularize Coral Conservation	
67	B	<p>Coral Celebration: Plan and implement a high visibility annual celebration of Puerto Rico’s fisheries and coral reefs. Potentially coordinate with existing celebrations such as Planet Earth Month, Ocean Week or the celebrations surrounding <i>La Noche de San Juan</i>. Engage the Governor in the event with presentations that honor teams working on coral reef stewardship, educational programs, science achievements etc., and conclude with brief summary of what is being done to and commitment for support of coral reef management. The Governor could give prizes to initiatives by individuals, groups and governmental and nongovernmental organizations that make reef stewardship operational. The publication of updated versions of “Puerto Rico and the Sea: An Action Program for Marine Affairs” (Recommendation 3.4A) could be tied to this annual celebration.</p> <p>Associated PSD Goals: Promotes formal commitment to support all PSD goals Recommended Lead: DNER Coral Reef Committee Potential Partners: All parties involved in coral reef management</p>	<p>Complexity</p>  <p>Time</p>
68	C	<p>Update and Disseminate Revised “Puerto Rico and the Sea”: The DNER-published “Puerto Rico and the Sea: An Action Program for Marine Affairs” is a valuable publication that should be updated and widely disseminated as soon as practical, and should be revised in the future on a regular schedule (e.g. every five years). This publication can serve as a useful vehicle to re-assess the state of the Commonwealth’s reefs and marine resources and can be used as a tool to improve continuity across political administrations and to build political will for marine conservation. Of note were the detailed recommendations that were based on a wide systems view and written by people from within the system who have a far stronger sense of the current reality as opposed to external consultants.</p> <p>Associated PSD Goals: Promotes formal commitment to support all PSD goals Recommended Lead: DNER Potential Partners: CZM Program</p>	<p>Complexity</p>  <p>Time</p>
68	PR 3.6	<p>Broaden Focus of Any Coral-Related Conferences and Symposia: To the extent that NOAA and DNER are consulted or involved in the creation of agendas or conference themes, any managers involved should encourage future symposia and conferences on coral reefs and associated fisheries issues to bring together managers, administrators and stakeholders and not limit presentations and discussion to only “the science.” Use of a common management conceptual framework will increase the quality of panel discussions, simulations and other techniques for instigating exchange and integration.</p> <p>Associated PSD Goals: Improves capacity in support of all PSD goals Recommended Lead: DNER Potential Partners: NOAA CRCP and Caribbean Field Office, Puerto Rico Sea Grant, EPA, USFWS, CLCC and all relevant implementation partners</p>	<p>Complexity</p>  <p>Time</p>

Section One: Introduction

1.1 Scope and Purpose of this Assessment

This capacity assessment is a component of the coral reef management priority setting process facilitated by the NOAA Coral Reef Conservation Program (CRCP) that began in 2009. The stated purpose of this process was “to develop place-based, local coral reef management priorities” for the seven US state and territorial coral reef jurisdictions, including Puerto Rico. In Puerto Rico, these priorities were developed through a series of workshops that culminated in the 2010 publication of “Puerto Rico’s Coral Reef Management Priorities” (henceforth, the “Priority Setting Document” or “PSD”). The PSD includes, in Appendix Three, a brief summary of capacity issues entitled “Preliminary Identification of Capacity Gaps.” In this appendix, CRCP states that the preliminary analysis “will be followed by a more detailed assessment and analysis that will focus on capacity gaps in relation to the specific management goals and objectives that are finalized by the priority setting process.” The primary purpose is to examine capacity in Puerto Rico as it relates to the priorities expressed in the PSD. In September 2011, NOAA CRCP selected SustainaMetric to conduct this more detailed assessment across all seven jurisdictions including Puerto Rico. This report summarizes the findings of our capacity assessment conducted in Puerto Rico between August 2012 and March 2013, including a 10-day site visit to the Commonwealth from October 24 to November 2, 2012 and follow-up site visit in March 2013.

The 2009 NOAA document “Coral Reef Conservation Program Goals & Objectives 2010-2015” acknowledges that while threats to coral reefs are diverse and operate at a range of scales, from local fishing pressures and regional pollution impacts to the global drivers of climate change and ocean acidification, the document concludes that “within each threat...[there is a] common need to select and work in priority coral reef areas to ensure a holistic and integrated management approach to support healthy, resilient coral reef ecosystems.” In Puerto Rico, this directive was expressed by the creation, in the PSD, of goals under three broad “issue areas” (Land-based Sources of Pollution, Fisheries, and Human Impacts) to be addressed primarily at four priority sites (Culebra, North East Reserves, Cabo Rojo and Guánica). In the strictest sense, as envisioned by these high-level CRCP documents (the PSD and the 2010-2015 Goals & Objectives), the scope of our work in the Commonwealth is to assess the capacity to manage coral reefs in Puerto Rico as it relates to the PSD goals and objectives made operational at the priority sites. These goals and objectives were further defined in a Local Action Strategies (LAS) for Puerto Rico prepared in 2011 that is intended to help guide implementation.

That being said, however, we recognize the complexity inherent in managing coral resources and realize that issues are dynamic, uncertain and emergent. As a result capacities are needed to address a range of topics (that require a broad range of competencies and capabilities) and at a variety of scales to adequately address the challenge of managing Puerto Rico’s marine resources. Often, the issues are at scales that go beyond the bounds of individual programs targeted within the priority sites. Indeed, in many cases, we found that many of the practitioners involved with coral reef management in Puerto Rico felt that the PSD and the LAS were unduly restrictive and that they did not adequately encompass the reality of the task of managing coral and other coastal resources across the Commonwealth. One of the challenges of this capacity assessment, which we believe mirrors, in many ways, the challenges of marine and coastal management, has been to balance our inquiry flexibly across multiple scales and

topics with the critical need to preserve focus on the more circumscribed issues laid out by the PSD goals and objectives addressed at the priority sites.

1.2 Our Approach: Ecosystem-based Management

Our approach to conducting this capacity assessment, which we believe aids in creating the required flexibility, is thoroughly described in the document prepared by SustainaMetrix “Coral Reef Management Capacity Assessment Methodology” which was submitted to, and approved by, CRCP in February 2012. Our methodology builds off of a conceptual framework known as “Ecosystem-based Management”, or simply “the ecosystem approach” (NRC, 2008; Olsen et al., 2009; McLeod and Leslie, 2009). This approach has been expressly endorsed by CRCP in its 2010-2015 Goals & Objectives document and in the language included in the preliminary capacity assessment appendices in the jurisdictional PSDs. Simply put, the ecosystem approach acknowledges that ecosystems and the people that live within and in proximity to them, and depend on them for goods and services, must be understood and managed as a dynamically linked, interdependent system. The ecosystem approach requires a fundamental shift that transcends single-species management, as well as the more holistic consideration of larger natural systems (e.g. watersheds, coral reefs), to explicitly include the human and social dimension in the management paradigm. It further accepts that natural and social systems are dynamically linked and that changes in one realm have impacts in the other and that these impacts can include self-reinforcing feedbacks (see Figure 1).

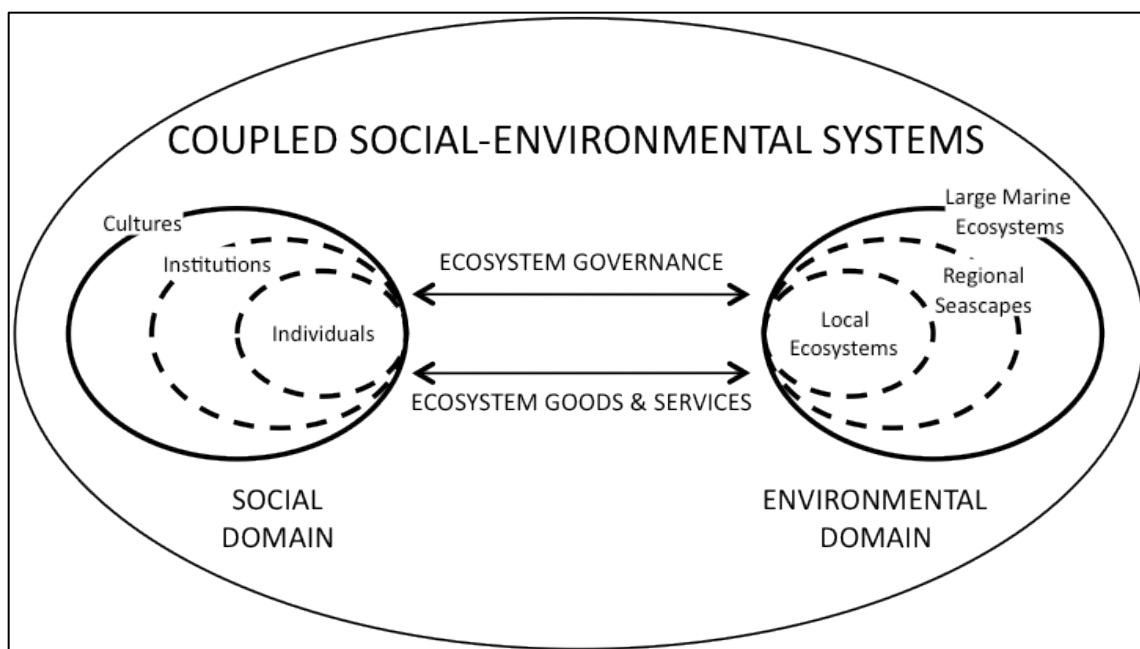


Figure 1: Dynamic human and ecological systems are referred to as “coupled social-ecological systems.” Interactions between the social and ecological domains occur over multiple geographic scales, and understanding connections across scales is critical to long-term success. Figure adapted from McCleod and Leslie (2009).

In our approach to the practice of Ecosystem-based Management, we have complemented a core philosophy with a peer-reviewed set of tools, methods and a common vocabulary. The common vocabulary terms are defined in Appendix B. These methods are designed to be applied in a variety of locations, embracing the local context as well as the complexity and dynamism of the coupled social and natural ecosystem. Our purpose is to help assess capacity of a

given management system's readiness and capability to truly pursue management that is holistic, and that understands, considers and adapts to changes in the coupled human/natural system. Our goal is to provide products and services that have the best likelihood of meaningful success in preserving and enhancing both the natural and social systems being managed. Among these tools are two related frameworks for assessing the maturity of a given program and its progression along a series of steps toward program success, growth and long-term goal attainment. We have designed these to be simplifying frameworks that feature systems thinking and complexity concepts to enhance innovation in management and the use of findings.

The first of these tools is the **Management Cycle** (Figure 2), which gives a clear and straightforward presentation of the main steps through which a program should progress. These steps are:

- Analysis of problems and opportunities (Step 1);
- Formulation of a course of action (Step 2);
- Formalization of a commitment to a set of policies and a plan of action and the allocation of the necessary authority and funds to carry it forward (Step 3);
- Implementation of the policies and actions (Step 4); and,
- Evaluation of successes, failures, learning and a re-examination of how the issues themselves have changed (Step 5).

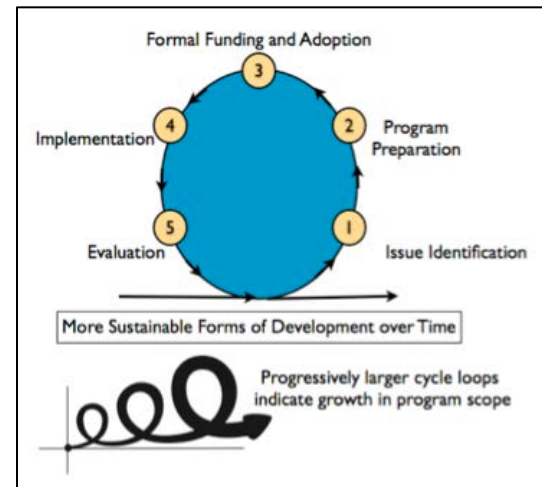


Figure 2: *The Management and Learning Cycle (Olsen et al., 2009).*

These steps are imagined as a cycle, in that evaluation and learning in Step 5 can and should inform a new round of analysis, matching program formulation with the situation and context (ideally more ambitious and innovative as time progresses), the securing of additional formal commitment, new program implementation, followed by reflection and so on. Ideally, thoughtful progression through these linked cycles facilitates true “adaptive management.”

The second tool, **Outcome Analysis**, is envisioned as a complement to the Management Cycle and is intended to help focus analysis clearly on the specific, intended outcomes of programs that seek to work generally to achieve societal and environmental goals. This tool helps to disaggregate and characterize the goals of a program into well-defined “Orders of Outcome” that can be readily discussed, analyzed and compared across disparate settings (e.g. priority areas or the seven US flagged jurisdictions where there are coral reefs). Within the Orders framework, the four Orders of Outcome progress from assembling the enabling conditions for success through to the realization of long-term, sustained social and natural systems health, with two intermediate steps:

- **The First Order:** Assembling the enabling conditions for the successful implementation of a plan of action;
 1. Unambiguous goals that describe both realistic and desired societal and biophysical conditions that may be reached in the near term (such as 5-10 years),
 2. Supportive and informed constituencies for attainment of the desired coral reef management goals,

3. Formal commitment for a desired plan of action to meet the coral reef management goals, and,
 4. Sufficient institutional capacity to implement the plan of action to meet the coral reef management goals.
- **The Second Order:** Successful program implementation resulting in the desired behavioral change of resources users, coral reef managers and funders and administrators of coral reef management that is required to meet the coral reef management goals;
 - **The Third Order:** Achievement of target coral reef biophysical conditions as well as specific societal benefits (e.g. livelihoods generated from commercial and recreational fisheries and tourism, coastal protection, increased property values, increased community resilience) as defined in the First Order; and,
 - **The Fourth Order:** Guiding long-term vision toward sustainable development in Puerto Rico with increased protection and stewardship of marine and coastal resources in order to maximize their benefits over the long term.

While the “Preliminary Identification of Capacity Gaps” presented in the Puerto Rico PSD makes explicit reference to the necessity of assembling the “enabling conditions” for program success, it does not expressly refer to the enabling conditions within the Orders framework. Doing so simply recognizes that assembling the key enabling conditions is a First Order Outcome; that is, there are appropriate first order goals that must be achieved before programs can be mounted that seek to change behaviors (2nd Order), in order to achieve targeted social and environmental outcomes (3rd Order), which can then be institutionalized to achieve a stable, sustainable and healthy social and environmental norm (4th Order). It should also be noted that Appendix Three of the PSD includes supportive and informed constituencies, formal commitment and sufficient institutional capacity as enabling the ecosystem approach to coral reef management. The formulation of clear and unambiguous goals as a key enabling condition is also prerequisite for long-term coral reef management success.

With respect to this (or any) capacity needs assessment, this implies that having the capacity present within an organization (e.g. the Commonwealth’s DNER) is only one piece of a whole that also includes setting clear and realistic goals, having supportive constituencies, and obtaining formal commitment across all levels of the government. This necessitates a broader view of “capacity” beyond the financial, personnel and equipment resources that reside within the target organization.

It is our intent in this capacity assessment to apply these analytical tools to our examination of the coral reef management system in Puerto Rico. While the concepts and vocabulary may be unfamiliar to some, we believe that they provide a clear and well-developed methodological framework for both process and outcomes that will help coral practitioners across the Commonwealth, from local site managers to high-level government officials, clearly evaluate and compare plans and programs that intend on improving social and environmental outcomes. In the remainder of this Section, we briefly review the specific methods we used to gather data about coral management in Puerto Rico and analyzed and integrated it into a coherent description of the problems affecting the system, the “diagnosis,” and generated our recommendations for how to improve it, the “prescription.”

1.3 Our Approach: Adaptive Capacity

While employing the tools and language of Ecosystem-based Management can add great clarity to the process of identifying issues, developing goals and the plans to accomplish them, and engaging in meaningful reflection and learning, it is equally important to recognize that the process is inherently complex, dynamic and highly contextual. Social and environmental conditions are undergoing constant change, and the nature of this change, and how best to respond to it, can vary significantly from place to place. Acknowledging this, and creating robust methods to detect, understand and respond to change in a contextually relevant manner (i.e. “adaptive capacity”) is essential.

Accomplishing this in the complex and multi-level system that exists to manage and protect coral reefs in the Commonwealth of Puerto Rico presents many unique challenges. Building resilient and flexible management regimes that can sense, learn from, and adapt to operational and strategic issues that emerge and evolve at a variety of scales across federal, state and local natural resource management programs (Figure 3) will be critical to long-term, sustainable and successful coral management in Puerto Rico (Armitage, 2005). In the remainder of this Section, we review the specific methods we used to gather data about coral reef management in Puerto Rico and analyzed and integrated it into a coherent description of the problems affecting the system. We review the findings and explain the development of our recommendations for sequencing and prioritizing capacity building activities that meet the management needs as understood from the perspective of adaptive capacity and Ecosystem-based Management.

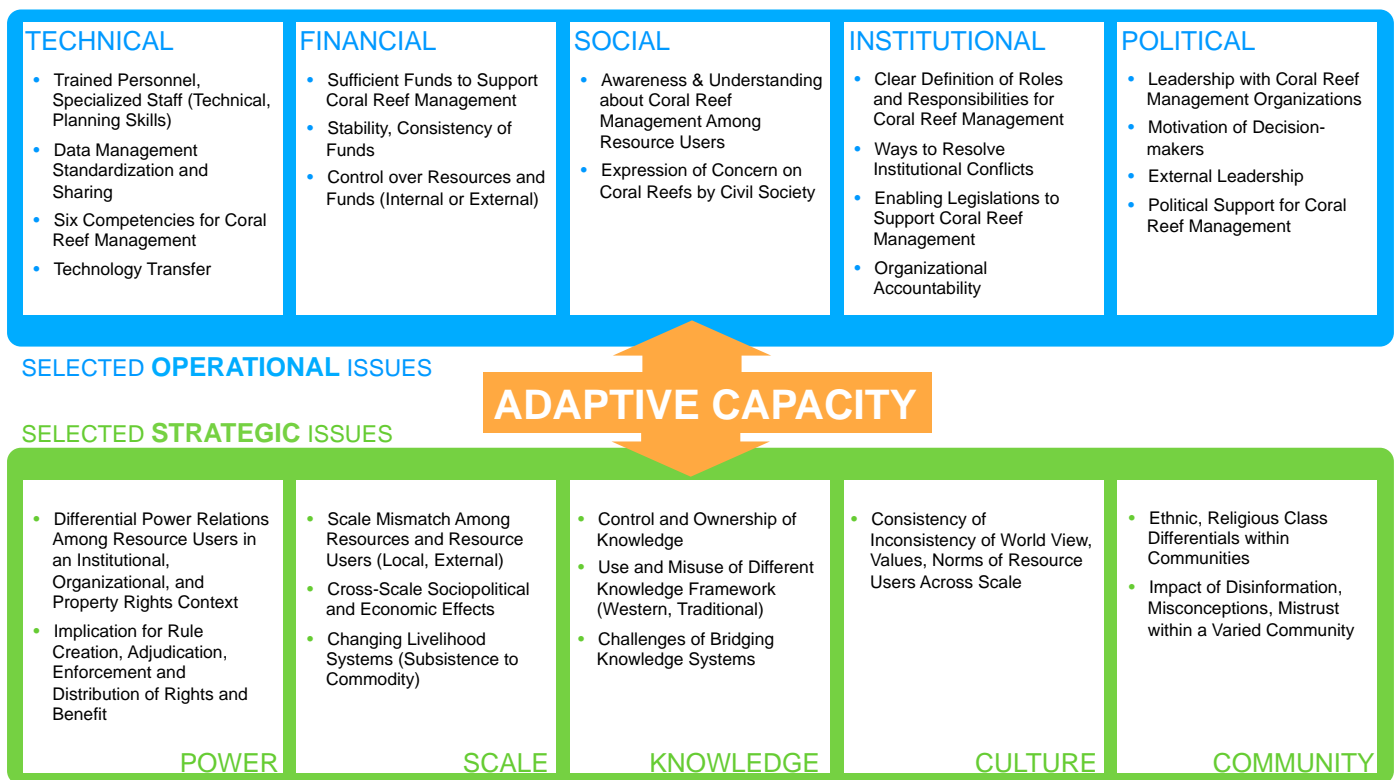


Figure 3: Adaptive capacity diagram displays the dialectic between operational and strategic issues (adapted from Armitage, 2005).

1.4 Additional Capacity Assessment Tools

The capacity assessment work began with a detailed document review and discussions with key NOAA personnel, and continued with in-depth telephone, email correspondence, and extensive in-person interviews and focus groups conducted during a site visit in October/November 2012. After the site visit, the data gathering continued with follow-up interviews, further document review, analysis and synthesis through March 2013 with a wide range of stakeholders throughout the Puerto Rico coral reef management system. The key components of how we gathered and analyzed data and conducted the capacity assessment are summarized below.

J-CAT: As part of the process of inquiry into capacity needs, we convened a small standing committee with in-depth knowledge and deep personal involvement in coral reef management in Puerto Rico that we dubbed the Jurisdictional Capacity Assessment Team, or “J-CAT.” We held six meetings with this group, either by conference call or in person, between August 2012 and March 2013, including one during our October/November 2012 site visit and the final meeting again in-person in early March 2013. We collaborated with J-CAT members during scheduled meetings, as well as on an ad hoc basis, to:

- Share available information at key points in the capacity assessment process;
- Create a shared communications strategy about the capacity assessment process;
- Customize the methods based on local context;
- Coordinate an efficient process of data collection;
- Provide input to assist in prioritizing capacity building needs;
- Analyze and summarize results and recommendations; and,
- Make the overall process as useful as possible.

J-CAT members summarized the experience with largely positive comments particularly noting the huge amount of material gathered for the analysis and learning that occurred during the process. Our goal was to build a high-quality collaborative experience among the consultant team and the J-CAT with a clear beginning, middle and end to our process that provided extensive opportunity for input along the way. This document was developed, carefully reviewed, prioritized and edited in consultation with the Puerto Rico J-CAT.

Analysis of Issues and Potential Projects: The Puerto Rico PSD identifies four primary management targets, referred to as “Issue Areas,” three of which were deemed “priorities”:

- Issue Area 1. Improve water quality and related reef systems by reducing pollutant inputs from terrestrial sources.
- Issue Area 2. Apply immediate protection to commercial, recreational and artisanal coral reef fisheries and related coral ecosystems by employing available and known management tools to protect and conserve.
- Issue Area 3. Reduce those human impacts that are most critical to corals’ protection and health.

- Issue Area 4. Manage for climate change and diseases emanating from increase in storm frequency and impact, water temperature and air pollution and promote recovery of reefs from previous events. [Issue Area 4 was not deemed a Priority Issue Area.]

Under each Issue Area, the document is organized into goal statements, with specific objectives listed under each goal. It also identifies four “high priority geographic areas” at which to apply these goals and objectives. The PSD guided our initial approach to the capacity assessment, essentially framing the assessment in terms of the capacity present in the system to accomplish the goals and objectives detailed in it. From this starting point, we adaptively deployed a set of methodological tools aimed at building our understanding of the system and illuminating current capacity gaps, as well as persistent barriers to building capacity (hereafter referred to as “gaps and barriers”), as they related to realizing the goals and objectives in the PSD. The priority goals as stated in the PSD remain the primary organizing principal of the capacity assessment and this report.

An early step in the capacity assessment was to review the site-based “Local Action Strategies (LAS) for Coral Reef Conservation 2011-2015,” which addresses project plans for the four priority sites. From these plans we developed a detailed matrix, cross-referencing the extensive lists of projects proposed in the plans with the appropriate goal and objective in the PSD, with the goal of investigating the capacity present in the system to execute these projects and achieve the goals and objectives stated in the PSD. It became apparent that the number of proposed projects was vast, many were not yet implemented, (which was not entirely surprising given the relative newness of this document), and that a representative list of active projects were selected for more detailed review to better understand issues related to capacity present in the system to manage coral reefs. We worked with the J-CAT to understand this “project pipeline”, to help illuminate what may be capacity gaps and barriers in the system.

For each project in the pipeline, we identified key contacts and interview strategies to better understand its “performance story.” We prepared detailed qualitative summaries of each interview, coded and collated results, including gaps and barriers under “issue themes.”

Timeline for Coral Reef Management in Puerto Rico: The inquiry also focused on gathering evidence of examples of successes in building capacity for coral reef management which was placed into a timeline that also included biophysical events and other governance and socioeconomic events in order to build a growing picture of capacity to respond to ecosystem change. Appendix A features a detailed timeline of key events affecting coral reefs in Puerto Rico, and their management, some events dating to pre-colonial times but mostly focusing on the time period of the Commonwealth of 1900 to the present. The timeline includes natural events such as large hurricanes and bleaching events, as well as key governance milestones, from political events like the establishment of Puerto Rico as a US territory, to laws and rulings that directly affect coral management. The timeline was based upon our documentation of interviews and anecdotes as well as historical information published about the system from perspectives in social science, humanities and natural science.

Prior to our interviews during the site visit, we printed out, on a long sheet of paper (~10 feet), a physical timeline and brought it with us to meetings during the site visit for review and input. The timeline proved to be extremely popular with interviewees, who often expressed interest in the level of detailed information about reef management over time pulled together in one place. All were encouraged to “grab a Sharpie” and add new events. While such an exercise is never complete as more details can continuously be added, the timeline was developed with strong input across many



Ricardo Laureano of VIDAS (local NGO) adding details to the timeline. Photo credit: Glenn Page, SustainaMetricx.)

stakeholders and features a more complete picture of the development of capacity to manage coral reefs. The timeline not only presents highly useful, contextually relevant information, but it serves as a visual reminder of the wide range of antecedents, actions, and plans that have built the platform for contemporary coral reef management and that current and future managers need to consider these historical antecedents. The timeline also became an “icebreaker” that created an engaging environment within which to conduct our interviews. The final timeline is presented in Appendix A of this report.

The timeline and project analysis reveal that there has been significant capacity built to manage the coastal zone, and more recently coral reefs. However, our analysis revealed a range of management plans that have been formulated and may have received formal commitment, but are not fully implemented. Thus, there is a positive trend for building capacity for integrated coral reef management in Puerto Rico, but also provides evidence of implementation gaps, forces of fragmentation, periods of high and low political will and management capacity, challenges posed by dynamic natural and social systems, and conflicting priorities. These forces constrain institutional capacity building and adaptive implementation of coral reef management and are the focus of this assessment.

Adaptive Approach to Capacity Needs Assessment: Over the course of conducting the assessment and applying the tools discussed above, we adapted our approach due to exigencies on the ground. In some places, and among some actors, neither the PSD, nor the relevant LAS or management plan, appeared to be the key expressed driver of their coral reef management priorities or activities. Furthermore, in some instances, when we investigated the status of a given current project with staff that were thought to be involved in the activity, they were not familiar with it, or dismissed it as something in a document in which they had little investment. Nonetheless, our semi-structured interview approach worked well as we often began inquiring about a specific activity and expanded the scope to include more open-ended dialogue that illuminated gaps and barriers, successes, and more broadly, the current status and context of the coral reef management system in Puerto Rico. Using an adaptive approach to the capacity needs assessment, it became clear that the overarching themes of the PSD were still valid as general categories for the issues analysis and recommendations for a capacity building strategy, although many crosscutting issues were also identified. Finally, we also conducted an analysis of the enabling conditions (1st Order), which includes reflections on what may be needed regarding changes in behavior and social norms (2nd Order) required to effectively build capacity to improve coral reef management in Puerto Rico.

Our investigation of current activities and case studies did yield specific and often detailed information about gaps and barriers to successful implementation of the projects. These findings are not presented here in a project-by-project review, as that would be beyond the scope of this effort. The findings on capacity building needs, as presented here, are therefore informed by:

- A review of dozens of documents relevant to the system (please see Literature Cited and Appendix C: For More Information);
- Over 60 in-depth interviews with key actors in the system (please see Appendix D for full interview list);
- Development of the timeline (Appendix A), case studies and current activities as defined above;
- Our discussions with, and feedback from, the J-CAT;
- Our immersion in and contributions to the professional literature of coastal governance, capacity assessment, organizational behavior and other related disciplines; and,
- Our professional judgment, informed by similar assessments in locations around the world.

Generation and Prioritization of Recommendations: The recommendations presented in this report were generated after careful consideration of the information gathered as described above, and in close coordination with the Puerto Rico J-CAT. SustainaMetrix used the results of this process to present the recommendations in their final, prioritized order as presented in the summary tables in the Summary of Major Findings and Recommendations section of this report.



Black-necked Stilts flying to a wetland destination near Cabo Rojo. (Photo credit: Glenn Page, SustainaMetrix.)

Section Two: The Context for Coral Reef Management in Puerto Rico: Trends and Current Conditions

Assessment of capacity to manage coral reefs in Puerto Rico is highly dependent on the socio-ecological context within which such management is taking place. This calls for an understanding of the pressures on coral reef systems, the current state (condition) and likely trends in the reef condition and comprehension of the larger governance dimensions that are responding to the drivers/pressures and state of the coral reef resource. This consideration of the broader context of capacity for coral reef management is a central tenet of the ecosystem approach. Understanding interactions across spatial and temporal scales is essential to interpreting the context of coral reef management in Puerto Rico. This analysis helps to ensure that recommendations in later chapters of this report are grounded in the awareness that specific attributes and determinants of adaptive capacity may be scale-dependent (Adger and Vincent, 2005), culture and place specific (Adger, 2003), and may involve tradeoffs (Folke et al., 2002; Allison and Hobbs, 2004; Pelling and High, 2005).

In this section we briefly characterize the context for coral reef management in Puerto Rico across these dimensions. We use the term drivers to include natural or human induced factors that cause changes to the state of the reefs of Puerto Rico. Direct drivers unequivocally influence ecosystem processes while indirect drivers cause ecosystem change by influencing one or more direct drivers (Millennium Ecosystem Assessment, 2005). For a more complete review of the ecological system of Puerto Rico, please consult the June 2009 International Institute of Tropical Forestry publication [Guide to the Ecological Systems of Puerto Rico](#) (Miller and Lugo, 2009). For a more detailed summary of reef health please consult the 2008 NOAA technical memorandum [The State of Coral Reef Ecosystems of Puerto Rico](#) (NOAA, 2008).

2.1 Major Drivers of Reef Condition

CLIMATE CHANGE

Climate change is expected to bring increasing ocean temperature and acidity, and the potential for more destructive storms, to the reefs of Puerto Rico in the coming decades. Many impacts of climate change already appear to be affecting the Commonwealth's reefs. The first recorded bleaching caused by elevated shallow water temperatures associated with climate change in 1989 was minor compared to the massive bleaching in 2005 that caused declines in coral cover of 50 -80% in reefs in the 45 – 70 ft range, and caused bleaching down to at least 140 feet (Waddell and Clark, 2008; Appeldoorn, pers. comm.). According to annual DNER reef surveys, corals that survived the 2005 bleaching event continued to decline in health through at least 2007. Since then the annual surveys show some signs of recovery – but often with different types of coral replacing former species. These improvements are seen at stations both within and external to marine management areas and cannot be definitively attributed to coral reef management initiatives. The coral reef monitoring program therefore suggests that impacts associated with climate change, including bleaching events, and changes in reef biota due to disease and regional ecosystem shifts such as the black sea urchin (*Diadema antillarum*) die-off, overshadow localized stresses and threats that can be addressed at the scale of Puerto Rico and its nine nautical mile territorial sea.

LAND-BASED SOURCES OF POLLUTION

Land-based sources of pollution have had a varying impact on health of Puerto Rico's reefs over the past century or more. In the 1920s, Puerto Rico's economy depended primarily on agriculture, principally sugar for export, and the population was dispersed throughout the island with many livelihoods depending on subsistence agriculture on steep slopes. As a result, forest cover was as low as 5% and sediment flows to the sea coast were high. In that period there was no sewage treatment and many settlements discharged raw sewage and other wastewater directly to waterways or the sea. The 1950s saw major investments in industrialization, a large proportion of the population migrated to the United States and the remaining population became increasingly concentrated around San Juan (Miller and Lugo, 2009). In recent decades, land-based sources of pollution have been reduced by investments in municipal sewage treatment facilities, the promotion of shade-grown coffee and by the re-forestation of former agricultural land. Today, approximately 57% of the island is forested and flows of sediment to the sea have therefore likely been reduced from their peak. All in all, we have repeatedly been told that there have been major efforts and advances in reducing land-based sources of pollution flowing to the coastal and coral reefs in the priority areas such as Guánica. However, across the Commonwealth there remain many unpaved roads and other poor land use practices, as well sewage treatment plants with only primary treatment that generate flows of sediment and nutrients to coastal waters, and land-based sources of pollution and sediments remain a major issue in Puerto Rico.

OPEN ACCESS, UNREGULATED FISHERIES

Puerto Rico's fisheries remain deeply depleted and generally poorly controlled. The current estimates are that there are approximately 800 commercial fishers and over 200,000 recreational fishers (Matos-Caraballo and Agar, 2011). Despite a sequence of laws and the promulgation of associated regulations over marine fisheries, Puerto Rico's commercial and recreational fisheries remain essentially open access and unregulated, sale of fish by "recreational" fishers is common and a large poacher community operates with near total impunity. As a result, the pressure on reef fish is intense from a combination of spear fishing, hook and line angling, gill nets, trammel nets and the traps that are the major gear of the commercial fishery. Beginning in the 1980s, recreational and commercial fishers began identifying spawning aggregations of many important reef species and this has made it possible to remove large proportions of important populations with great efficiency. As discussed in more detail in Section Three, there is little enforcement of fisheries regulations, including the implementation of the "no-take" areas in marine reserves and the many regulations over fishing gear, minimum sizes, catch limits and closed seasons. The result is the rarity of large fish and the very low numbers of herbivorous fish on coral reefs. The problem of the reduction in herbivorous fish is amplified by the slow recovery of *Diadema antillarum* in deeper waters following the wide-scale coral die-off in the 1980s. These issues, coupled with increased nutrient inputs from land, contribute to the proliferation of macroalgae competing with corals for substrate.

PHYSICAL DAMAGE TO REEFS

The enormous increase in recreational vessels since the 1970s has contributed to an increase in physical damage to reefs that is another significant, but more localized, cause of reef degradation. The most popular anchoring areas on Culebra on a summer weekend, for example, may contain over 200 boats ranging in size from small runabouts to large yachts. These numbers far exceed the capacity of the mooring buoys (where they are present) and lead often unskilled boat handlers to illegally drop anchor on coral or seagrass beds or to tie up to mangrove trees. Since there are no limits to the numbers of boats that can enter such popular sites, damage from anchors and groundings, though usually

individually small, have a cumulatively significant impact in some areas. In addition to anchor damage, the physical trampling of reefs, including frequently by octopus fishers, is another source of potentially serious, but generally localized, damage to reefs. The general impression gained from those interviewed is that the impacts of groundings of boats and trampling, while significant in some places, are less important than fishing pressure and land based sources of pollution.

2.2 Recent Shifts in the Condition of Puerto Rico's Reefs

Puerto Rico has a linear coastline of 620 km, surrounded by over 5,000 km² of shallow coral reef ecosystems. In the 1970s the reefs within Puerto Rico's nine nautical mile territorial waters were nearly all considered to be in good to excellent condition. Degraded reefs were highly localized and damages were attributable to dredging and other harbor related physical disturbances and to localized water pollution problems linked to sewage outfalls and sediments discharged by rivers and streams. Among the scientists interviewed there is agreement that the dramatic losses in the condition of shallow water (to roughly 100 foot depths) coral reefs that began in the 1980s have been caused by regional and global drivers of ecosystem change, including climate change, that operate at scales beyond what can be influenced by the Commonwealth. Regional drivers include high population density and land uses that have resulted in harmful impacts to coral reefs by sedimentation, eutrophication, and pollution, further compounded by algal growth and overfishing. Physical damage has also contributed to the declining health of the reefs. According to NOAA's Coral Reef Information System, "overall, approximately 93 percent of Puerto Rico's coral reefs are rated as threatened, with 84 percent at high risk and therefore among the most threatened in the Caribbean" (NOAA's Coral Reef Information System). The first big impacts came from intense hurricanes in 1970s, 1980s and 1990s, including David in 1979, Hugo in 1989 and Georges in 1998. These storms brought extensive physical damage to shallow reefs. Damage to the reefs was exacerbated by worldwide disease outbreaks and a very major shift in the ecology of reefs when black sea urchin populations collapsed throughout the Caribbean region in 1983.

The largest concentrations of remaining coral reefs are found in the southwest (areas offshore of Cabo Rojo/La Parguera) and the northeast (areas offshore Fajardo to Culebra and Vieques) and the many small islets located east toward the U.S. Virgin Islands (Miller & Lugo, 2009). The two largest areas of the insular shelf are west of Boquerón, where it extends for 22 kilometers (13 miles), and east of Fajardo, where it extends to St. Thomas in the U.S. Virgin Islands. There are numerous well-developed reefs in the eastern area around Vieques Sound and on the line of fringing reefs that run along a narrow 18-mile submarine ridge from the northeastern tip of Puerto Rico to Culebra in an east-southeast direction. In the 2008 State of Coral Reef Ecosystems of Puerto Rico, deeper "mesophotic" reefs were described at depths of 90-200 feet at Isla Desecheo and at Bajo de Sico in Mona Passage. These reefs may be protected from the land-based sources of pollution and can

Summary highlights of changes in coral reef conditions in Puerto Rico:

- 1979-98: Major hurricanes cause extensive damage to staghorn and other corals.
- 1983: Black sea urchin (*Diadema antillarum*) mass mortality event.
- 1989: Coral disease outbreaks worldwide.
- 2005: Catastrophic bleaching event.
- 2007: State of coral continues to decline.
- Post-2007: Incipient signs of recovery.

serve as essential habitats for large commercially exploited fish populations and “can serve as recruitment habitats for a variety of shallow reef fish populations” (García-Sais et al., 2008).

2.3 Trends in the Societal Connection to, and Use of, Coral Reefs

Human population in Puerto Rico has increased dramatically over the past 100 years (Figure 4) and remains a major driver of ecosystem change across the territory. At about 3,500 square miles, Puerto Rico is smaller than all but two US states (Delaware and Rhode Island), but its population density of 418 people per square kilometer is higher than all states except New Jersey, and is higher still in the flatter coastal zone. Adding to the population pressure of its approximately 3.7 million residents, another almost five million tourists visit the island annually (US Census, 2010). Population growth has slowed in recent decades (Figure 4), and even declined in recent years, although some estimates put the population at well over 4 million by 2020.

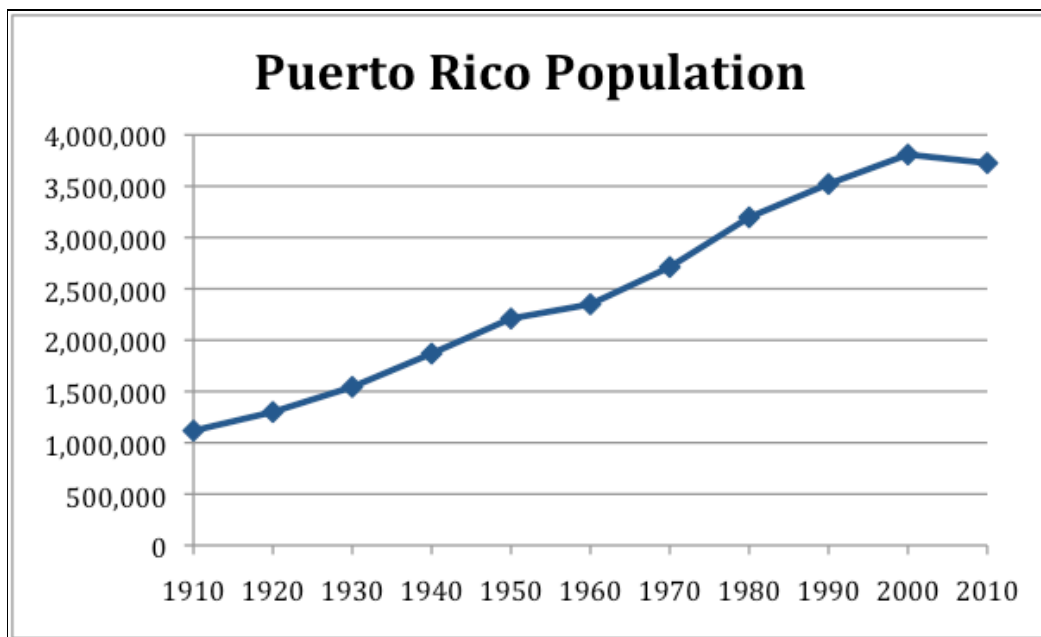


Figure 4: Population increase in Puerto Rico over the previous century (adapted from US Census data, 2010).

Several interviewees shared that Puerto Rico is not a maritime society and that “Puerto Ricans turn their back to the sea.” While early inhabitants likely relied on the reefs for food security, cultural traditions, navigation and more, today we are told people are increasingly disconnected from the reefs and their health. From food preference (we were told many Puerto Ricans prefer beef, pork and chicken to fish) to health concerns (i.e. fear of sharks, drowning, lionfish etc.) there exists a general sense of disconnection from the reefs. When probing for the resistance in the legislature towards rules and constraints on fishing, some interviewees offered that the common perception is that the ocean is very big, that fish are abundant, that the potential for severe overfishing is exaggerated and that fishing is an important option for poor people who struggle to feed their families. It is also clear that the shore and shallow coastal waters are a primary target for recreation, vacation homes and off-island tourists. The greater prosperity of many Puerto Ricans, combined with major influxes of tourists, have produced a surge in the construction of vacation homes and hotels along the coast. The number of recreational boats and recreational fishers have increased over the past 20 years, all leading to increasing pressure on coastal resources. However, despite these trends, several interviewees noted that

there is a growing reservoir of public awareness about the pressures on fish, seagrasses and corals, and that the potential for support for more effective forms of management is slowly increasing in the Commonwealth.

2.4 The Governance Context for Coral Reef Management

Puerto Rico's sovereign boundaries were negotiated as part of the Organic Act of 1917 (Jones Act) and later confirmed by US Congress in 1950 in the Puerto Rican Federal Relations Act. This was later amended in 1980 and upholds sovereignty that extends seaward nine nautical miles and includes submerged lands, coral reefs and territorial seas. The Department of Natural and Environmental Resources (DNER) was established in 1972 as the lead institution responsible for the administration of many of the laws concerned with environmental quality and the management of natural resources of the Commonwealth of Puerto Rico, including the 9 nautical mile territorial waters. As was noted in the 1999 Report to the Governor entitled "Puerto Rico and the Sea," published by DNER, "The main problem related to coastal zone management is the enforcement of the fragmented coastal zone laws, rules and regulations." The Secretary of the Department is a member of the Governor's cabinet and is a political appointee, as are the most senior members of the Secretary's staff.

The laws administered by DNER that are most relevant to the management of coral reefs are:

- Law #147 of 1999 concerning the protection, conservation and management of coral reefs;
- Laws #278 enacted in 1998, and #115 of 1999 concerning the regulation of fisheries; and,
- Law #23 of 1972, that provides the Department with a role in the permitting of various forms of construction that can contribute to land-based sources of pollution,
- Controls over development in the coastal zone are based on the Spanish Harbor Act (Law #6 of May 1886) which was confirmed by Section 8 of the Foraker Act in April 12, 1902 and Article 57 of the Jones Act on March 2, 1917; the US Coastal Zone Management Act of 1972, The Planning Board Organic Act (Law #75 of June 24, 1975); and the Organic Act of the Department of Natural and Environmental resources (Law #23 of June 23, 1972).

While fragmented and legislated for different purposes, these laws could provide the institutional and legal basis for an effective coral reef management program. However, in order to become fully operational all such laws require that the DNER develops and formally adopts the regulations and procedures by which they will be implemented. This rulemaking process requires consultation with other institutions of government and the public through hearings. As shown by the timeline, in many instances the rulemaking process has occurred several years after legislation has been enacted or not at all. The rulemaking process for the coral reef conservation law (Law #147), for example, has not yet culminated, though the process is currently underway. The regulations for fisheries Law #83 enacted in 1936 were not promulgated until 1988. Similarly, the regulations for Law #115 on the licensing of recreational fishers may be approved and made operational in 2013, fourteen years after the legislation was enacted. This reinforces the impression that the Department has not viewed rulemaking as a priority and has been reluctant to assume regulatory responsibilities.

LAW #147 OF 1999: CORAL REEF PROTECTION, CONSERVATION AND MANAGEMENT

This is comprehensive legislation that could provide the core for a Puerto Rico Coral Conservation Program. It has not successfully completed the rulemaking process but progress is underway. This legislation requires:

- The Secretary of DNER to prepare a coral reef management plan [for corals within the territorial sea],
- Regulations and procedures to specify appropriate uses of coral reefs and mechanisms for their protection, conservation and management,
- Impact assessments for activities that have the potential to damage coral reefs,
- Adoption of land use zoning plans for developments near reefs,
- Restoration of reefs impacted by vessel groundings,
- Fines (of \$500 to \$10,000) for non-compliance with rules, and
- Delivery of an intense public education program.

LAWS REGARDING THE REGULATION OF FISHERIES

The first legislation on the regulation and promotion of commercial fisheries was enacted in 1936 as Law #83. Adopted as a response to the great depression, it was designed to promote commercial fisheries as a source of employment and economic development. This very basic law did not establish any criteria for determining who qualified as a commercial fisher, and did not recognize the concepts of recreational fishing or aquaculture. Today the central legislation is Law #278 enacted in 1998 and made operational by regulations adopted in 2004 and 2010. Further refinements are slated for 2013. Law #278 of 1998 provided DNER with a mandate to revise the regulations governing commercial fishing licenses, gear restrictions, size limits and closed seasons for various species of fish and shellfish. Law #15 of 1999 provides for recreational licenses. The rulemaking and design of this law has been subject to many delays and difficulties in designing a viable recreational licensing process with a variety of issues including determining a fee structure for different age groups and sales through sport shops. The system software to issue licenses is complete and it is anticipated that the recreational licensing program will go into effect in 2013.

ENFORCEMENT

The DNER Ranger Corps was created in 1977 with the enabling legislation of Law No. 1, p. 533, § 4, June 29, 1977 and further defined through Law No. 320, § 1, December 24, 1998. It is important to note that this program began several years after the creation of the Department of Natural and Environmental Resources whereby the chain of command, associations, etc. within the DNER were already established. At the time, we were told, the DNER Ranger Corps was seen as "something else" and not fully integrated from the start, even though there were and are many excellent enforcement personnel within the Corps. From our interviews, we heard that the DNER Ranger Corps was established specifically for the purpose of dealing with the very serious issue of extraction of sand from dunes and beaches and for getting under control the proliferation of and abuses that occurred with quarries. That is, it was created as a terrestrial resource enforcement group, and was very much isolated from the Department from the start. The results of this isolation and original focus seem to persist to this day. Efforts to integrate more effectively have been initiated but remain a persistent challenge. Nevertheless, enforcement of DNER regulations is expected to be carried out by the DNER Ranger Corps that in recent years has had a complement of about 420 armed officers. DNER has an internal judicial process for processing sanctions issued by Rangers for non-compliance with DNER regulations. The procedure calls for the Ranger to file a report with the Department's legal office, detailing the offense, the associated evidence and assessing the severity of the violation. A Departmental administrative judge schedules a hearing that the person sanctioned, and typically his or her lawyer attend. In some cases the Ranger, or the Departmental biologist who may have prepared the report on the infraction, will be present. The proceeding allows

for both parties to present evidence and defend their positions. The judicial officer then sets the penalty or dismisses the case. This can be a complex process that, in some cases, can last as long as three years. The Rangers also enforce boating safety regulations. These are administered external to the Department, by the judiciary, and follow a more simple and direct procedure whereby the Ranger applies a pre-defined fine for the infraction(s) identified. The appeal process is far less complex and this difference in due process will be further explored in following sections. Finally, the DNER Ranger Corps is tasked with providing support to the Puerto Rico Joint Forces of Rapid Action or Fuerzas Unidas de Rápida Acción (FURA), which may reduce its capacity to enforce natural resource violations.

As noted above, the governance of the territorial sea is primarily the responsibility of the Commonwealth but cooperative agreements with federal agencies provide for various forms of support and additional sources of funding. The Joint Enforcement Agreement with the National Marine Fisheries Service (NMFS), for example, in recent years has provided approximately \$200,000 annually for funding the DNER Ranger Corps and jointly conducted patrols that extend out into federal waters, with the agreement that minor cases will be addressed administratively in DNER.

DNER ORGANIZATIONAL STRUCTURE

The Department of Natural and Environmental Resources is the primary natural resource agency in Puerto Rico and is a prime focus of this capacity assessment. While there are many other implementing organizations that are critical to coral reef management, and to building capacity for improved coral reef management, the DNER is the responsible agency within the Commonwealth to oversee management actions. The organizational structure of the agency is relevant to many aspects of how capacity to manage coral reefs is distributed in Puerto Rico. The organizational structure is dynamic so when asked for a copy of the organizational chart, it was not surprising that one was not readily available. However, in our attempt to understand the organizational structure, we attempted to create a chart based upon current conditions as of March 2013 with significant input from members of the J-CAT (see Figure 5). This is particularly true for how enforcement effort within the DNER Ranger Corps is apportioned to the various divisions within the program's purview, which is discussed in detail in Section Four.

RECENT REDUCTIONS IN DNER PERSONNEL

In 2007, under the administration of Governor Aníbal Acevedo Vilá, the staff of the Department was approximately 2,000. The DNER Ranger Corps added another 420 personnel. In a dramatic move to reduce the size of government, in 2010 Governor Luis Fortuño, made an early priority of his administration the passage of Law #7 that resulted in a 12% reduction in all governmental personnel. By 2010, the staff of the DNER had been reduced through Law #7 and incentives for early retirement by approximately 70%. There were, however, no significant reductions in the DNER Ranger Corps, that was excluded from the effects of Law #7. Such drastic cuts have affected both the morale and the capacity of the Department.



DNER Ranger Corps Logo

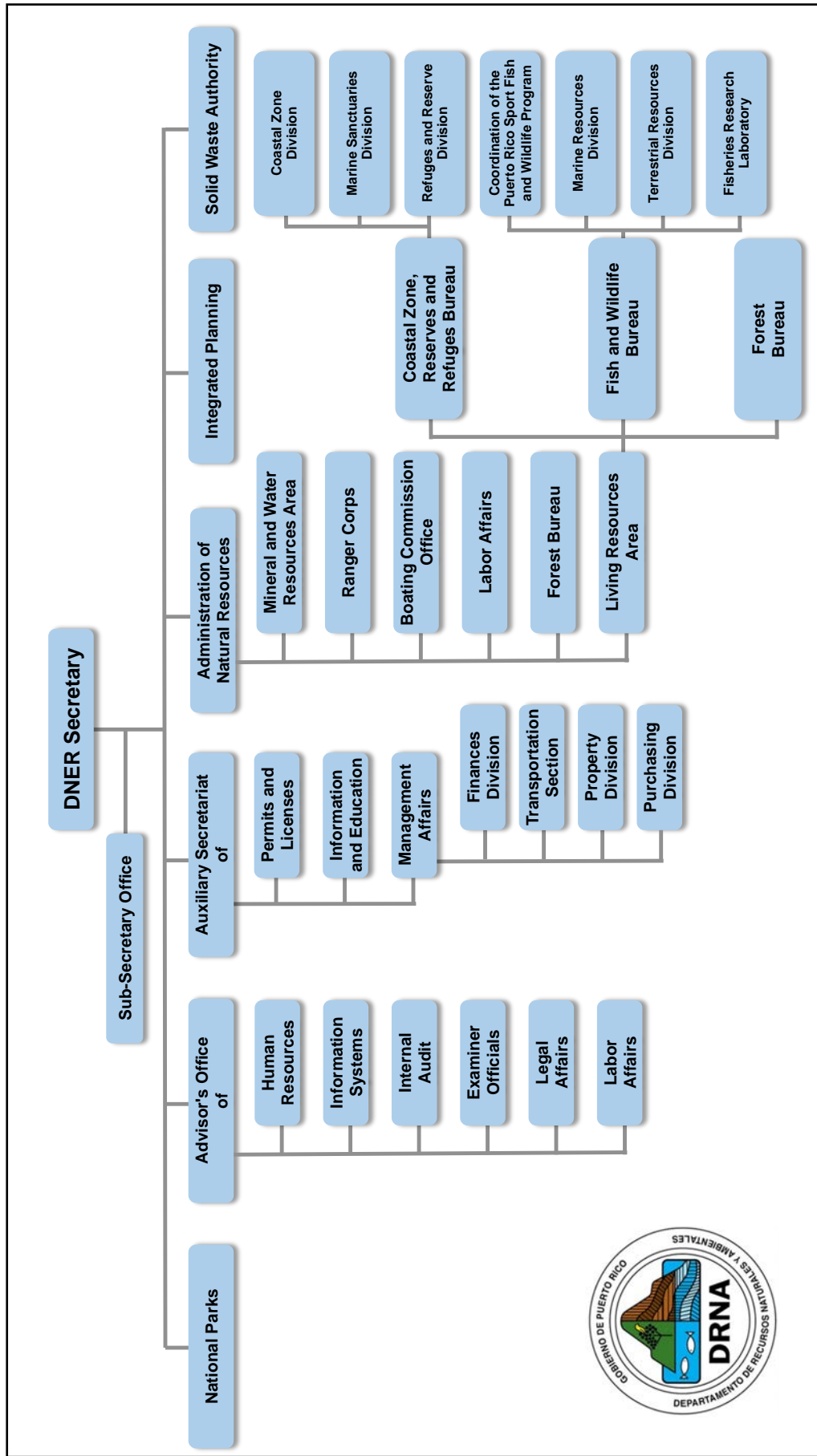


Figure 5: Organizational Structure of the Department of Natural and Environmental Resources (compiled with the assistance of C. Libyestrom, PR DNER).

Section Three: Process and Outcomes for Building Adaptive Capacity

3.1 Introduction

In this section we consider both “Process” and “Outcomes” analysis as tools to foster the building of adaptive capacity for the management of coral reefs in Puerto Rico. For analysis of management process we apply the management cycle and for outcome attainment we apply the Orders of Outcomes frameworks described in Section One of this report. These conceptual frameworks are applied to recent past and current coral reef management in Puerto Rico to help shape capacity building recommendations for the future. Ideally, we would hope to see progress in building adaptive capacity at the scale of the Commonwealth, led by DNER as one major track and supported by a range of government and NGO partners. That track is complemented by a number of supporting coral reef management initiatives at the local scale, a second track. This “two track” approach is a structure that builds both top-down and bottom-up support for coral reef management.

As laid out in the Orders of Outcome framework (Section 1.2), the assembly of the four key enabling conditions at the scale of the Commonwealth, that in turn supports and encourages effective expressions of coral reef management at local scales, is essential to success. The basis of this argument is included in Appendix Three of the Puerto Rico PSD. Once the enabling conditions are in place, the expectation is that local level management strategies would proceed through the issue analysis, planning and formal commitment steps of the management cycle (Steps 1 through 3), and make the transition to the implementation of a local management plan (Step 4) that over time generates tangible evidence (Step 5) of effective coral reef management. Conditions in Puerto Rico demonstrate that the key capacity issue is the implementation gap – the difficulties of making a successful transition from analysis to implementation of a formally approved management plan, supported by the necessary rules, incentives and enforcement tools that make effective coral reef management viable. The following section briefly examines this situation first at the scale of the Commonwealth and then at the scale of local area coral reef management initiatives. We then make a similar review of the conditions at the two scales as they apply to the Orders of Outcomes framework in order to provide an overarching lens for both process and outcomes to build capacity for coral reef management.

3.2 Status of Coral Reef Management in Terms of the Management Cycle

At the scale of the Commonwealth, an early threat to coral reefs recognized by the Commonwealth government was the breaking of reefs for sale as souvenirs to tourists. In 1979, DNER adopted rules that prohibited this practice and they were successfully enforced. In 1994, DNER recognized the damage caused by the anchoring of recreational and commercial dive boats on reefs and instituted a mooring buoy program. Enforcement was initially successful. These initial DNER efforts completed the sequence of issue definition, formulation of a plan of action, formal adoption and rulemaking, and implementation of the plan of action that constitute Steps 1 through 4 of effective coral reef management. These actions were taken through DNER authorities as defined in 1972 and did not require additional legislation. To our knowledge, formal evaluation or assessment (Step 5) has historically been rare in the Puerto Rico coral reef management system, and when it has occurred, it has been less structured and not well documented.

Work on a comprehensive coral reef conservation and management strategy that built upon the successful responses to these initial issues culminated in the formulation of Law #147, the Coral Reef Protection, Conservation and Management Act, that was enacted by the legislature in 1999. This legislation provides a powerful mandate for a coral reef management program (Step 3) at the scale of the Commonwealth. However, to become fully operational, Law #147 requires that DNER propose the rules and procedures by which it will be implemented, and subject them to the scrutiny of fellow institutions and the public. Fourteen years later, and despite several attempts, this crucial step has not been fully realized as a mandate from the Legislature and then signed by the Governor.

As outlined in Section Two, the Commonwealth has made a series of legislative initiatives to regulate fisheries and a sequence of regulations have proceeded through the rulemaking process. In addition, marine reserves (there are two marine reserves in Puerto Rico, Desecheo Island and Luis Peña Channel) have been formally designated, some of which include no-take areas where all fishing is prohibited¹. These fishing regulations and no-take areas would make a major contribution to coral reef management if they were effectively enforced. Their enforcement, however, is frequently described as lax as compared to cases relating to infractions such as vessel operation, vessel navigation or illegal parking.

DNER is responsible for the management of 25 areas with marine components that include natural reserves, marine reserves and a Commonwealth forest. Management of the natural and marine reserves is under the aegis of the Natural Reserves and Commonwealth Forests Divisions of the Bureau of Reserves, Refuges and Coastal Resources of DNER. The Forestry Bureau of DNER manages the Commonwealth Forest. The Puerto Rico Conservation Trust administers and manages additional sites across the island (www.mpa.gov/helpful_resources/states/puerto_rico.html). On the terrestrial side, efforts to control and reduce land-based sources of pollution damaging to coral reefs include the designation of a variety of protected areas, preparation and adoption of watershed management plans and investments in sewage treatment. These are widely believed to have achieved varying degrees of implementation, but their impacts on coral reef conditions are difficult to quantify and are thought to be localized.

At the local area scale the same pattern is repeated. Many, independent and unconnected projects, funded largely by the NOAA Coral Reef Conservation Program, are being undertaken in the form of research projects, monitoring programs and public education campaigns. Management plans have been prepared for five reserves (see footnote below). These plans include myriad specific projects aimed at reducing a variety of threats to coral reefs, including land-based sources of pollutants and sedimentation, overfishing, and physical damage, as well as improving public behavior through education and outreach. However, while there is a growing number of management plans, they are often not supported by strong and enforceable rules or regulations nor is there generally adequate staff resources in place to accomplish their ambitious, multi-faceted agendas. Relevant research, monitoring and public education may be undertaken, but often without a discernible strategic sequence. The plans do typically describe and document reef conditions, identify threats and provide a “vision” for desired conditions and intensities of human use, but absent the adequate capacity or regulatory authority to implement, they are not a basis for effective management and have not brought changes in how human activities in these areas are conducted and have had little impact on threat reduction.

¹ It is our understanding that there are only two officially designated marine reserves in Puerto Rico, Desecheo Island and Luis Peña Channel. Many of the sites with a terrestrial and marine component are actually classified as natural reserves not marine reserves. Management plans have now been developed for the following 7 reserves: Luis Peña Channel in Culebra, Cordillera Reefs, Vieques, Tres Palmas in Rincon, Mona Island, Desecheo Island and Caja de Muertos. Many of these sites were identified as priority coral reef reserves by DNER managers. Only 2 of these management plans have been officially approved by DNER and the PR Planning Board, Tres Palmas and Luis Peña. Please see more info on MPAs in Puerto Rico in Wusinich-Mendez, D. and C. Trappe (eds.). 2007. Report on the Status of Marine Protected Areas in Coral Reef Ecosystems of the United States Volume 1: Marine Protected Areas Managed by U.S. States, Territories, and Commonwealths: 2007.

It is important to note that the Guánica Bay Watershed Management Plan is an example of a sound management plan and does feature many of these elements and could potentially be a model for planning that informs strategy. However, the situation remains that there are numerous plans that do not move into implementation and the implementation gap is the dominant feature of the coral reef management cycle at both the Commonwealth and local area scales and capacity building recommendations are directed at closing that gap.

3.3 Status of Coral Reef Management Using the Outcomes Framework

The abundant evidence of the implementation gap suggests that the 1st Order enabling conditions for effective coral reef management in Puerto Rico – unambiguous goals, supportive constituencies, high-level commitment and adequate capacity - are not sufficiently present to enable effective implementation. The 4th Order is the definition of the long-term conditions and priorities of a governance system and defines the degree to which economic development, conservation and/or sustainable forms of development guide development and the processes of governance. It would appear that from the early 1970s when DNER was created and through the 1990s, a conservation ethic and significant investments in science as a basis for environmental planning and decision-making was a central theme in DNER and this was supported by the legislature. Many of those interviewed spoke of a shift in the first decade of the 21st century in which DNER leadership placed a greater emphasis on the use of the Commonwealth’s natural resources and income generating strategies and less emphasis on conservation and restricting human activities in designated protected areas.

Law #147 states that it is the policy of the Commonwealth,

“to protect, preserve and conserve the coral reefs along the territorial waters of Puerto Rico for the benefit and enjoyment of this and future generations. It is furthermore hereby stated, that the public interest demands that the continuous and irreparable damage to the coral reefs and its associated marine life be avoided and prevented. The Department of Natural and Environmental Resources shall promote the development of sustainable management plans for the coral reefs of Puerto Rico.”

This statement may be considered the definition of the 4th Order goal for coral management by the Commonwealth.

As discussed above, the 2010 PSD identifies four primary management targets, referred to as “Issue Areas,” three of which were deemed “priorities”: LBSP, fisheries and “human impacts” to reefs. These priorities were “developed in consensus by coral reef managers.” The fourth concerns responding to climate change which was not identified as a priority issue area. The PSD neither attempts to define the coral reef conditions and qualities that management efforts are designed to achieve, nor does it attempt to define the associated desired forms and intensities of coral reef use by society and the goods and services that healthy reefs could generate. In terms of the Orders framework, the 3rd Order goals therefore remain undefined. The emphasis is upon the 2nd Order modifications to human activity that are viewed as the priorities for coral management initiatives in Puerto Rico. Under the three priority Issue Areas, the PSD includes a total of eight priority goals that should be accomplished to achieve the larger goal identified by the issue statement. These goals are all essentially 2nd Order outcomes (human behavior change) and have a considerable degree of overlap and redundancy, and can be simplified and consolidated as follows:

- Issue Area 1: Land-based sources of pollution:
 - implement land use planning at the watershed scale,

- control and reduce pollutant transport to the marine environment,
- enable and promote sustainable development practices in the upland and coastal zone associated with priority coral reef areas, and
- strengthen enforcement.
- Issue Area 2: Fisheries:
 - enhance enforcement and management programs to encourage compliance with fishing regulations and reduce fishing impacts.
- Issue Area 3: Human Impacts:
 - manage uses and impacts that [directly] affect coral reefs [such as vessel groundings and shoreline construction].

The 1st Order (enabling conditions) priorities associated with these goals are limited to “education to encourage public compliance with fishing regulations” and an “informed planning process to protect coral reefs from large and small scale fisheries impacts.”

Local Action Strategies: These were developed in 2011 through a series of workshops held in each of the four priority areas identified in the PSD. The four workshops drew together those with interests and involvement in coral reef management and produced a list of 80 potential projects that could be expressed at one or more of the priority sites. The goals identified for each of the priority areas are consistent with those set forth in the PSD and address land-based sources of pollution, fisheries and physical damage to reefs. The re-ordering and re-phrasing of the priority goals in the Local Action Strategies did not produce any specific 3rd Order targets for the conditions that management hopes to achieve. Nearly all of the proposed projects could contribute to the assembly of the 1st Order enabling conditions and could be contributions to the planning phase of local area management (Step 2 of the Management Cycle). The proposed projects may be grouped as follows:

- Documentation and identification of reef related conditions: 2
- Baseline assessments and monitoring: 15
- Research: 18
- Planning: 16
- Public education: 11
- Training: 5
- Interagency collaboration: 2
- Entries identified as a broad topic rather than a project: 4

Eight of the proposed projects can be classified as implementation actions (Step 4). None of these, however, make reference to the implementation of a management plan or regulations. They call for the application of best management practices (associated with land-based sources of pollution) and the construction of facilities such as a public bathroom or an education booth. It is notable that none of the numerous projects listed refer to the preparation or approval of a place-based management plan nor the enforcement of existing regulations.

3.4 The Current Status of the 1st Order Enabling Conditions

Past and current conditions in Puerto Rico directly relevant to coral reef conditions and management described in Section Two and the above application of process and outcome organizing frameworks lead to following assessment of the 1st Order enabling conditions for coral reef management.

- *Unambiguous goals define desired coral reef conditions and intensities of use.* While the long-term goal and mandate for coral reef conservation and management in Puerto Rico as stated in Law # 147 sets an unambiguous 4th Order standard, the failure to proceed through the rulemaking process makes it an unfulfilled mandate. There is no document that sets specific 3rd Order goals that define the coral reef conditions that management should be working to achieve. The many 2nd Order goals and objectives listed in the Priority Setting Document and Local Area Strategies, if acted upon, would provide targets for an ambitious, multi-dimensional management scheme. The problem is that the goals and objectives are organized by the major drivers of coral reef degradation at the scale of the Commonwealth but not in a sequence that could guide the assembly of the necessary research and the negotiation of a plan of action that could win formal approval and culminate in an implementable plan with both the “teeth” and the incentives that would promote voluntary compliance. Neither the PSD nor the LAS can be considered a strategic guide to an inclusive process with a clear sequence and implementation priorities, nor are there documents that guide how to measure performance through outcome attainment. They are not operational and they are widely perceived as “another document” and not as the basis for a collective commitment to formulate the management plans designed to address the causes of poor reef conditions. Several of those familiar with the content of the PSD and LAS stated that they did not agree with the goals as identified or do not find them helpful.
- *Informed and supportive constituencies for coral reef conservation.* The many individuals and institutions with interest in coral reef conservation form a significant and diversified constituency for more effective management. These include those who benefit from, and are aware of, activities related to coral conservation and management. We conclude that there is also a far larger constituency within the public including the hundreds of thousands of Puerto Ricans who enjoy recreating at the shore, boating and recreational fishing. This largely untapped constituency includes fishers that advocated for establishing the initial marine reserves and have complained of the lack of enforcement in such high priority sites as Mona Island and Luis Peña Channel.
- *Capacity to implement coral reef management plans and rules.* There is abundant capacity in Puerto Rico that could be channeled to produce effective coral reef management. There is a community of natural and social scientists associated with the universities, several governmental agencies and the NGO community that are experienced in aspects of coral reef management and would be willing and able to contribute to a well designed and effectively lead coral reef management program. There are experienced and highly competent managers of protected areas, many now nearing retirement, who could play important roles in training and mentoring the next generation of managers. The DNER Ranger Corps has the staff and the equipment that could be far more effective in implementing existing regulations if fundamental problems in its procedures and leadership were addressed. Because these many resources are fragmented, morale is

low, and there is no overarching strategy that has the support to draw together these resources, the challenges of strengthening capacity are complex and seemingly intractable.

- *Governmental commitment to coral reef conservation, protection and management.* It is widely perceived that recent DNER leadership, as well as leadership at higher levels of the territorial government, does not see coral reef management as a priority. Many believe that over the last several years the leadership has actively discouraged initiatives that have attempted to improve management and promote coral reef stewardship. This perception is supported by the resistance to proceeding through rulemaking for the Coral Reef Conservation and Management Law, the slow pace in fisheries rulemaking, the lack of meaningful investment of Commonwealth funds in coordinating coral reef management activities through the internal coral reef committee and the dormant state of the interagency committee. Several of those interviewed remarked on resistance within the legislature to any attempts to limit fisheries. Apparently many legislators believe that fish are abundant and that fishers are relatively poor people engaged in a precarious livelihood that should not be hampered by unnecessary regulations. We conclude that the absence of high-level governmental support for effective coral reef management is the root challenge in Puerto Rico and capacity should be directed at both the process and intended outcomes that would enable more effective coral reef management. The recent appointment of a new DNER Secretary and the election of a new governor with a strong conservation agenda presents an important window of opportunity to increase formal commitment across the government of the Commonwealth.



Legacy of military activity still visible on the reefs off of Culebra. (Photo credit: Glenn Page, SustainaMetric.)

Section Four: Capacity Building Recommendations for More Effective Coral Reef Management in Puerto Rico

4.1 Scope of Available Financial Resources

An assessment of capacity building needs for coral management in Puerto Rico has to balance the responses to identified needs with the scope of the funding and resources that can be brought to bear. In Puerto Rico the financial context for coral management can be divided into external resources, principally from NOAA, and financing provided by the Commonwealth. While it is beyond the scope of this capacity assessment to completely quantify the magnitude of Commonwealth funds that, to varying degrees, may impact coral reef conditions and coral reef management, it is useful to assess the general scope of funds available to address coral reef management needs. These investments include programs and activities that concern the management of fisheries on the continental shelf – the majority of which are closely related to coral reef conditions - and a diverse array of programs and activities associated with coastal management, infrastructure improvements, wastewater treatment, land use, watershed management and other measures to control the flow of pollutants to the sea. In addition to these programs and activities, the Commonwealth funds the DNER Ranger Corps, estimated at \$10 to 12 million per year. There is currently only one employee dedicated to coral reef management within the DNER offices in San Juan. This employee is 80% funded through the NOAA CRCP cooperative grants program, and devotes approximately 80% of her time to coral matters. The remainder of her funding comes from DNER, and accordingly, the remaining 20% of her time is devoted to other non-coral related matters within the Department.

Funding directed at Puerto Rico from various elements of the NOAA Coral Reef Conservation Program is estimated to be in the vicinity of \$1.5 to 2 million per year of which approximately \$250,000 to \$400,000 comes through the cooperative agreement between NOAA CRCP and DNER. Activities funded through the cooperative agreement is the primary program to which this capacity assessment is directed. The balance of funds flowing to the Commonwealth include various grants and agreements funding scientific monitoring, public education, reserve staff as well as regional programs that contribute to Puerto Rico coral management. An additional approximately \$1-2 million is awarded annually to support the implementation of the Puerto Rico Coastal Zone Management Program located within DNER through NOAA's Office of Coastal Resources Management. A cooperative agreement between NOAA Office of Law Enforcement and DNER has annually provided approximately an additional \$200,000 in recent years to support the DNER Ranger Corps. Funds from a variety of other federal sources such as the US Fish and Wildlife Service (USFWS), the Environmental Protection Agency (EPA), National Resources Conservation Service (NRCS) and the National Marine Fisheries Service (NMFS) within NOAA all directly or indirectly support fisheries management, land use management and pollution abatement programs that may bring benefits to the condition of coral reefs in Puerto Rico. This suggests that a strong interagency commitment exists for coral reef management in the Commonwealth that, if structured along the lines suggested in this section, should be within the scope of funding that is currently available. Crucially important, much of what is needed to build capacity in terms of some aspects of human resources and equipment is already present, but needs to be integrated within an overall Commonwealth coral reef management program, implemented through an appropriately sequenced plan of action. There are other elements that will likely require external funding beyond what is available for a sustained long-term investment in capacity building.

Note on recommendations: The recommendations in this section have been divided into three groups based upon their complexity, scale, practicality and the degree of control over their implementation. The first group is highly political in nature, will require high-level governmental action, and in many respects lies beyond the direct reach of the coral management network. The second group will require a collaborative and coordinated approach to management at select priority areas and involve interconnected systems and engagement with multiple resource users, government entities, NGOs and funders. The third and final group is designed to build capacity at an organizational scale where leadership and control over implementation is relatively high. Each recommendation includes insight on the degree of complexity, cost, and the time required to implement. The recommendations in Group 1 are presented in simple priority order, from highest to lowest, incorporating guidance from the Puerto Rico Jurisdictional Capacity Assessment Committee (J-CAT) and our best professional judgement. The recommendations in Group 2 are organized into a logical sequence that will aid their implementation at one or two priority sites in Puerto Rico and were not subject to prioritization. The recommendations in Group 3 are grouped according to sub-theme, with the highest priority sub-themes presented first, and the recommendations within each sub-theme also presented in general priority order, again incorporating the guidance of the J-CAT and our best professional judgement.

4.2 Group 1 Recommendations: Politically Challenging Goals to Improve Formal Commitment to Coral Reef Conservation

The recommendations in this section are complex and politically challenging, and in many respects, accomplishing them will require actions beyond the reach of CRCP, DNER and the larger coral reef management network in Puerto Rico. Nonetheless, there are concrete measures that NOAA and DNER can take to improve the likelihood of success and lead to an improved climate for coral management and marine conservation in the Commonwealth. Indeed, a top priority for building the capacity for effective coral reef management in Puerto Rico is to generate high-level institutional and political support for coral reef conservation and management. This assessment found that the lack of commitment within DNER and other divisions of the Puerto Rican government, including the legislature, is due in part to the prevailing sentiment that “there are plenty of fish in the sea” and that there is little to be gained by additional regulations or rigorously enforcing regulations that constrain human activities affecting the condition of coral reefs or the abundance of fish. Some recognize that coral reefs are degraded compared to their condition decades ago and have concluded that the primary cause is climate change. In this view, it makes little sense to invest in remedial actions at the scale of the Commonwealth since they will have little impact in the face of the dominant forces operating at the global scale. From these perspectives, constraints on human activity for “nature conservation” needlessly limits the public’s enjoyment of natural areas, sources of livelihoods, the economic benefits that can be generated by their fuller use by activities associated with resorts, and revenue generating activities such as off-road vehicles, jet skis and the placement of golf courses in or adjacent to protected areas. For some influential legislators and high-level administrators the low priority given to enforcement of existing regulations and more effective conservation and protection of reefs is justified by the greater importance of other issues and governmental priorities, not least the imperatives of economic growth and reduced unemployment. These values and perspectives must be addressed if commitment for more effective coral reef management is to be increased in the Commonwealth.

Recommendation 1.1: Reform the DNER Ranger Corps

The absence of enforcement of existing regulations on the conduct of fishing and activities that cause physical damage to reefs was a dominant theme in the interviews conducted for this assessment. Improving capacity to enforce DNER regulations must therefore be at the center of a capacity building program. This requires an examination of the structure, functioning and capacity-building needs of the DNER Ranger Corps and their alignment with the mission and function of DNER.

The DNER Ranger Corps was established in 1977, five years after the Department was created. Today there are seven main regions and a total of roughly 420 Rangers with responsibilities for enforcement, public education and monitoring, both on land and within the Commonwealth's territorial sea. The DNER Ranger Corps is responsible for the enforcement of regulations for all activities over which the Department has authority. These authorities are defined by the laws that the Department is charged to enforce once the rulemaking process has defined the standards and mechanism for their implementation. From a coral reef management perspective, these include land-based sources of pollution, physical damage to reefs by vessel groundings and poor anchoring practices, the regulation of fisheries and the regulations and/or good practices associated with the various categories of protected areas. As the term "ranger" implies, their duties span both education/extension and enforcement. They are therefore concerned with encouraging voluntary compliance as well as providing the policing function and the application of sanctions to those who break rules. The DNER Ranger Corps also enforces the regulations of the boating safety program, assists the Coast Guard periodically with issues relating to homeland security and illegal drug trade. The Rangers need to possess the knowledge and abilities to inform and educate the public on a wide range of issues including value of the goods and services produced by natural resources and healthy ecosystems, good policing practices and the ability to effectively apply DNER procedures by which infractions of the regulations are sanctioned. We learned, for example, that there have been many training programs designed for the DNER Ranger Corps but, as several interviewees noted, "training is not effective if the participants have no interest in improving their performance."

Many Rangers are former police officers. All receive basic training in law enforcement from the police academy. Some have received additional training in enforcement and compliance of natural resources regulations. Although for a period in the past the Rangers were assigned to specialized units, there is currently no distinction between Ranger teams that work in marine areas and those assigned to terrestrial areas. Individual Rangers may expect to be assigned to different areas during their careers. The exceptions are Culebra and Vieques. The Rangers in this relatively isolated island region are "resident Rangers" drawn from those communities, and they tend not to rotate for duty elsewhere.

A reoccurring theme in the interviews we conducted during our site visit and follow-up phone conversations (totaling over 60) was the perceived weakness in enforcement and the erosive effect it has on voluntary compliance with environmental regulations and other DNER-promoted good practices. These interviews were conducted with DNER staff and other natural resource professionals who work directly or tangentially to the Ranger Corps. Their observations informed our understanding of the current enforcement situation in Puerto Rico and are the basis for our analysis here. A consistent message from those who turn to the Rangers for enforcement and patrolling assistance is that there are dedicated Rangers who understand the values of reefs, the goods and services they generate for society and the need to protect them and reduce human activities that damage and degrade them. These individuals respond positively to requests for support. Many noted that there are also personnel who are unmotivated, have little interest in filling their functions, and are unlikely to respond to a request and that there are persistent problems in

some isolated areas such as Mona Island and Luis Peña Channel Natural Reserve in Culebra. From our interviews, a consistent message was that DNER Ranger Corps response depends on “who you know” among the Rangers assigned to that area. There is remarkable consistency among all those interviewed, including the Rangers themselves, as to the nature of these problems. One interviewee who has worked closely with the DNER Ranger Corps for several years characterized the problems as follows:

- There are some dedicated Rangers but the majority are not dedicated to the mandate as set forth by DNER,
- Those that are responsive to requests for assistance and take initiative have little support from their superiors,
- Many Rangers encounter conflicts of interest (personal and professional) in the areas where they operate,
- Many get their jobs through political patronage,
- While abundantly available, training is not helpful if the majority are unmotivated, and
- A fundamental problem is the DNER sanctioning system and the administrative process followed by the department’s lawyers.

Rangers frequently compare the differences between the DNER sanction process and enforcement of the boating safety regulations. If a boat does not possess the required lifejackets, flares or other equipment stipulated by the boating safety regulations, the fine associated with each is pre-defined and listed on a widely available form. When an infraction is found, the Ranger issues a ticket and his job is done. Non-compliance with DNER rules follows a different process. This requires filing a “sanction” in the form of a report that this submitted to, and processed by, the DNER legal office in San Juan. In the case of a vessel grounding on a reef, this requires the preparation of an assessment of the nature, extent and significance of the damage caused to corals. A lawyer retained by the defendant may question the technical qualifications of a Ranger to make such an assessment. From a Ranger’s point of view, this makes the preferable course to secure a Department biologist to make the required assessment of damage. This may present logistical difficulties, not least because the report must be filed within 48 hours. Once the report has been filed, the negotiation between the Department’s lawyer and the offender typically does not involve the Ranger and they are usually not informed of the penalty imposed. In the case of fishing infractions, the fine associated with a large catch of a species during its closed season, may be reduced to a small fraction of the full fine calculated by summing the penalty for each animal harvested (for example \$100 for each out of season queen conch harvested). There are therefore disincentives for a Ranger to embark on this complex process and far easier to simply inform the person that they are not in compliance and urge them to behave differently. In many cases, for example when dealing with an inexperienced boater, this is the appropriate response. It is not appropriate when dealing with a repeat offender. The result is that sanctions for breaking fisheries regulations or damage to a reef by a boat are very rare.

Valuable insights into the DNER Ranger Corps are provided by the recent Transition Report 2012 prepared by DNER and the statistical report on Ranger interventions for a one-year period ending on June 1, 2012. The Transition Report identifies the personnel at 395 positions distributed among eight geographic subareas, with 112 vehicles, 24 boats and 20 personal watercraft. The annual report on Ranger “interventions” for the 2011-2012 twelve month period lists nearly 6,000 interventions that resulted in fines totaling \$544,985. The interventions are grouped by the laws and regulations that the Rangers enforce. Interestingly, there were no interventions related to coral conservation

(Law #147) and only 28 related to Law #278 listed as “fishing without permit, holding lobster without a capture permit.” The report makes no mention of interventions on fisheries regulations for fresh water areas, marine reserves, closed seasons, size limits or protected species of corals – all of which require the filing of detailed reports under the internal DNER administrative judicial process. The bulk of the interventions concern boating safety and unauthorized parking – both of which only require the issuance of a ticket. Such enforcement of boating and vehicle regulations are also carried out by the police and do not concern natural resources. These data underscore that the marine patrolling by the Rangers produce a negligible number of enforcement actions.

The root problems appear to be twofold. The first is the complexity of the DNER enforcement procedures. The second is the absence of support from “higher ups” in the system. The culture is widely perceived to be one where personal initiative is not strongly encouraged. We were told of several instances where “something good was happening” in terms of a collaborative approach among Rangers and associated partners in federal agencies, or with local volunteers. We heard of a number of instances in which the response to such initiatives has been to disband them by assigning the participating Rangers to another region. Some suggest that the DNER Ranger Corps, now entering its fifth decade, is designed more as an auxiliary Police Force, while responding well to some issues, does not respond well to the main mission of DNER and requires a complete redesign.

It should also be noted that enforcement of the rules detailed by management plans is essential, but is only one side of the implementation coin. The heart of the successful enforcement of an ecosystem based management program is voluntary compliance. This requires that those who need to comply with the rules recognize the importance of what the management plan is working to achieve, support the goals and see the enforcement of the rules as fair and legitimate. Participation in the formulation of a management plan and an associated public education program, when well executed, should generate the informed and supportive constituency that is the basis for voluntary compliance. However, world experience has demonstrated repeatedly that if those who break the rules are not apprehended and appropriately punished voluntary compliance will quickly evaporate. Effective enforcement also requires that sanctions and punishments fit the crime. This requires that sanctions are graduated so that more serious offenses, and those who break the rules repeatedly, are punished more severely.

1.1A External Review of DNER Ranger Corps: Despite potentially adequate staffing (~420 Rangers) and funding (~\$11 million/year), and the presence of many dedicated and effective Rangers, the program does not appear to be meeting its stated goals. Lax enforcement of, and poor compliance with, environmental regulations are well-recognized problems across Puerto Rico. Accordingly, the DNER Ranger Corps, and coral reef management generally, could benefit from a thorough, external evaluation by professional evaluators with expressed expertise in evaluating natural resource regulatory enforcement programs. This recommendation is essential because without supportive and effective enforcement, compliance will be low and reef health will continue to decline. High-level leadership within DNER supports the idea of an external review of the DNER Ranger Corps, creating a window of opportunity to both perform the external review and then effectively implement the proposed recommendations. One potential organization that has conducted such reviews is [MPA Enforcement International](#).

Associated PSD Goals: A3 and B2

Recommended Lead: DNER Secretary

Potential Partners: DNER Ranger Corps, MPA Enforcement International

1.1B Specific DNER Ranger Corps Reforms: The following specific potential reforms do not remove the necessity of a professional evaluation, but can provide a reform agenda while pursuing an evaluation and can provide background for it.

- The sanction system for enforcing fisheries and other natural resource rule-breaking is ineffective. The system is complex and burdensome to Rangers and results in a strong disincentive for Rangers to pursue sanction-based enforcement actions. This is evidenced by the extremely small number of sanction violations that are actually pursued in the Commonwealth. The ticket-based boating infractions system is far more tractable. The sanction-based system should be completely redesigned.
- High-performing Rangers that achieve successful collaborative relationships with local partners or who aggressively pursue natural resource violators are often reassigned to other locations or otherwise discouraged from actively enforcing regulations. There is no formal system of performance evaluations or merit-based advancement within the DNER Ranger Corps. Low performing Rangers continue in their jobs with little threat of any consequences. Performance reviews and merit-based advancement should be instituted, and successful collaborations should be rewarded.
- A certification program based on both performance and knowledge could improve the efficacy of the DNER Ranger Corps.
- Rangers working in the terrestrial realm are frequently reassigned to the marine realm, and vice versa, interrupting continuity and lessening the likelihood of Rangers developing successful, collaborative working relationships with the communities they are charged with patrolling. Marine Rangers should be a dedicated unit and receive specific training relevant to marine enforcement responsibilities and should not be transferred between marine and terrestrial responsibilities.
- Ranger patrols should be unpredictable and scheduled to work in areas and at times when violations are known to be likely.
- Many Rangers are from coastal communities and may be operating in areas where they have personal connections to family and friends, raising the potential for conflicts of interest. Similarly, Rangers in Culebra and Vieques are “resident Rangers” that live near or among the communities they are charged with patrolling, again raising the potential for conflicts of interest. Rangers should be trained in avoiding and resolving conflicts of interest and their advancement should be based on successfully navigating these issues while achieving strong enforcement and compliance.

Associated PSD Goals: A3, B2, B3, and C1

Recommended Lead: DNER Secretary

Potential Partners: DNER Ranger Corps

1.1C Limited External Investment in DNER Ranger Corps Until Review Complete: Lax enforcement and weak compliance are so problematic across the Commonwealth that one possible strategy would be to limit further external investments in the Corps until an external evaluation is complete and reforms have been initiated.

Associated PSD Goal: B2

Recommended Lead: DNER Secretary

Potential Partners: NOAA CRCP, NOAA CZM, NOAA NMFS Office of Law Enforcement

Recommendation 1.2: Complete Recreational Fishing License Program and Invest Proceeds in Coral Conservation Activities

The recreational fishing licensing program is anticipated to become operational in 2013 and the revenue generated is expected to be in the range of \$1-2 million per year, as a minimum. Properly implemented, a license program can produce significant revenues that can be devoted to enhanced enforcement as well as marine conservation projects. Over time, improved habitat values and increasing fish populations can help build support for, and commitment to, improved management among the public and policy makers. We applaud that the fishing regulations state the percentages of the total recreational license funds that will be dedicated to various components of fisheries management, including improved recreational fishing effort and catch data acquisition and analysis, and fish nursery habitat restoration, among others.

1.2 Complete Recreational Fishing License Program and Invest Proceeds in Coral Conservation Activities:

Revenues generated by the recreational fishing licensing program should be invested in activities that sustain fish populations and the coral habitats upon which they depend as outlined in the fisheries regulations.

Associated PSD Goals: B1, B2, B3, and C1

Recommended Lead: DNER Secretary

Potential Partners: DNER Fish and Wildlife Bureau, DNER Ranger Corps, Office of Permits and Licenses

Recommendation 1.3: Finalize Regulations for PR Law #147

The Coral Reef Conservation Act of 1999 (PR Law #147) could provide a strong foundation for defining a Coral Reef Conservation Program across the Commonwealth. The Act has been drafted and passed but lacks the necessary final regulations to empower it. A newly drafted regulation would replace the existing coral regulation that dates back to 1979 (Regulation 2577). Completing the final rulemaking for the law is a critical pre-requisite to begin building political will to improve coral reef and marine conservation. The Act includes many features that would improve coral management including:

- A mandate for the Secretary of DNER to prepare a Strategic Management Plan for Puerto Rico's Coral Reefs;
- Regulations and procedures to specify appropriate uses of coral reefs and mechanisms for their protection, conservation and management;
- A requirement for Impact Assessments for activities that have the potential to damage coral reefs;
- Adoption of land use zoning plans for developments near reefs;
- Fines (of \$500 to \$10,000) for non-compliance with rules; and the delivery of an intense public education program.

The coral management system must make the completion of Law #147 a top priority and a plan to see this through should be aggressively prepared and pursued. This could be a top goal for the "first 100 days" of the new DNER Secretary.

1.3A Create Strategic Plan to Complete A New Regulation for PR Law #147: The new DNER secretary should quickly assign a DNER staff member to review the present status of the law and prepare a time-bound strategic plan to bring the final rulemaking for the law to completion.

Associated PSD Goals: Promotes formal commitment to support all PSD goals

Recommended Lead: DNER Coral Reef Committee

Potential Partners: DNER Secretary

1.3B Complete New Regulation for PR Law #147: After the creation of the strategic plan, the plan should be expeditiously put into action and aggressively pursued as both a substantive and symbolic expression of formal commitment to coral conservation in Puerto Rico. While Law #147 could be a strong asset for improved reef management, its language could be updated in the future to make it stronger. For example, the Act could include measures such as one or more additional, Commonwealth-funded full-time equivalents (FTEs) within DNER devoted to coral conservation. With the current political climate, there could be a window of opportunity to amend the law, otherwise amendments should be considered in future action plans.

Associated PSD Goals: Promotes formal commitment to support all PSD goals

Recommended Lead: DNER Secretary

Potential Partners: DNER Office of Legal Affairs, Puerto Rico State Department, DNER Coral Reef Committee

Recommendation 1.4: Increase Staff Capacity for Coral Management within DNER

Currently at DNER there is only 80% of one FTE devoted to coral reef management. This is an inadequate amount of staff capacity to manage the complex issues related to coral reef management, and an additional one or two staff positions could make a considerable impact on the ability of DNER to implement improved management techniques.

1.4 Increase Staff Capacity for Coral Management within DNER: One new staff position could be dedicated to increasing the quality of collaboration across partner agencies and organizations and a second new staff position could be focused on water issues and monitoring and evaluation. A strategic staffing plan, with well-written job descriptions, could prove valuable for justifying staff increases and securing funding. Adding coral-dedicated staff at DNER will also improve general capacity to manage the CRCP cooperative agreement, develop new projects and associated management plans, monitor ongoing projects, etc.

Associated PSD Goals: A2, A3, and improves capacity in support of all PSD goals

Recommended Lead: DNER Secretary

Potential Partners: NOAA CRCP, DNER Coral Reef Committee

Recommendation 1.5: Improve Coordination with Environmental Quality Board

The EQB serves an important environmental regulation function in Puerto Rico. The three member board (and one alternate) is appointed by the Governor of Puerto Rico with the advice and consent of the Senate. The EQB has attorneys who report to the Chairman of the Board and not the Office of the Attorney General of Puerto Rico. As such, the EQB is highly influential in environmental affairs across the Commonwealth, yet we repeatedly heard that it is largely disconnected from current watershed based activities and other matters of relevance to coral conservation.

1.5 Improve Coordination with Environmental Quality Board: DNER should work to improve coordination with the EQB. An annual briefing to the EQB on watershed activities such as emerging trends on agricultural best management practices and sediment and erosion control structures could begin to improve coordination and

collaboration. A liaison from EQB should be invited and encouraged to participate in regular meetings, seminars, and annual events associated with Ridge to Reef activities.

Associated PSD Goals: A1, A2, A3, and C2

Recommended Lead: DNER Secretary

Potential Partners: Environmental Quality Board

Recommendation 1.6: Improve DNER Staffing Procedures

While undoubtedly a complex and highly charged issue, many interviewees expressed that the process by which natural resource job openings are listed and subsequently filled is problematic and that a renewed formal commitment to improve hiring, retention and staff quality is badly needed. We frequently heard that when internal funds, or more frequently, external funds are secured for hiring staff, the hiring process does not often end up with the ideal candidate. Despite creating position postings calling for a specific skill set, managers and supervisors who received resumés of potential candidates, felt that they had little control of the hiring selection process and that “politics” seemed to determine who ultimately was hired, not qualifications. We heard several times that “new staff” to fill an open position would simply show up informing the hiring manager that he or she was ready to start. This situation frequently results in poorly qualified applicants being hired for positions that they are ill-equipped to fill, reducing the efficiency and effectiveness of coral management in the Commonwealth.

1.6 Create Hiring Practices Briefing for New DNER Secretary: The problems affecting the job listing and hiring process within DNER will require concerted effort from the highest level of the Department and perhaps within even higher levels of government to solve, and lie beyond the scope of this capacity assessment. A thorough briefing, with well-documented examples, should be prepared and presented to the new Secretary that alert her to these problems and will enable her to begin to craft an appropriate course of action. Ideally, this would include a “process flow chart” that shows how the key steps that a hiring manager would need to take flows through the DNER system, including securing resumés, selecting candidates for interviews, and completing the final selection process. At least one demonstration of hiring through this process may be needed early as a model to illustrate the process. The Human Resources Office (*Oficina de Recursos Humanos*) should lead the implementation of this recommendation by briefing the new DNER Secretary about future plans to develop standard operating procedures to formalize uniformed protocols for hiring candidates based on merit. Additional standards should be developed that base job retainment and pay increases on performance of duties. High-level support of this reform could bolster the confidence of DNER supervisors by ensuring that only quality candidates with appropriate credentials fill vacancies and retain high performance over time. Such a briefing on hiring practices should be re-assessed and repeated with each incoming Secretary at DNER.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER Secretary

Potential Partners: DNER Human Resources Office

4.3 Group 2 Recommendations: Using a Common Management Framework to Pursue Ecosystem-based Management at Priority Sites

This second group of recommendations, taken together, constitute what we believe can be a pilot program to pursue holistic Ecosystem-based Management at one or two of the previously identified priority coral reef management sites. Much of the suggested activity lies within the purview of DNER and the CRCP cooperative granting process, but accomplishing it will require a collaborative and coordinated approach to management and involve interconnected systems and engagement with multiple resource users, government entities, NGOs and additional funders. Given the relatively limited scope of available financial resources and personnel resources, and the complex issues of coral reef management that relate to politics, power, scale, knowledge, community and culture, we believe a common conceptual framework is needed to help sequence and prioritize coral reef management actions. Thus, a top priority for building capacity for coral reef management is to make a concerted effort to bring together the many contributing parties to gain a common understanding of the dynamic issues of the coral reef management process and improve the situational awareness of coral reef practitioners.

Several interviewees stressed that the managers of the various terrestrial and marine management areas operate in isolation, that they often do not have the necessary administrative skills, and do not receive the support they require from their superiors. They feel beleaguered and have little hope that conditions will improve. Those that are nearing retirement speak of how different the current context is from the conditions that prevailed in the 1980s and 1990s. We also heard that some managers devote a disproportionate amount of time and resources to personal “pet projects” such as sea turtle conservation to the detriment of an overall strategic management approach.

Many of those that are leaders or participants in projects funded through the NOAA CRCP grants program have PhDs from the University of Puerto Rico Marine Sciences Program. In many cases they are outstanding marine scientists. The majority, however, as students or young professionals, did not participate in courses on management, public policy or administration. The expectation has been that these skills would be learned “on the job.” This is inefficient and a source of considerable frustration for marine scientists who find that “the politics” of management, as well as a wide array of other “soft” skills such as grants management, navigating bureaucracy, facilitation, mediation, inspiring staff etc., are major factors affecting the prospects for the success or failure of a project. We learned that the Marine Sciences program has resisted suggestions that such topics should be made a part of the curriculum – or that students should be encouraged to seek out exposure to these fields.

A key finding of this assessment is that a priority capacity need is to develop a common understanding of the sequencing and prioritizing of the actions that can lead to an implementable coral reef management plan. Without exception, when those interviewed for this capacity assessment were asked about the Priority Setting Document and the Local Action Strategies, they stated that either that they did not know of these documents, did not view them as the template, or consider them a significant source of guidance on how to advance to more effective coral reef management in Puerto Rico. This suggests to us that the principle weakness of these documents is that they do not address the sequence in which the many actions identified should be undertaken nor recognize the manner in which activities need to inform each other in a planning process. They provide lists of actions organized by the issues (threats) that management should address but if a reader asks the question “what needs to be done now” at either the Commonwealth or local area scales these documents provide little guidance on how to sequence, prioritize, measure

progress and integrate actions that will generate effective expression of coral reef stewardship. The recommendations in this section (Group 2) are aimed at creating a common understanding of the key concepts of the ecosystem approach to natural resource management, across the Puerto Rico coral reef management community, including the building of a common vocabulary and the use of a useful management “toolkit” by managers to help facilitate improved collaboration, and applying it at two priority sites.

Recommendation 2.1: Build Capacity Through the Application of a Common Management Framework

As summarized in Section One of this report, we employ a peer-reviewed set of tools, methods and a common vocabulary¹ in our approach to the practice of Ecosystem-based Management. Together, the tools and vocabulary constitute a framework that can guide resource allocation and team-based actions that proceed through the logical steps of the management cycle: Steps 1 (issue identification), 2 (preparation of plan of action) and 3 (securing formal commitment) that should, if effectively completed, generate the enabling conditions for a transition to effective implementation (Step 4) and reflection and evaluation (i.e. “adaptive management,” Step 5). Furthermore, application of the Orders of Outcomes framework enables managers and funders to clearly define and analyze the current and desired state of the enabling conditions for successful program implementation as well as the appropriate short-, medium- and long-term program goals and outcomes. Together, these tools emphasize the importance of taking into account the nature of coral reef management actions, the target or purpose of the project, the range of other organizations and components involved, a “theory of change,” a concrete implementation strategy and the use of monitoring and evaluation to build adaptive learning.

The foundation of an Ecosystem-based Management initiative is an assessment of the issues – the problems and the opportunities - that are affecting an ecosystem, and the selection of the spatial scale at which a management initiative will be made. The outcomes that the initiative will work to achieve should be framed as goals that address both the environmental and societal dimensions of the coral reef conditions. Much effort has been expended on these topics as they relate to coral reef management in Puerto Rico. The three principle drivers of coral reef degradation originally identified by CRCP have been accepted as the guiding focus of both Puerto Rico’s PSD and LAS. At the Commonwealth scale, Law #147 has broadly defined the overarching goals for coral reef management and the strategies by which they will be made operational. At the priority site scale, the LAS lists linked ridge to reef watershed management initiatives at reserves and the seaward extensions of terrestrial management areas. A variety of other marine and coastal-marine management areas have been established through initiatives promoted by the federal government. We believe that training managers across the coral reef network in the tools and language of Ecosystem-based Management - a “common management framework”- will greatly help clarify goals and enable a more focused and strategic approach to management at these sites.

2.1A Promote the Use of a Common Language and Management Analysis Tools Through Management Training:

Select an institution of known competence in training on the practice of ecosystem governance (e.g. Coastal Resources Center at the University of Rhode Island) to offer an annual course (or courses) designed in partnership with a selected university unit that would address the principles and the practice of the ecosystem approach and core competencies required to build adaptive capacity for effective coral reef management. The expectation would be that once the curriculum has been developed and the course established, the university would assume full

¹ These methods, including the Management Cycle and the Orders of Outcome framework, build on work by GESAMP (1996), Olsen et al. (1997) and the United Nations Environment Programme (UNEP/GPA 2006).

responsibility for the program and incorporate it into its curriculum. The curriculum should emphasize lessons learned from Puerto Rico and other jurisdictions and address in particular the transition from issue analysis and planning (Steps 1 and 2) to commitment to, and implementation of, a management plan of action (Steps 3 and 4). A central theme should be recognition of how the contributions of the natural and social sciences shift with each step. Such courses should strive to attract a diversified participant mix so that each class is exposed to the views and experiences of natural and social scientists, managers, lawyers, educators, the NGO community and enforcement personnel. Such a capacity building curriculum could be adapted to feature short courses or seminars for senior administrators, judges, journalists and educators. Sample modules are suggested in Appendix E.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: NOAA CRCP

Potential Partners: DNER Coral Reef Committee, an organization of known competence in training on the practice of ecosystem governance, Puerto Rican Public and Private Universities

2.1B Case Study Curriculum: Natural resource managers, funders and practitioners could benefit from improved documenting and sharing of case studies of management success stories and lessons learned through a case study curriculum. This curriculum of coral reef management would emphasize case studies from Puerto Rico and other jurisdictions and address in particular the transition from issue analysis and planning (Steps 1 and 2) to commitment to, and implementation of, a management plan of action (Steps 3 and 4). A central theme should be recognition of how the contributions of the natural and social sciences shift with each step. Such courses should strive to attract a diversified participant mix so that each class is exposed to the views and experience of natural and social scientists, managers, lawyers, educators, the NGO community and enforcement personnel. Such a curriculum would have multiple uses as:

- An information sharing database amongst the natural resources managers, funders and practitioners;
- Ideally, Puerto Rico could share such a curricular base with other US jurisdictions through the All Islands Committee of the US Coral Reef Task Force. A pilot set of case studies to begin the establishment of a broader library of case study curricula to be housed at the Caribbean Landscape Conservation Cooperative (CLCC) to improve systems-learning across the conservation community;
- Lesson plans of curriculum from junior high schools through PhD-level;
- Short courses or seminars for senior administrators, judges, journalists and educators after adaptation (Recommendation 2.1A); and,
- Public education and outreach materials, after necessary re-tooling.

Creating a Puerto Rico-specific knowledge base and then sharing the information through multiple avenues through quality documentation and distribution would foment continued learning within the Puerto Rico conservation network and beyond.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER

Potential Partners: An organization of known competence in training on the practice of ecosystem governance, CLCC, USFWS, coral reef management network of Puerto Rico, Puerto Rican Public and Private Universities

2.1C Tie Coral Reef Project Funding to Steps in Management Cycle: We recognize that to truly build capacity to manage coral reefs is a large step. To be successful it is important to use a common management framework that is integrated with the CAP process and is widely distributed across the entire coral management community, including among funders (i.e. CRCP and NGOs). This would be enhanced by specifically requiring grantees to propose their strategy in relation to the steps in the management cycle as an organizing principal for grant requests. Funding decisions, tracking of progress and reporting would also fit well into this organizing framework. Specifically, we recommend that projects funded by CRCP and other funders such as National Fish and Wildlife Foundation (NFWF) involved at the priority sites link the proposed activity to the appropriate step or steps in the coral reef management process at the site or sites where the activity is to be conducted. Research and monitoring proposals should also explicitly link the proposed activity to the issues addressed by management and identify how the activity will inform the management process.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER Coral Reef Committee

Potential Partners: TNC, NFWF, NOAA CRCP, an organization of known competence in training on the practice of ecosystem governance, Guánica Bay Watershed Initiative, NRCS, USFWS, USDA, USGS, CLCC

2.1D Link Funding of Research and Monitoring to Management Outcomes: We recommend that future research and monitoring projects funded by CRCP link the proposed activity to the appropriate step or steps in the coral reef management process at the site or sites where the activity is to be conducted. Research and monitoring proposals should explicitly link the proposed activity to the issues addressed by management and identify how the activity will inform the management process.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: NOAA CRCP

Potential Partners: DNER Coral Reef Committee, an organization of known competence in training on the practice of ecosystem governance, Guánica Bay Watershed Initiative, North East Reserves management teams, USFWS, CLCC

Recommendation 2.2: Pursue Ecosystem-based Management at Two Priority Sites

In the near term, DNER and NOAA should work together to identify one or two management areas upon which the program will focus its efforts and target investments in order to successfully make the transition to effective implementation of the management plans for those areas. The North East Reserves/Culebra and Guánica are good candidate priority areas to choose to increase the level of accountability among the implementation partners.

Management plans for the sites should specify the rules and incentives by which specific goals for both the condition of corals reefs and how the desired types and intensities of human activity will be achieved. Targeting future investments on successfully completing the management cycle in a small number of target areas and would produce “living models” that can guide and inspire effective reef management elsewhere in the Commonwealth. Further strengthening the linkages between the many activities undertaken through CRCP would be achieved if all future projects are linked to the appropriate step or steps in the coral reef management process at the site or sites where the activity is to be conducted. Research and monitoring proposals should explicitly link the proposed activity to the issues addressed by management and specify how the activity will inform the management process.

Further planning and associated research at the focal sites should be directed in the form of a strategic process of analysis and planning that includes:

- The documentation of baseline conditions;
- Monitoring protocols;
- Research on key issues that is designed to address key uncertainties about cause-effect relationships and inform strategies for addressing the key issues affecting coral reef health and appropriate forms of human use;
- Social science designed to better understand human uses and perceptions as these relate to an emerging management scheme;
- Public education and involvement in all steps of plan formulation; and,
- Frequent consultation with DNER leadership and with other institutions in government that will need to concur with the management plan and contribute to its implementation.

2.2A Focus Efforts at One or Two Areas: We recommend that in the short term, DNER and NOAA work together to identify one or two of the existing priority sites upon which the program will focus its efforts and target investments in order to successfully make the transition to effective implementation of a management plan for those areas. By focusing on one or two sites (specifically Guánica and North East Reserves/Culebra), this provides the opportunity for implementation partners to focus their efforts and pilot new approaches for increased quality linkages across their programs. Piloting this approach at one or two priority sites will create the opportunity for deep learning about how such quality collaboration could function. It is important to note while concerted effort will be made at these one or two sites, other protected areas will not be abandoned. Such management plans should specify the rules and incentives by which specific goals for both the condition of the corals and how the desired types and intensities of human activity will be achieved. Dissemination of these plans and an overall coral reef strategy is essential. NOAA CRCP's MPA Management Assessment Checklist could be a model for outlining the assessment structure for increasing the level of accountability and setting criteria for improved engagement and fostering more unified efforts at the selected site or sites ([MPA Management Assessment Checklist](#)). Current managers of the protected areas will be key partners for the implementation of this recommendation along with DNER and NOAA spearheading the effort.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER Coral Reef Committee and DNER Secretary

Potential Partners: NOAA CRCP and Caribbean Field Office, an organization of known competence in training on the practice of ecosystem governance, Guánica Bay Watershed Initiative, North East Reserves management teams

2.2B Ridge to Reef Summit: Management is complex and multi-dimensional, requiring a wide range of actors working together, bringing together a wide range of capacities. For example NOAA, DNER, NRCS, USFWS, and EPA have all pooled resources to develop and implement a watershed management plan in Guánica. We recommend a regular summit on ridge to reef management approximately every two years at Guánica and other sites, where participants are employing the conceptual frameworks for management process and outcomes to further learn from experiences at priority sites and elsewhere so as to report out on the priority site investments and learn from what is going on elsewhere. The use of the management cycle and orders framework can show how highly integrated and coordinated site-specific management actions at the scale of a watershed will further

increase adaptive learning. Audiences should include field operations staff, managers and policy/decision makers as well as students and educators interested in this topic.

Associated PSD Goals: A1, A2, A3, C1, and C2

Recommended Lead: USCRTF (as part of their Watersheds Initiative)

Potential Partners: All relevant partners involved in coral reef management including DNER Coral Reef Committee, Guánica Bay Watershed Initiative, North East Reserves management teams, USFWS, NOAA CRCP and Caribbean Field Office, EPA, NRCS

Recommendation 2.3: Improved Management Plans

The implementation of a coral reef management plan should result in changes in the intensity and types of human uses within the boundaries of the management area and, in some cases, adjoining areas such as watersheds, where impacts affecting coral reef condition are generated. The critical evidence of implementation is that human activities change. Without such change there is no evidence of a management initiative and “business as usual” continues as before. The expressions of alterations in human activity range across a wide spectrum that includes direct and immediately tangible impacts such as reduced trampling and other forms of physical damage, reductions in fishing pressure on intensively fished reefs and controls over more defuse activities that generate pollutants and sediments in a watershed. Equally important are shifts in the behavior of the various public and private institutions that may need to collaborate or otherwise adjust their activities and investments to make implementation of a course of action feasible and sustainable over the long term.

Any meaningful coral reef management plan sets forth the policies and the rules by which the goals for the management area are to be achieved. Without rules business as usual will continue as before. It is essential that such rules not only address what actions or uses are regulated or prohibited, but also what forms of human activity are encouraged. Positive incentives are as critical as the limitations placed on destructive or incompatible activities. Unfortunately, the management plans we have reviewed do not contain a section on rules and regulations or the courses of action by which the goals of management will be achieved. This means that implementation is limited to the enforcement of less area-specific rules and policies such as those governing fisheries.

The coral reef management goals and objectives identified in the PSD, and further developed in the many projects and activities envisioned in the LAS create an ambitious and multi-faceted agenda that, if accomplished, would create great gains for coral reefs across the Commonwealth. However, the goals, objectives and plans are not fully integrated into a strategic, coherent and prioritized plan that is essential to the formulation of an implementable management plan. Accordingly, the projects funded by CRCP do not form a strategic sequence that optimizes the chance for success.

The challenge is to design a process of consultation and planning that has the support of the leadership of DNER and relevant stakeholders that will be affected by the changes in human activity that would be brought by plan implementation. This includes selecting rules that have a measure of support among commercial and recreational fishers and should include strategies that have the potential to control and eventually eliminate illegal fishing in targeted reserves.

Management plans for the priority areas should similarly include implementable regulations and – equally important – incentives for achieving the good practices and recommendations identified by the existing management plans. The Guánica Bay Watershed Management Plan is a good model for management plans and presents many recommendations for actions and good practices but is largely silent about enforcement and compliance issues and

how the recommendations could be sequenced and evaluated for both process and outcome attainment. Such management plans need to provide for meaningful sanctions and the expectation that they will be applied to those who disregard formally adopted rules. If there are no consequences for those who violate the rules, voluntary compliance among those who support the plan will be undercut.

Several interviewees at DNER headquarters stated that another reason for lack of support within DNER leadership is that some protected area management plans, particularly those prepared by off-island teams of consultants, are drawn up with little or no consultation with DNER leadership and, once completed, have little support within the department.

2.3 Create and Adopt Improved Plans: While formal plans exist for the priority areas and other sites across the Commonwealth, the plans generally do not present a clear and operational sequence of actions to be followed. By linking the creation and adoption of new plans, as well as the review, revision and implementation of existing plans, to the management training suggested in Recommendation 2.1, managers can evaluate their plans and create a more operational, logical and sequenced implementation plan for their sites that can guide funding decisions for CRCP and beyond. Improved plans should feature:

- The regulations by which the goals are to be achieved;
- Positive incentives to encourage desired behavior change;
- Broad-based stakeholder support before implementation; and
- Support across the DNER hierarchy prior to program implementation.

Such plans will gain further strength if they can build on improved formal commitment to conservation, as evidenced by completed rulemaking for Law #147 and reforms to the DNER Ranger Corps (Recommendations 1.1 and 1.2).

Associated PSD Goals: A1, A2, A3, B1, B2, B3, C1, C2, and C3

Recommended Lead: DNER

Potential Partners: An organization of known competence in training on the practice of ecosystem governance, Guánica Bay Watershed Initiative, North East Reserves management teams, NOAA CRCP and Caribbean Field Office

Recommendation 2.4: High Quality Collaboration

Collaboration is a nested phenomenon that takes place at many scales. During a time of shrinking budgets and growth of organizations committed to natural resource protection (“doing more with less”) there is an increase in the urgency for high quality collaboration. Therefore, collaboration needs to be better understood and constructed as a nested system that draws together researchers, stakeholders and managers at the LAS scale, at the Commonwealth scale and on up to federal agencies operating in Puerto Rico. High quality collaboration should extend to what is being learned regionally (there has been an increase in regional collaborations in the Caribbean, see Recommendation 3.3B for more detail) and even across all seven US coral jurisdictions. There must be incentives for collaboration and clarity on the needs and goals at each “layer.”

Managing coral reefs is conducted at the intersection of complex human and natural systems. In Puerto Rico, like most places around the world concerned with coral reef management, there is a strong tendency to focus attention on understanding the health of the natural systems and to work to remove the threats posed by human activity. As

appropriate, the work requires collaboration within organizations, between organizations and across sectors, disciplines and professional communities of practice. In a context of low overall political will for improved coral reef management, forces of fragmentation can and often do dominate and even with the best intentions can result in multiple, largely disconnected, short term projects that are heavily dependent on the sheer will and charisma of devoted individuals. While the practitioners within the coral reef management community are relatively few in number, and generally know each other well, there are few formal opportunities for them to share what they are doing and collaborate meaningfully. While the *quantity* of engagement with each other was not always an issue, it became clear during the capacity assessment that the low *quality* of collaboration is a persistent and pervasive issue across the coral reef management system.

We believe there is a pressing need, and a window of opportunity, for the coral reef management community (including CRCP and others that fund projects) to build capacity for high quality collaboration as a core competency for addressing the range of complex, interconnected social-biophysical coral reef management issues. If done well, collaboration can increase organizational learning and performance, reduce fragmentation, enhance coordination and cooperation and increase overall efficiency for coral reef management. Ideally, this can lead to increased resilience and adaptive capacity to respond to long-term ecosystem change. While this can be implemented rather inexpensively, achieving high quality collaboration requires committing to a process and it cannot be sustained without thoughtful attention to its development and context.

2.4 Enhance Collaboration and Employ Collaboration Frameworks: DNER and the larger coral management network should take concrete steps to improve collaboration across the network. By promoting the use of a common management framework and language and employing management training, as suggested in Recommendation 2.1, managers will be better equipped to communicate and collaborate. If DNER and CRCP seek a common framework to improve the quality of collaboration, we recommend that it investigates employing the Collaboration Evaluation and Improvement Framework (CEIF) high quality collaboration methodology, or similar collaboration framework, as a means to improve collaboration across the Puerto Rico coral reef management system. The CEIF is a simplifying methodology that has recently been developed to systematically measure, assess and promote the process and outcomes of high quality collaboration by employing five “points of entry” to thinking about where, when, and how to engage in building capacity for improved collaboration (Woodland and Hutton, 2012). It is based on a synthesis of lessons learned across multiple disciplines, sectors, management hierarchies, fields, settings and stages of partnership development. Appendix F details the five phases of the framework intended to provide specific and actionable steps to building capacity for high quality collaboration for coral reef management in Puerto Rico. To make operational, this framework would be best applied as part of the common language for improved ecosystem management.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: NOAA CRCP

Potential Partners: An organization of known competence in training on the practice of ecosystem governance, Guánica Bay Watershed Initiative, North East Reserves management teams, USFWS, USGS, NRCS, EPA, NOAA Caribbean Field Office, CLCC

Recommendation 2.5: Strategies to Improve the Use of Monitoring and Evaluation to Enhance Adaptive Management

Engaging in regular, systematic monitoring, evaluation, reflection and adaptation is a key component of the ecosystem approach. Realities on the ground (and sea) are fluid and emergent, and even the best crafted management plan or project outline can become outdated or in need of adaptation. The process of evaluation, reflection and adaptation must be institutionalized into the management framework to be effective and consistent.

Monitoring, self-assessment and evaluation must not be relegated to the final phase of a generation of coral reef management. They are highlighted as a distinct step in the management cycle to underscore the importance of a learning-based approach that features adaptation and refinement of a management initiative during all steps in the generation of a program. However, such assessments and adjustments are particularly critical after an implementation phase (Step 4) that calls for a thorough examination of an initiative that has succeeded in completing Steps 1 through 4. Such assessments should identify what has been learned and recognize how the issues to be addressed by the next generation of management may have changed and how this should influence the priorities and design of future work. Where an initiative has failed to meet expectations it is essential to thoughtfully examine what did and did not occur as anticipated by the design and what changes should be made as the initiative moves forward. This capacity assessment is one example of such stock taking and the resulting emphasis upon examining how Steps 1 through 3 have been undertaken in Puerto Rico and why they have not produced the enabling conditions required for effective coral reef management.

Any important priority setting document should be reviewed, and where appropriate, revised, every five to ten years. We recommend that by 2016 both the PSD and the LAS documents should be revised and updated as an expression of adaptive management. Revisions should be based on an assessment of how well they have served their intended purpose, what has been learned, and how the priorities for coral management may have evolved since they were prepared. We strongly recommend that revised versions be structured to highlight the sequence in which identified priority actions should be taken. A priority theme should be to apply strategies designed to overcome the implementation gap. Revisions to the PSD and LAS documents would be most useful and effective if they included a review of all coral related investments made by NOAA in Puerto Rico including coral related activities that flow directly from NOAA to individuals and organizations rather than through DNER.

We have been told that in the past there was a period when Puerto Rico hosted an annual symposium on coral reefs. We gather that the emphasis was upon the natural science being conducted, with little attention on the challenges of management efforts, enforcement and the related social science questions and perspectives. The ecosystem approach requires a more comprehensive view of research and how the two realms of the environment and human society intersect and combine in the governance and associated politics that mark the dynamics of ecosystem stewardship. In the future, the managers of protected areas need to identify the gaps in knowledge and the issues that they believe to be most critical. This should be the basis for an informed and sustained dialogue with natural and social scientists to frame the research that would directly contribute to more effective management.

2.5A Institutionalize Monitoring and Evaluation (M&E): M&E should be built into the management process, not conducted as an “afterthought.” Starting with one or two target priority areas, programs should undergo semi-annual self-assessments, bringing together an experienced, interdisciplinary team, including high-level administrators. Programs should use simple scorecards to prepare baselines of both environmental and social

conditions against which progress can be measured. This should be scaled up to multiple sites after being successfully piloted.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: NOAA CRCP, NFWF

Potential Partners: An organization of known competence in training on the practice of ecosystem governance, Guánica Bay Watershed Initiative, North East Reserves management teams, USFWS, USGS, NRCS, EPA, CLCC

2.5B Revise Primary Management Documents: Both the PSD and the LAS documents should be revised and updated as an expression of adaptive management by 2016. A primary focus of updating the LAS should be to create a clear sequence of priority actions for each management area.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER Coral Reef Committee

Potential Partners: All relevant stakeholders and partners

2.5C Use Scorecards to Track Evidence of Enabling Conditions for Improved Coral Reef Management: Finally, experience suggests that use of a simplifying scorecarding tool can be extremely useful to track the ongoing assembly and maintenance of the enabling conditions as part of implementation of a coral reef management initiative. A simple scorecard can track all four of the following conditions and the degree that they are present:

- A core group of well-informed and supportive constituencies supports the program;
- Sufficient capacity is present within the institutions responsible for the program to implement its policies and plan of action;
- Governmental commitment to the policies of a program has been expressed by the delegation of the necessary authorities and the allocation of the financial resources required for long-term program implementation;
- Unambiguous goals define both the societal and the environmental conditions against which the efforts of the program can be measured.

Each of these enabling conditions as well as steps through the management cycle can be measured using simplifying scorecarding tools and it is our recommendation that the coral reef initiative in Puerto Rico pilot test these tools in the two priority areas to guide adaptive management and continued learning.

While picking and applying scorecards such as those recommended here may be unfamiliar and many managers lack training in their application, they are quite simple to use and trainings in their use are available by organizations familiar with the practice of ecosystem governance.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER

Potential Partners: NFWF, an organization of known competence in training on the practice of ecosystem governance, Guánica Bay Watershed Initiative, North East Reserves management teams, USFWS, USGS, NRCS, EPA, CLCC

4.4 Group 3 Recommendations: Tractable Projects

This third and final group of recommendations includes actions that contribute to building adaptive capacity, yet their implementation can be controlled by a small group of people, an organization or a network of organizations. While some do involve improving coordination with other government agencies or non-governmental organizations, many can be pursued and led from within DNER or other implementing partners. This group of recommendations includes programs, trainings etc. that focus on building a range of technical, financial, social, institutional and political capacities. While this group is more commonly associated with traditional building of knowledge, skills and competencies, all forms of capacity, we believe investment here will have far greater return as long as attention is paid to implementing the two groups described above.

Recommendation 3.1: Improve Aspects of DNER Function and Capacity

Clearly, many of the challenges limiting improved overall management and functioning within DNER are systemic and operate at a scale beyond the reach of DNER's coral program. Some, such as seeking additional personnel capacity for coral work and addressing pervasive problems affecting job creation, listing and hiring are addressed elsewhere in this report. However, DNER and CRCP do have the ability to address several reasonably tractable issues in the near term, particularly if overall staffing devoted to coral management can be increased.

3.1A Sustainable Finance Plan: With over three million tourists visiting Puerto Rico each year, the Commonwealth has the opportunity to build capacity to take advantage of innovative potential funding sources, including tourism user fees, tourism and entry/exit fees, mooring user fees, as well as mechanisms for generating funding to encourage conservation activities, including cost and benefit sharing, using social media and “text to donate” services, investment and enterprise funds, and fiscal instruments and arrangements for private or community management of marine reserves and natural reserves and associated facilities. DNER could sponsor a “Philanthropy Roundtable” whereby members of foundations can meet to discuss funding priorities that match their mission, vision, and values. We believe such a forum could provide a unique opportunity to bring together both private and public funders, hear from those funders what is important to them, and let them hear from the people on the ground working in management about what is needed. This helps to foster a multi-party relationship for sustainable funding so that even if critical point-people move on, the roundtable can be sustained. The Puerto Rico Conservation Trust is a model organization that engages well with donors and may welcome an opportunity to share lessons learned for ways to engage philanthropy. NFWF could be another potential convener. These strategies and potential sources of income should be carefully studied and presented to both the new DNER Secretary and the new Governor with the goal of gaining formal commitment for raising funds dedicated directly to reef conservation and management programs. The management cycle would be an ideal organizing principle to guide adaptive action and reflection on this critical long-term need.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER

Potential Partners: Puerto Rico Conservation Trust, TNC, NFWF and other interested philanthropies and representatives from the Puerto Rico coral network

3.1B Re-engage DNER Oversight of the Creation of Management Plans: Oversight of management plans can be improved by increasing the personnel devoted to coral reef management within DNER. The plans, and their

likelihood of successful implementation, can be enhanced by ensuring that they have a strategic focus and a clear set of unified priorities, policies and desired outcomes. DNER needs to build capacity to improve central oversight of this process to reach a coordinated focus on what changes in the current environmental conditions and forms of human activity and use that implementation of management plans seeks to effect. This process should also improve and support enhanced coordination among site and area managers in the field. Improved DNER oversight is especially important when management plans are developed by contractors to help ensure the strategic focus of outsourced plans.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER Secretary

Potential Partners: All parties involved with the development of management plans, an organization of known competence in training on the practice of ecosystem governance

3.1C Strategies to Improve Grants Management: Strategies to improve grants management performance include:

- Maintain staff and funding to address administrative support for grants management within DNER. This is a case where training in grants management is needed for multiple people to create some level of redundancy in the event that key staff leave to avoid disruption in service;
- Adding routine training for grants managers into the NOAA CRCP proposal on an annual basis, such as orientation workshops for the software used for grant applications, specific updates to accounting procedures that link with NOAA cooperative agreement accounting etc.; and,
- Linking grants management lessons learned between Florida, the USVI and Puerto Rico such as how to increase efficiency with procurement, how to more effectively communicate with management staff, how to build redundancy into the grants management system.

Associated PSD Goals: Improves capacity in support of all PSD goals depending on grant area

Recommended Lead: NOAA CRCP

Potential Partners: DNER and all parties involved in financial reporting/accounting

Recommendation 3.2: Enhance and Promote Linkage with EPA Region 2

With increased coordination and linkages between NOAA CRCP, the Puerto Rico coral management community and EPA Region 2 could foster improved conservation outcomes by positively leveraging the resources of the entities. Clarity of roles, responsibilities and shared goals through well-developed MOU could help operationalize effective partnerships between the NOAA CRCP, EPA Region 2 and the Puerto Rico coral management community.

3.2A Local Water Quality Standards: Through stronger partnerships with EQB and EPA, DNER should work to define a process for the adoption of water quality standards that are developed by EPA for use in a tropical context. While this is underway, tracking the progress including barriers and opportunities will help guide action that may be needed to complete this process.

Associated PSD Goals: A1 and A2

Recommended Lead: DNER

Potential Partners: EPA Region 2, EQB, NOAA CRCP

3.2B Link with EPA Region 2: Positive linkages have been developed with EPA Region 2. These should be pursued and made formal through an MOU with clear time bound and measurable milestones. Possible linkages between EPA Region 2 and NOAA CRCP and the Puerto Rico coral management community could include:

- Region 2 representation at United States Coral Reef Task Force;
- Enhanced communication regarding on the ground planning associated with coral reef management between Region 2 and Region 4;
- More communication between Region 2 and CRCP headquarters in Silver Spring;
- Local integration with ongoing projects and stakeholders related to water quality and LBSP issues;
- EQB integration into, and active participation, in coral efforts;
- Integrating stakeholders in planning of efforts and activities on early stages in Steps 1 and 2 of the management cycle;
- Identify an EPA person that is familiar with coral reef management efforts and circumstances in Puerto Rico that can serve as liaison to Region 2 and Region 4, as well as jurisdictional and federal agencies;
- Improve communication between DNER and EPA regarding how funds will be spent to increase collaboration opportunities;
- EPA integration in steering management committee for North East Reserve Management Plan Project (land and marine aspect); and,
- Integration in Watershed Management Plan development for NE Reserves and Culebra.

Associated PSD Goals: A1 and A2

Recommended Lead: NOAA CRCP, DNER

Potential Partners: EPA Region 2

Recommendation 3.3: Re-invigorate Working Groups, Committees and Regional Partnerships

While the idea of creating (or renewing) “another committee” may not be met with universal elation, there is a history of effective committees and working groups within the Puerto Rican natural resource management network that can be built upon to improve collaboration and management function. For example, since its creation in the 1970s, DNER has formed task forces on fisheries, coral reefs, and protected areas. DNER’s Coral Reef Committee includes representatives from relevant units within the agency who communicate, share ideas and make recommendations to the Secretary on coral affairs. The group evaluates the status of ongoing projects associated with coral reefs, discusses needs, and identify future steps and plans. This includes coral permits, and the development of proposals, among other tasks. Working groups at various field sites have reportedly been productive at times. The quality of the collaboration of these groups was described as depending on a combination of factors including the personality and drive of the key contributors and the degree to which they are issue driven and have secured formal commitment. Similarly, there are several regional initiatives in place around the Caribbean that could be useful to the Puerto Rican coral management community. One example of a recently formed group that intends to add to the regional coordination is the EPA Caribbean Coral Reef Protection Group.

3.3A Re-invigorate Coral Committees and Fisheries Working Group (*Junta de Pesca*) Coral committees, both within and external to DNER, should be re-invigorated to provide a forum for managers to continue to

collaborate, coordinate and synergize their activities. While the intra-DNER coral committee works relatively well, it will be important to improve the coral committees external to DNER. The *Junta de Pesca* and the fisheries task force within the DNER Ranger Corps are in the process of being re-invigorated after disbanding several years ago and we applaud this renewed effort. The *Junta de Pesca* involves recreational fishers, commercial fishers and people from DNER to review fisheries regulations and make recommendations. The Coral Committee contributes to highlighting issues of coral reef management within the agendas of the participating agencies, including issues such as non-point source pollution and water quality. An inventory and simple timeline of these collaborative groups as well as a scan of other effective collaborative strategies in other jurisdictions is needed to help inform the process of building task forces that generate meaningful results.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER

Potential Partners: All relevant partners

3.3B Link to Regional Initiatives: The Puerto Rico coral reef management system could benefit from linking to regional partnerships including the Caribbean Challenge, NOAA in the Caribbean, EPA Caribbean Coral Reef Protection Group, and the National Ocean Policy, and the Caribbean Landscape Conservation Cooperative (CLCC) among others. A regional perspective would encourage a broader analysis of issues related to coral reef management that includes fisheries, marine spatial planning, enforcement and compliance, supportive and informed constituencies, political will, etc. DNER could bring forth these issues in such a collaborative forum and that would allow the steering committee to decide what issues (Step 1) they will and will not address in their current management generation.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER

Potential Partners: Caribbean Challenge, EPA Caribbean Coral Reef Protection Group, NOAA in the Caribbean, CLCC, and the National Ocean Policy

Recommendation 3.4: Valuation Studies

Another strategy for strengthening formal commitment and building constituencies for coral conservation would be to “make the business case” for improved coral reef management, such as investing in studies that document the economic and societal benefits of sustaining and restoring coral reefs and their associated fisheries. The economic activity generated by coastal and beach recreation and by recreational boating are large and include the funds expended each year in boats, marina fees, maintenance and repairs, fuel, fishing tackle and associated restaurants, hotels and other related businesses. Studies that link this economic activity to recreational fishing and appreciation of coral reefs can underscore their significance as generators of revenue. Dissemination of information on the potential economic benefits of recreational fisheries demonstrates the economic benefits of more effective fisheries management. For example, a mature bonefish repeatedly caught and released in waters off Florida has been shown to generate several thousand dollars a year in economic activity. In Puerto Rico, these fish are found as juveniles in several lagoons where many are caught before they become mature – primarily by illegal fishers who place gill nets in the inlets of lagoons at night. This is a powerful illustration of the potential economic benefits of more forceful implementation of existing fishery regulations.

3.4 Valuation Studies: Inventory available, and conduct or update, as appropriate, studies that document the market and non-market value of healthy coral reefs. For example, a recent report prepared by IVM Institute for Environmental Studies documents the economic value of the coral reef ecosystem in US Virgin Islands. The resulting annual total economic values vary between ecosystem services: reef related tourism (\$96 million); recreation (\$48 million); amenity (\$35 million); coastal protection (\$6 million); and support to commercial fisheries (\$3 million) adds up to \$188 million per year. Such values can be used to make the case for financing coral reef management and building adaptive capacity. Such an analysis should also include important non-market, ecosystem services of healthy reefs such as cultural aesthetic and intrinsic values. Such studies could provide needed support to invest in programs such as addressing illegal gill-netting that catches juvenile fish and hampers fish population recoveries particularly herbivores that perform an ecosystem function of removing macro-algae.

Associated PSD Goals: Promotes formal commitment to support all PSD goals

Recommended Lead: DNER, NOAA CRCP

Potential Partners: TNC, World Resources Institute, IVM Institute for Environmental Studies, Stratus Consulting

Recommendation 3.5: Products and Events to Promote and Popularize Coral Conservation

Building supportive and informed constituencies for improved coral conservation and management is an ongoing task that is never truly complete or accomplished. Nonetheless, CRCP and DNER can promote concrete initiatives that build momentum toward this goal.

3.5A Encourage Compliance: In addition to a strong and functional DNER Ranger Corps, investments should be made to engage the fishing community in a strong, participatory process to help fishers develop a specific and achievable vision of a sustainable future for fishing in Puerto Rico that includes measurable and time-bound interim goals. For example, the St. Thomas Fisherman's Association in the USVI has been involving fishers in the active process of conducting research and collecting data, both providing supplemental income to some fishers as well as bolstering communication and trust between the research and fishing communities. In Puerto Rico, such a process could be focused on an issue in a specific geography such as development pressure near the Northeast Reserves. An iterative process to engage fishers in selecting and refining closed areas and other geographic-based restrictions has proved successful elsewhere (Lopes et al. 2013). Ideally, leadership from a trusted organization such as the Caribbean Fisheries Management Council could serve to guide such an effort. Only with such an agreed-upon and mutual vision can the fishing community can work collaboratively to ensure widespread compliance with rules.

Associated PSD Goals: A3, B2, B3, C1, and C3

Recommended Lead: DNER

Potential Partners: NOAA CRCP, Caribbean Fisheries Management Council, recreational and commercial fishers and their networks

3.5B Coral Celebration: Plan and implement a high visibility annual celebration of Puerto Rico's fisheries and coral reefs. Potentially coordinate with existing celebrations such as Planet Earth Month, Ocean Week or the celebrations surrounding *La Noche de San Juan* or Saint John's Night (June 23). Engage the Governor in the event with presentations that honor teams working on coral reef stewardship, educational programs, science achievements etc., and conclude with brief summary of what is being done to and commitment for support of coral reef management. The Governor could give prizes to initiatives by individuals, groups and governmental

and nongovernmental organizations that make reef stewardship operational. The publication of updated versions of “Puerto Rico and the Sea: An Action Program for Marine Affairs” (Recommendation 3.4A) could be tied to this annual celebration.

Associated PSD Goals: Promotes formal commitment to support all PSD goals

Recommended Lead: DNER Coral Reef Committee

Potential Partners: All parties involved in coral reef management

3.5C Update and Disseminate Revised “Puerto Rico and the Sea”: In 1972 and again in 1999, DNER published “Puerto Rico and the Sea: An Action Program for Marine Affairs.” This valuable publication should be updated and widely disseminated as soon as practical, and should be revised in the future on a regular schedule (e.g. every five years). This publication can serve as a useful vehicle to re-assess the state of the Commonwealth’s reefs and marine resources and can be used as a tool to improve continuity across political administrations and to build political will for marine conservation. Of note were the detailed recommendations that were based on a wide systems view and written from people from within the system who have a far stronger sense of current reality as opposed to external consultants.

Associated PSD Goals: Promotes formal commitment to support all PSD goals

Recommended Lead: DNER

Potential Partners: CZM Program

Recommendation 3.6: Define Priorities for Integrating Natural and Social Science in Coral Reef Management

There was clear recognition for the need to integrate information and knowledge across scientific disciplines and more specifically, ensure that issues including human dimensions, ecosystem valuation, adaptive capacity, and scenario studies for alternative and plausible futures in the face of ecosystem change are better understood and effectively responded to in Puerto Rico. Such integrative and adaptive action is recommended at priority sites so that future LAS management strategies emerge that integrate social science into the more traditional natural science and resource tracking and monitoring focus.

3.6 Broaden Focus of Any Coral-Related Conferences and Symposia: To the extent that NOAA and DNER are consulted or involved in the creation of agendas or conference themes, any managers involved should encourage future symposia and conferences on coral reefs and associated fisheries issues to bring together managers, administrators and stakeholders and not limit presentations and discussion to only “the science.” Use of a common management conceptual framework will increase the quality of panel discussions, simulations and other techniques for instigating exchange and integration.

Associated PSD Goals: Improves capacity in support of all PSD goals

Recommended Lead: DNER

Potential Partners: NOAA CRCP and Caribbean Field Office, Puerto Rico Sea Grant, EPA, USFWS, CLCC and all relevant implementation partners

Section Five: Developing a Strategy for Building Adaptive Capacity in Puerto Rico to Improve Management of Coral Reefs

5.1 Short- and Long-term Capacity Building Strategies

This section begins with a review of the three-phased approach to the capacity assessment process and the critical importance of the final phase of post-assessment. This is the most important phase as it represents a transition from the capacity assessment to the development of an action plan that features three main groups of recommendations, many of which can be framed into a series of implementable activities that can be sequenced and prioritized to build needed momentum for effective coral management. While there are no panaceas or “silver bullets” for building capacity for coral reef management, this action plan is needed to guide involvement of multiple implementing partners. Capacity building for improved coral reef management is a long-term process and no one group alone will have the power, resources or skills to respond to the increasing issues, challenges and degree of complexity. Likewise, there is no single group that is expected to provide the wide portfolio of tools, methods, trainings etc., to support adaptive capacity and more effective coral reef management. Therefore, a distributed approach to capacity building is needed that features both short-term and long-term investments. In other words, it takes a village.

A blended approach is recommended to sequence and prioritize what is done. Less expensive tactical capacity building is needed to build momentum, adding building blocks that address some aspects the current challenges of coral reef management. Long-term sustained strategies are also needed to address operational issues of staff turn-over and retirement, changing political administrations, as well as dynamic trends in social and biophysical health and well-being. Blending strategies that address both short- and long-term capacity building issues can guide an action plan.

To develop this action plan, the recommendations within this document have been divided into three groups based upon their complexity, scale, practicality and control of implementation. The first group is a set of essential recommendations that are complex largely because they are highly political in nature and therefore decisions regarding the timing and strategy must be made at upper administrative levels who will factor in a wider range of issues. The second group involves implementing a more collaborative and coordinated approach to management at select focal areas and involves interconnected systems and engagement with resource users, other managers and funders of coral reef management. Implementing these recommendations will require a significant degree of coordination, formal commitment and adaptive implementation. To assist in this process, a common management framework is featured to underscore the importance of tracking both process and outcomes to help map the development of this action plan. The third and final group is a prioritized range of recommendations that are designed to build capacity at an organizational scale where leadership and control over implementation is relatively high. This final group of capacity building recommendations is important, but likely will not be as effective without progress made in the first two groups.

This section concludes with a set of principles, tips and suggestions for a more integrated and strategic approach for how to implement and track the development of capacity building, paying attention to patterns, trends and indicators of how to improve capacity building strategies. While much of the focus of this document is on DNER, capacity

building is a shared responsibility across all management partners. The process of building and maintaining adaptive capacity, as a key function of the ecosystem approach, takes far longer than one might expect and is a long-term commitment. It requires the development of an action plan, adaptively implementing and experimenting, and seeking out leaders across the implementing partners who can carry forward its importance. The action plan requires an honest assessment of what can actually be done in a given timeframe and at what scale, constantly assessing and reassessing where the power is in the system and how power may be shifting, where the threats are and how they are shifting, where the windows of opportunities are and how they are opening and closing. Building a shared understanding of these dynamics and acting upon them is a process that develops over time, ideally across organizations. This section of the report provides a preliminary strategy or “road-map” for the development of an action plan that ultimately can only be developed by implementing partners.

5.2 Three Phases of the Assessment of Coral Reef Management Capacity

There are three phases to the capacity assessment process: Phase I featured a focus and initiation of the capacity assessment and began with the priority setting process in Puerto Rico in 2010 and continued through the development of the most recent Local Action Strategies in 2011 and concluded with the formation of the J-CAT in Fall 2012. Phase II featured the collection and examination of information related to capacity, a building understanding of needs across stakeholders, summarizing key issues and prioritizing recommendations. This phase is concluded with the preparation of this report. Phase III is based upon the distribution of the report, a socialization process that includes soliciting and receiving comments, preparing an action plan based upon local context, implementing and monitoring the plan for a defined time period, and evaluating what was learned from the capacity assessment process and defining further action.

Given that building capacity of coral reef management is a journey, with no clear and precise destination, a “road map” can be a useful tool. This section is intended to provide the basics of a roadmap for making the transition from Phase II to Phase III.

The importance of Phase III or post-capacity assessment, cannot be overstated because very little will happen if post-assessment activities do not take place. If Phase III is done well, it positions DNER and the coral reef management network for improvement and further development toward its intended goals. If results are not acted upon in some manner, it can serve to undermine future processes of stakeholder engagement in Puerto Rico and underscore the inadequacy of the status quo. Key actions in the building of an action plan include engaging a team to finalize the sequence and prioritization of the strategy, identifying persons responsible, and creating timelines and mechanisms for assessing progress. Success will be determined by both the substance of the plan as well as the facilitation process used to broadly communicate and gain support for the plan, adaptively implement it, monitor activities associated with it, and revise it as needed. The following sections have been developed with insight from experiences in building capacity for the ecosystem approach in other locations around the world and in a wide range of organizational development contexts (Stevahn & King, 2010).

Building capacity requires change. Change, by its definition is acting in new ways, using resources differently, and seeing the world through fresh eyes. This is neither easy nor simple, indeed it is complex and can create discomfort, anxiety, confusion, and some ineffectiveness when transition occurs from one way of doing something to another. Adaptive capacity is rooted in the ability to collectively work through concerns, anxiety and fears as new practices are

tested, new skills developed, and new understandings are revealed (Fullan, 2007). Done well, positive momentum is built and can be leveraged for greater change. Done poorly, it reinforces fear, anxiety and mistrust. A range of literature exists that can guide organizations through the developmental steps of change and selected references are presented in the organizational development section of Appendix C.

Potential positive benefits include reinvigoration of members of the coral reef management network in Puerto Rico, providing actionable steps for the new DNER leadership to commit to building stronger collaborations across the network of organizations involved in coral reef management, and increased adaptive capacity. Given the new administration within DNER, a window of opportunity exists to focus on long-term commitment for sustained capacity building for coral reef (and other natural resource) management. As such, a customized plan is recommended which identifies a “home” and most accountable person for overseeing implementation of capacity building efforts. Such a strategy should feature a detailed budget, timeline, milestones, and contextually relevant principles for capacity building within DNER. The strategy document should be distributed widely and feature clear opportunities and specific budget justifications that could become part of external funding requests to federal implementing partners and foundations. Such a strategy should include a detailed directory of capacity building training modules that currently exist and those that need to be developed (see Appendix E).

5.3 Key Considerations For Developing A Post-Assessment Action Plan

Key considerations include whom to involve in the capacity building action plan/implementation process, defining the necessary logistics, networks and norms for communication, and developing proper methods for information management (Stevahn & King, 2010). These elements are described briefly below:

- **Involvement in a Capacity Building Action Plan:** Involvement in the process of defining the capacity building action plan and overseeing its implementation should be carefully considered. Major tasks may include the development of an action plan, making final decisions about when to implement which specific actions, monitoring progress and evaluating the effectiveness of the plan as it relates to goals for building capacity. The first major step is circulating the document and seeking input. The J-CAT members are ideal distribution channels but should not end with this. A distribution strategy and possibly convening a listening session to review response may elicit useful feedback. Ideally, a small representative group who are invested in seeing resources directed to address persistent capacity issues, barriers etc. would make an ideal committee to oversee implementation. While it does not need to be precisely the same members as the J-CAT, it serves as a logical starting point from which to build. A capacity building committee could nest within an existing committee structure, such as a coral reef committee within DNER that would report out to the All Islands Committee of the Coral Reef Task Force. However, capacity building should be a shared responsibility and needs to have appropriate authority from upper-level administrators to assign activities and delegate tasks so that implementation is a distributed and shared agenda.
- **Logistical Concerns:** A central aspect for implementing a capacity building action plan is to engage the group defined above in the process and outcomes. A series of logistical concerns should be attended to that includes maintaining calendars, scheduling committee meetings, preparing agendas, and documenting completion of capacity building activities. A major step is defining who is responsible for managing

logistics. One or two additional FTEs should be sufficient to oversee this work if it was blended with other related tasks and responsibilities of coordinating capacity building for resource management in Puerto Rico.

- **High Quality Communication:** The culture and quality of communication around the importance of building capacity defines the spirit and intent. Ideally, communication around capacity building is appreciative, open, honest, responsive, and culturally appropriate. Unfortunately, breakdowns and other issues associated with communications are at the heart of organizational conflicts, interpersonal challenges and program difficulties. Establishing agreed upon communication protocols and adhering to them can improve the communications process.
 - Communication within committees: good committee behavior is the responsibility of all involved and will only become a norm if it is established from the start and reinforced through periodic reflection. A brief list of best meeting practices should be distributed that should be customized to fit the cultural context and could include the following: engage all voices, listen respectfully, explore alternatives, raise issues constructively, appreciate each persons skills, unique histories, perspectives, and talents. Assume confidentiality unless otherwise defined and mutually agree on what information is to be shared with others outside the meeting.
 - Communication among committees: Since there are a growing range of committees that are associated with coral reef management, defining the general guidelines for how to track their progress and ways to best communicate among them is an essential element of capacity building. Once established, a short and simple protocol may be needed to ensure that this level of communications sharing is maintained.
 - Communication beyond committees: It is often not made clear what information can be shared outside of coral reef management committee structures such as other administrative hierarchies, governing or advisory boards, private sector operations, program funders etc. The leadership team should define policies, guidelines and procedures for communication beyond the coral reef management committees.
 - Electronic communication: Sharing information electronically is rapid, efficient and inexpensive with quick turnaround potential. Given that e-mail and technology overload is a possible downside, set guidelines for electronic communications such as a file naming convention, using shared directories or a shared project website to host information in one location, and describe the situations where e-mail is preferred or face-to-face communication is preferred.
 - Confidentiality: Transparency fosters trust but can work against confidentiality. It is helpful to appreciate the tension between confidentiality and transparency and by agreeing with the group what information, documents, can be shared and what should remain confidential. Be clear and direct on matters regarding confidentiality.
- **Information Management:** document and keep records of actions that have been taken to build capacity so there is an easy to follow trail that documents the degree to which resources have been allocated to this end. Such a document trail is useful for reflecting on actions taken and the level of

investment allocated. Examples include chronological timetables of various steps in the capacity assessment and capacity building, records of training, assessment reports and findings, evaluations of coral reef management and capacity building efforts. Such information is the basis for high quality lessons learned, ensuring a knowledge base is maintained in the face of unexpected events, such as staff turnover, new leadership, new budget priorities, and program audits.

5.4 Grouping Recommendations

As presented in Section Four, the recommendations that would serve as the basis for an action plan are divided into three groups. The first group involves recommendations that require decisions that are political in nature and requires decision-making from senior administrators. The ultimate timing, control and direction needs to be decided from the highest levels of government within the Commonwealth. These actions are the most critical for long-term adaptive capacity to be built into the system of coral reef and other Ecosystem-based Management. The second group requires the collaborative force of implementing partners working closely with funding partners to model a customized form of Ecosystem-based Management that is based on a shared language and process of management. The outcomes of these actions are in the hands of the implementing partners. The third group are a range of actions that can be done at the scale of committees, task forces, within organizations, and by groups of individuals. These are important, but their overall impact will only be realized if there is significant progress with capacity building in the other two groups. Much of what we have found regarding capacity to manage coral reefs in Puerto Rico is positive. As the timeline shows, there is a strong history of building capacity to manage coral reefs in response to systems change.¹ Currently, with new leadership in DNER, there is a revived sense of hope for building capacity within the Commonwealth to manage natural systems. The Puerto Rico DNER Ranger Corps (hereafter DNER Ranger Corps) is an enforcement unit that provides an outstanding basis for building enforcement capacity. There are increasing numbers of natural and social scientists, with experience in Puerto Rico, growing an academic and research capacity base. There is a growing number of NGOs that are working at multiple scales, growing a civil society capacity base. Federal agency investments to improve management of coral reef have increased over the past 10 years, adding significant capacity for improved management. However, as stated in this report, there are clear gaps, barriers and impediments to management. While there is no clear path or panacea, there are highly significant actions that we believe, if accomplished, would have a major and visible impact signaling clearly that there is momentum for improved coral reef management in Puerto Rico.

This first group begins with utterly critical recommendations aimed at accomplishing true reform of the DNER Ranger Corps. If enforcement remains dysfunctional and nonoperational, voluntary compliance is undermined and the entire management system crumbles. Addressing the DNER Ranger Corps must be done in a clear-headed recognition of the dangers, pressures, and threats of the drug trade.

Next in the first group of recommendations is the enactment of a recreational fishing license program (Recommendation 1.2), and the use of associated funds to support fishing data acquisition, habitat restoration and other measures to improve marine resource conservation. Completing the license program is related to the larger issue of completing formal rulemaking for Law #147, making the law truly operational (Recommendation 1.3). If the new leadership felt that the political timing for taking these steps is correct (this is their judgment and we cannot make this

¹As an example, the brave and improbable quest in 1972 to save the coral reefs of Culebra from use as a target range is now a 260-page book entitled [Islands Under Fire](#) by Kevin McCarey.

decision) and they were completed, it could have a huge impact. All of this requires formal commitment and needs political support and should be decided very carefully. The decisions that are made should be tracked as to why they were made and the likely consequences regarding capacity. It is important to restate that this first group of recommendations includes difficult political decisions that need to be made by senior officials in Puerto Rico who must factor in a wide range of issues, goals and agendas so that the implementation fits within the larger political context.

The second group involves a series of actions that can be done largely within a relatively small segment of the coral management network. This set of actions is largely independent of progress associated with the first group, although they would be greatly enhanced by accomplishing measures with that group, but are nevertheless important and would positively affect the development of adaptive capacity. Together, the recommendations in Group 2 promote the collaborative use of a common management framework to sequence and prioritize implementation in select priority areas. To be effective, this would require linking with funding partners such as NOAA and NFWF in the short run to tie funding to the strategy for implementation and adaptive learning. Ideally there are additional federal partners in the future, but in the near term, this would be applied at a demonstration scale, with a few select partners that is tied to specific funding opportunities such as the NOAA Cooperative agreement and NFWF support for priority watershed investments at Guánica. As a condition of the grant, the recipients would track progress of implementation through a simplified monitoring and evaluation process. Since this strategy pertains to the preparation of proposals, including how they are written, the setting of priorities and how they administered, this action requires strong commitment, partnership and a shared agenda among funders and the recipients. In short run, it is our advice to keep it as simple of a process as possible, provide clear guidance and training for those who are preparing proposals so they are clearly identifying what part of the management cycle they are contributing to, and how they will track progress along the way. As a pilot demonstration, we suggest starting in the priority areas of Guánica and NE Reserves/Culebra.

The third group of recommendations includes actions that contribute to building capacity, can be controlled by one or a few organizations and don't require significant resources. We believe these are good places to build capacity as long as attention is paid to implementing the top two groups described above.

5.4 Principles of Building Adaptive Capacity

The process of developing coral reef management strategies, winning support among a diversity of stakeholders and commitment from government, and then implementing a plan of action over the long term is a complex undertaking. It requires integration among a great diversity of activities while remaining sensitive to the broader political and social context. Well-integrated and strategic management can generate and sustain the conditions in which a coral reef management initiative can take root, flourish and generate the outcomes that justify the time and resources invested in the process. Our assessment of coral reef management in Puerto Rico has found that a common understanding of the management process, and confidence that the necessary institutions can be successfully brought together to commit to a common course of action, are not currently present. Creating these conditions and thereby assembling the enabling conditions for effective coral reef management needs to be built upon a shared understanding of how the diverse factors that contribute to effective management can be brought together.

A summary set of principles to undergird a long-term capacity building strategy is as follows:

Principle #1: Issues Drive Need for Building Capacity. Building adaptive capacity needs to be directed at a set of issues, as described in this and earlier reports on coupled social biophysical issues relating to coral reef health. There should be direct links between the issues and this strategy. Issues should matter most to the people of the place and represent both challenges and opportunities. Issues change and may become more or less important over time and new ones will form in the coming years, some through crisis and others gradually over time. Therefore an adaptive strategy is needed to respond to the range of issues associated with management of coral reefs.

Principle #2: Define the Audience. Once the issues are identified, an assessment of capacity needs should follow that is directed at the appropriate “levels” in the management system (field operations, managers, decision makers). Capacities can be directed at an individual, groups, teams, organizations, and across networks. What matters most is defining who currently needs the capacity and who may need such capacity in the future.

Principle #3: Focus on the Purpose of Building Capacity. Once the audience has been identified, the questions center around defining what capacity is needed and what it will accomplish. Identifying the competencies that are desired in precise terms is essential and best accomplished with clear and unambiguous goals.

Principle #4: Context is Key. There is no “one” strategy to build capacity, and if one strategy works well in one location, it may or may not work well elsewhere. Given the complexities in coral reef management, bundles of capacity building strategies are needed that fit in the local context, are timely, appropriate and balanced across audiences. While basic capacity building needs in Puerto Rico are mostly similar across the territory, issues play out differently across the mosaic of contexts on Puerto Rico.

Principle #5: Long Term and Sustained Action, Built on Success. A long-term and sustained commitment to building capacity must address frequent staff turnover, shifts in the social, political and environmental issues, ongoing learning and the need for adaptation. Fortunately, such a long-term perspective seems to be evidenced across current federal, territorial and NGO partners. A long-term strategy must be built on successes within Puerto Rico to keep momentum strong.

- Evoke purpose: “To build capacity to cope with and adapt to the long-term pace of ecosystem change that’s likely ahead and still have functional reefs to support a tourism economy, fishing communities and a unique way of life.”
- Must understand current governance structures – what does exist – and what does not yet exist but may be needed.
- Great progress has been made in developing a range of management responses to coral reef condition but the proper fit, interplay and scale of governance response to ecosystem change will be an issue into the future. We recommend using a range of effective diagnostic methods² to periodically assess the capacity to manage coral reefs and the governance structures within which they fit as a central feature of a long-term strategy.
- Periodically review the issues (every three to four years) and the degree to which the issues are important to key stakeholders. Such an assessment should include a review of the power relationships, effectiveness

²The methods used for this capacity building assessment could serve as a baseline from which to measure future changes, particularly if analysis of governance structures is featured as a unit of analysis.

of enforcement and compliance, best management practices and the degree to which there is formal commitment and supportive and constituencies for sustained coral reef management. Excellent facilitation is needed to host the dialogue and invite other key stakeholders from across civil society, market forces such as tourism and other forms of government to engage.



Honeybees enjoying the nectar of a waterlily in Cabo Rojo. (Photo credit: Glenn Page, SustainaMetricx.)

Literature Cited

- 2010 Census. (n.d.). Census Bureau Homepage. Retrieved April 9, 2013, from <http://www.census.gov/2010census/>
- Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. *Economic geography*, 79(4), 387-404.
- Adger, W. N., & Vincent, K. (2005). Uncertainty in adaptive capacity. *Comptes Rendus Geoscience*, 337(4), 399-410.
- Allison, H. E., & Hobbs, R. J. (2004). Resilience, adaptive capacity, and the lock-in trap of the western Australian agricultural region. *Ecology and Society*, 9(1).
- Assessment, M. E. (2005). Millennium Ecosystem Assessment. *Ecosystems and Human Well-being. Synthesis*.
- Ballantine, D. L., Appeldoorn, R. S., Yoshioka, P., Weil, E., Armstrong, R., García, J. R., ... & Lilyestrom, C. (2008). Biology and ecology of Puerto Rican coral reefs. In *Coral Reefs of the USA* (pp. 375-406). Springer Netherlands.
- FAO. (1995) Code of Conduct for Responsible Fisheries Rome, FAO. 41 p.
- Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S., & Walker, B. (2002). Resilience and sustainable development: building adaptive capacity in a world of transformations. *AMBIO: A journal of the human environment*, 31(5), 437-440.
- García-Sais, J., Appeldoorn, R., Battista, T., Bauer, L., Bruckner, A., Caldow, C., ... & Williams, S. (2008). The state of coral reef ecosystems of Puerto Rico. *The state of coral reef ecosystems of the United States and Pacific Freely Associated States*.
- Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (26th sess.: 1996: Paris), & Intergovernmental Oceanographic Commission. (1996). IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP): Report of the 26th Session, Paris, 25-29 March 1996.
- Matos-Caraballo, D., & Agar, J. J. (2011). Census of Active Commercial Fishermen in Puerto Rico: 2008. *Marine Fisheries Review*, 73(1), 13-27.
- McCarey, K. (2012). *Islands under fire: the improbable quest to save the corals of Puerto Rico*. Flagler Beach, Fla.: Ocean Publishing.
- McLeod, K., & Leslie, H. (Eds.). (2009). *Ecosystem-based management for the oceans* (p. 392). Washington, DC: Island Press.
- Miller, G. L., & Lugo, A. E. (2009). *Guide to the ecological systems of Puerto Rico*. US Department of Agriculture, Forest Service, International Institute of Tropical Forestry.
- National Research Council (2008) *Increasing Capacity for Stewardship of Oceans and Coasts: A Priority for the 21st Century*, National Academy Press.
- NOAA CoRIS - Regional Portal - Puerto Rico. (n.d.). NOAA Coral Reef Information System (CoRIS) Home Page. Retrieved April 9, 2013, from <http://coris.noaa.gov/portals/puertorico.html>
- Olsen, S., Tobey, J., & Kerr, M. (1997). A common framework for learning from ICM experience. *Ocean and Coastal Management*, 37(2), 155-174.
- Olsen, S.B.; Page, G.G. & Ochoa, E. (2009): *The Analysis of Governance Responses to Ecosystem Change: A Handbook for Assembling a Baseline*. LOICZ Reports & Studies No. 34. GKSS Research Center, Geesthacht, 87 pages.
- Pelling, M., & High, C. (2005). Understanding adaptation: what can social capital offer assessments of adaptive capacity?. *Global Environmental Change*, 15(4), 308-319.
- Reef Resilience Tool Kit. (n.d.). Reef Resilience: Building Resilience into Coral Reef Conservation. Retrieved April 9, 2013, from http://reefresilience.org/Toolkit_Coral/C1_I
- Stevahn, Laurie, Jean A. King. 2010. *Needs Assessment Phase III: Taking Action for Change* (Book 5 of Needs Assessment Kit). Sage Publications, Thousand Oaks, CA.
- The Commonwealth of Puerto Rico and NOAA Coral Reef Conservation Program. 2010). *Puerto Rico's Coral Reef Management Priorities*. Silver Spring, MD: NOAA.
- UNEP/GPA (2006). *Ecosystem-based management: Markers for assessing progress*. UNEP/GPA, The Hague
- University of Puerto Rico, (1972) *Puerto Rico and the Sea: An Action Program for Marine Affairs : a Report to the Governor*, San Juan

User's Guide for the NOAA Coral Reef Conservation Program MPA Checklist. (n.d.). National Oceanic and Atmospheric Administration. Retrieved April 9, 2013, from http://data.nodc.noaa.gov/coris/library/NOAA/CRCP/other/other_crcp_publications/mpa_checklist/noaa_mpa_checklist_user_guide.pdf

Woodland, R. H., & Hutton, M. S. (2012). Evaluating Organizational Collaborations Suggested Entry Points and Strategies. *American Journal of Evaluation*, 33(3), 366-383.

Wusinich-Mendez, D. and C. Trappe (eds.). 2007. Report on the Status of Marine Protected Areas in Coral Reef Ecosystems of the United States Volume 1: Marine Protected Areas Managed by U.S. States, Territories, and Commonwealths: 2007.



Mangrove Crab in its habitat in Cabo Rojo. (Photo credit: Glenn Page, SustainaMetricx.)

Appendix A: Timeline

Event	Start Date	End Date	Description
First reports of the Taínos inhabiting the Island	1270	1570	Agrarian community, first inhabitants of the Island.
Puerto Rico discovered by Westerners on Christopher Columbus's 2nd voyage	1493		
Spanish colonists promoted and established sugarcane plantations from sugarcane exported from Dominican Republic	1500		48% of the land was cleared of its native forests.
Africans introduced to the Island	1518		Used as force for the agrarian labor.
Coffee is introduced in the island	1755		Agricultural boom starts around this period with its peak in the 1800's.
Spanish-American War: Puerto Rico is officially ceded to the United States	1898		
Island's name is changed to Porto Rico and the US dollar is instituted as currency	1899		
Puerto Rico's Department of Education is created	1900		
US passes the Foraker Act instituting a civil government in Puerto Rico	1900		
University of Puerto Rico created	1903		
Jones Act grants US Citizenship to Puerto Ricans	1917		
7.7 Earthquake with Tsunami that affected the west of the area (i.e. Mayagüez)	1918		Extensive damage occurred.
The island receives funds from the Smith-Hughes law	1930		Provided funding to establish vocational education in areas like agriculture and industry.
Creation of the Puerto Rico Reconstruction Administration	1935	1940	As part of the New Deal, the Puerto Rico Reconstruction Administration is created to provide for agricultural development, public works, and electricity.
Luis Muñoz Marín founded the Popular Democratic Party (PPD)	1936		
First Fisheries Law #83 enacted	1936		Established during the Great Depression with the purpose of opening up opportunities for people to make money and feed their families by fishing on the reef.
Land Reform Act (Muñoz Marín and Tugwell's)	1941		Muñoz Marín and Tugwell spearheaded the creation of land reform laws that limited land ownership, allowed for growing crops for profit for both export and internal use, thereby breaking up the land monopoly of the large sugar companies.
Fisheries Industry Support Program established (Dept. of Interior and PR Agriculture Dept.)	1941		
Fishery Management Plan for Corals and Reef Associated Plants and Invertebrates of Puerto Rico and the USVI published	1994		First documents with specific management recommendations for coral reefs for these jurisdictions.
Post-war wave of Puerto Ricans immigration to the US mainland	1945	1953	Spurred by economic opportunities in the US's booming post-war economy.
Puerto Rican Independence Party (PIP) formed	1946		
US appoints Jesus T Pinero as Puerto Rico's first Governor	1946	1949	
Elective's Governor Act	1947		US approves legislation, Puerto Ricans were allowed to chose their own governors and vote.

Event	Start Date	End Date	Description
New Progressive Party (PNP) formed	1948		
Operation Bootstrap	1948	1960	450 new factories and businesses started, major transition for Puerto Rico from a largely rural agrarian society, to the modern industrial economy it is today. By 1956, industrial development had surpassed agriculture as the principal source of income. New initiatives in public education and vocational training were part of this program.
Luis Muñoz Marín	1949	1964	Munoz Marin was elected by popular vote and served four terms. His economic development program, Operation Bootstrap, industrializes and urbanizes the island leading to a higher standard of living than ever before.
The San Juan National Historic Site was established	1949		
Sand extraction from 10-meter high sand dunes in Piñones for use as fill for the wetlands south of the Piñones' lagoons to build the International Airport	1950	1959	This created a permanent problem of shoreline erosion and recurrent coastal flooding.
The Puerto Rican Commonwealth Bill is signed, paving the way for a Puerto Rican constitution	1950		
Puerto Rico's Constitution is proclaimed establishing a commonwealth with autonomy in its internal affairs	1952		
Peak migration of about 75,000 Puerto Ricans move to the US	1953		
UPR Mayagüez campus gets an institute of marine biology	1953		It did not offer degrees, but it supported marine ecology courses, marine research, etc.
Organic Act	1954		Established Puerto Rico as a US Territory.
Punta Miquillo, a tourist resort and residential development, is built	1960	1969	Deforestation and filling of more than 1,000 hectares of continuous mangrove forest, wetlands and other estuarine habitats.
Refugio de Vida Silvestre opens as an agricultural station (USDA)	1964		
Governor Roberto Sanchez Viella administration	1965	1969	
Fisheries Research and Development Program (Dept. of Interior and PR Agriculture Dept.)	1966		
Ocean Eagle accident in San Juan	1968		
UPR Mayagüez Institute of Marine Biology is turned into the Department of Marine Science	1968		Offered masters and PhDs, but not bachelors degrees.
Fisheries research Laboratory created	1969		
Governor Luis A. Ferre administration	1969	1973	
Operation Bootstrap (Second phase, stimulated by Fomento: Puerto Rico's Development Bank and Economic Development Administration)	1970		This program attracted capital-intensive industries such as petro-chemical and pharmaceutical companies. The Operation Bootstrap Program also made it possible to develop a thriving professional class of lawyers, engineers, business managers, and financial executives needed to make these businesses run. It worked, and Puerto Rico became a showcase for other less developed economies in the Caribbean to emulate.
Sea turtle species listed under US Endangered Species Act	1970	1980	
Refugio de Vida Silvestre becomes a DNER refuge	1972		
Senate Act proposing Territorial Park System	1972		

Event	Start Date	End Date	Description
Creation of the Department of Natural Resources (later becomes the Department of Natural and Environmental Resources)	1972		
Release of a citizens' report Puerto Rico and the Sea	1972		Program sponsored by the governor to develop a blueprint for Puerto Rico and the Sea (section on education, tourism, economic development, fisheries, etc.).
Proposed regulation for coral conservation, including control of dredging that causes reef sedimentation, are rejected	1972		
First and only currently existing undergraduate degrees in bachelors of marine biology offered at UPR Humacao	1972		
Convention on International Trade of Endangered Flora and Fauna went into effect	1973		
Governor Rafael Hernández Colon administration	1973	1977	
Oil tanker Zoe Colocotronis runs aground on a reef off of La Parguera	1973		Caused a big oil spill - first time that such a huge impact was made at that part of the island.
NOAA proposed a marine sanctuary in Parguera (not approved)	1975		The community opposed the program because they were not consulted and the sanctuary did not go through
The US Navy left Culebra	1975		Unexploded ordinance was still seen as recently as 2001. After the Navy left, 702 acres were transferred to the Fish and Wildlife Service.
The Environmental Quality Board again proposes new coral policy regulations	1975		Not effectively instituted.
First PhD in marine science awarded by UPR Mayagüez	1976		
Caribbean Fisheries Management Council is started	1976		Responsible for nearshore resources if local governments do not effectively protect and Councils also develops fisheries management plans for coral reefs as a habitat.
Governor Carlos Romero Barcelo administration	1977	1985	
Creation of DNER Ranger Corps	1977		First time fisheries protocol was managed in PR.
UPR Sea Grant Program created	1977		
Puerto Rico's Coastal Program was approved by NOAA	1978		Eight Special Planning Areas are defined in the PRCMP of 1978 as "important areas subject to serious present or potential use conflicts, and therefore, required detailed planning."
Puerto Rico sued the US Navy for damages incurred from military testing in Vieques	1978		Major landmark case first bringing into question the human health affects of the bombing, not to mention the coastal ecosystem damage from the testing site.
DNER incorporates a new planning board policy of avoiding "activities and land subdivision" which could damage coral reefs	1978		
Regulation to control extraction, possession, transportation, sale of coral (#260A) enacted	1979		Limited in scope - limited to extraction, possession, transportation and sale of coral (people were selling them to tourists).
Hurricane David	1979		Huge impact on coral reefs on the western part of the Island, Department of Marine Science on Isla Magueyes completed research on impacts of hurricanes on reefs.
Hurricane Frederic	1979		

Event	Start Date	End Date	Description
Accion Comunal Program	1980		DOA of PR decided to revamp artisanal fisheries into commercial fisheries, brought in huge trawlers for fishermen there which didn't work (small communities could not handle the large vessels and new technology); a special unit of the Department of Agriculture was assigned to do that (CODREMAR); it is still alive on paper; this is when the fisheries statistics program started (had to report stats to DOA on gear, catch, vessels, etc.).
Jobos Bay is designated as part of the National Estuarine Reserve System	1981		Jobos is the second largest estuarine area in Puerto Rico. The reserve protects some of the most extensive mangrove forests on the island and encompasses nearly 2,883 acres. The reserve is home to the endangered brown pelican, peregrine falcon, hawksbill turtle, and West Indian manatee. The reserve is co-managed by NOAA and DNER.
An additional 776 acres are transferred from the Navy to the Culebra Natural Wildlife Refuge	1982		
Coral Bleaching Event	1983		Most of the bleaching for the Western Caribbean occurred in 1983.
The Puerto Rican tanker San Francisco exploded	1984		Spilled two million gallons as the ship caught fire.
Diadema sea urchin die-off in the Caribbean	1985		There were only a few placed in Puerto Rico where there were still Diadema, had a huge negative impact on reefs.
Governor Rafael Hernández Colon administration	1985	1993	
Ponce mudslide after tropical storm Isabel	1985		Killed at least 129 people and is Puerto Rico's worst disaster in 20th century.
Mass bleaching event in Puerto Rico	1987		Reports include extensive partial coral mortalities and coral reef organisms, including death of some 400-500 year old colonies.
Deepwater superport proposed in Ponce (eventually discarded)	1988		The community stood up and didn't allow the superport to be built - first example of community action against the government in terms of environmental and marine resource protection; the program was eventually discarded.
Hurricane Hugo	1989		Category 5 hurricane, minor bleaching.
Fisheries Research Laboratory under DNER created	1990		
Most severe bleaching ever experienced in the Western North Atlantic	1990		From Bermuda, Texas, Florida, throughout the Caribbean, and down to Brazil. Mass mortalities of fire corals and stony corals. Over the long term, corals, gorgonians, sponges, and other coral reef organisms died.
Restored 100 acres of Mangroves in Los Machos and Red Mangrove Forests in Puerto Rico	1992		
Economic valuation of the blue marlin fishery in Puerto Rico	1992		
Governor Pedro Rossello Gonzalez administration	1993	2001	
750,000 gallons of oil were spilled off of the coast of Puerto Rico	1993		A fine totaling over \$75 million was levied against the three companies responsible.
The US Navy dropped 24 bombs of napalm on a target practice area on the island Vieques	1993		
The barge Morris J. Berman runs aground off of Punta Escambron near San Juan	1994		Battle is still being fought in the courts over this issue.
Change of name from Department of Natural Resources to Department of Natural and Environmental Resources (DNER)	1995		Based on the reorganization plan in the legislature.

Event	Start Date	End Date	Description
Hurricane Hortense	1996		Category 4 hurricane, caused at least 21 deaths and destroyed thousands of homes.
Coral bleaching study	1997	1999	Dr. Ernesto Weil tagged and tracked colonies of 23 coral species after bleaching in 1998 and saw that 99% recovered in 3 years. He considers that there has not been a "deadly" bleaching in Puerto Rico.
Erosion and Sedimentation regulation adopted by EQB	1997		
Hurricane Georges	1998		Category 4 hurricane, Puerto Rico is declared a disaster zone. Severe bleaching in the Caribbean, especially Puerto Rico.
NASA planned to launch 11 rockets over 30 days from the Tortuguero base	1998		
Fisheries Law #278 enacted	1998		
Population was about 3.7 million	1998		
Bleaching Event	1998		Most of the colonies bleached in many reefs, but without significant mortality. Followed by a white plague outbreak from 1998-1999 which caused 10-20% mortality.
Jobos Bay National Estuarine Reserve management plan approved by the Planning Board	1998		
Coral Conservation Law 147 enacted	1999		Requires regulation to replace the old one (still not implemented to date); allows PR to create restoration areas, marine reserves, definition of protected areas, follow-up protocol on groundings, etc.
Off-target bombing at Vieques triggered community outrage	1999		Eventually lead to the shut-down of the bombing site. The US Navy conceded that it had fired 263 uranium shells on the island.
Designation of the first no-take natural reserve in Puerto Rico (Canal Luis Peña Natural Reserve)	1999		
Puerto Rico and the Sea report revisited	1999		
Beginning of the Coral Reef Initiative	2000		
Marine recreational fishermen surveys conducted	2000		
Puerto Rico coastal non-point pollution program approved by NOAA and EPA	2000		
Governor Sila M. Calderon administration	2001	2005	Calderon becomes the first female governor of Puerto Rico.
President Bush announces stop to bombings on Vieques in May 2003	2003		The cleanup effort is estimated to cost millions and take years.
Construction of two large resorts on Punta Miquillo (previously part of the Rio Espiritu Santo Estuary Natural Reserve)	2003		Causes great amount of documented sedimentation that affected offshore coral reefs.
Total on- and off-site release of toxic chemicals totaled 8.8 million pounds	2003		
NOAA funded offshore fish farming projects	2003		Found in Hawaii, New Hampshire, Puerto Rico, and the Gulf of Mexico, these projects hope to reduce the stress placed on the local fisheries by fishing and to develop an alternative, sustainable method.
First Local Action Strategy created	2004		First generation of coral reef management in Puerto Rico - projects were implemented but few were evaluated.
First modern fisheries regulation enacted	2004		Needed to show tax forms for your commercial fishing license - major decline in the number of commercial fishermen on-island.
Navy closed the last base on Puerto Rico, Roosevelt Roads	2004		
Tropical Storm Jeanne	2004		

Event	Start Date	End Date	Description
Governor Anibal Acevedo Vila administration	2005	2009	
Study "Assessment of the Condition of Coral Reefs off the former Navy Bombing Ranges at Isla de Culler and Isla de Viennese, Puerto Rico" published	2005		
NASA documented coral bleaching	2005		
Voters, in a referendum, back the idea of conjoining the legislature into one house	2005		
Blue Flag Program created in Puerto Rico	2005		Any beach near coral reefs needs to have a reef survey and a plan so that damaging activities do not take place there.
Bleaching event	2005		Massive bleaching event resulting in 60-80% mortality and loss of live coral cover.
The PR Environmental Quality Board report published	2006		States that only 55% of the population is connected to sewage treatment plants.
Budget shortfalls lead to the closure of schools and many government agencies	2006		
Puerto Rico adopts its first sales tax	2006		
Acropora palmata is listed in the ESA	2006		
Funds compensating for a 1994 oil spill allocated	2007		Proposed to be used to build an artificial reef, create a shoreline nature reserve, and restore the walls of a Spanish colonial fort.
Tropical Storm Olga	2007		Triggered floods and mudslides throughout the Caribbean.
The 2008 winners of the Golden awards included Puerto Rican	2008		Rosa Hilda Ramos awarded for heading the movement to protect the Las Cicharillas Marsh.
Study published about Vieques soil	2008		Report countered the US Navy's claim that the soil was safe. The study measured dangerous levels of toxic chemicals in produce grown on Vieques.
Vega Baja mid and outer reef massive mortality caused by public beach reconstruction project	2009		
Priority Setting Document published	2009		
Governor Luis Fortuño administration	2009	2012	
Twenty-second meeting of the Coral Reef Task Force in San Juan, Puerto Rico	2009		CORAL held its first Sustainable Marine Recreation workshop in Puerto Rico at the 22nd Annual U.S. Coral Reef Task Force Meeting.
Explosion at the Caribbean Petroleum Corp. oil refinery near San Juan	2009		The explosion registered as a 2.8 magnitude earthquake and led to the evacuation of a nearby village and caused major fires.
The EPA announced that the US Dept. of Agriculture has agreed to pay \$30,000 in penalties for alleged improper maintenance of underground storage tanks	2009		
Special fund created for the restoration of the San Juan Bay Estuary	2009		
Law for the Control of Phosphates in Detergents	2009		
Gov. Fortuño eliminates the Northeast Ecological Corridor designation as a Natural Reserve	2009		Fortuño allows large-scale development inside a 3,200 acre parcel of land, the only tropical rain forest in the US National Forest system. Previous Governor Anibal Acevedo Vila had declared the Northeast Ecological Corridor off limits to all but to small eco-friendly projects.
Gov. Fortuño signs the Law for the Reform of the Permitting Process	2009		Makes it discretionary (and only through the Supreme Court) if a challenge to a development permit is processed.
Economic valuation of the coral reefs in the Cordillera Reserve published	2009		
New permits system adopted through Law #161	2009		Makes the permitting process for development easier and faster.

Event	Start Date	End Date	Description
President Obama adopts EQ13547	2010		Created the need for regional planning (CMSP) that ignited the need for the Caribbean Regional Ocean Partnership (USVI and PR).
New Fisheries Regulation enacted	2010		
Puerto Rico Climate Change Council	2010		
Joint permit regulation for construction permits and land use adopted by OGPE	2010		
Vega Baja inner reef mortality caused by 686 road reconstruction	2010		
Economic add-on for commercial fisheries	2011		
Barack Obama visits Puerto Rico	2011		First US President to visit since John F. Kennedy.
Refined Local Action Strategy	2011		
Hurricane Irene	2011		Category 3 hurricane.
The Fortuño administration approved the new Great Northeastern Reserve, as well as a new Special Land Use Plan	2011		Allowed the fragmentation and urban development of the Corridor by allowing the construction of residential-tourism projects within 450 acres of the former Natural Reserve.
Puerto Rico Climate Change Vulnerability Assessment report completed	2012		
Puerto Rico Climate Change Adaptation Strategies report completed	2012		
Caribbean Regional Ocean Partnership formalized by governors of USVI and PR	2012		
Puerto Rico Declaration 20-20 adhering to Caribbean Challenge Initiative	2012		
Social Networking boom in Puerto Rico	2012		“I Fish and I Vote” campaign is an example.
Proposal to include nassau grouper on endangered species list	2012		Poaching of juveniles increasingly an issue.

Appendix B: Glossary

Adaptive Management: A central feature of the practice of any form of Ecosystem-based Management is that it must respond positively to changing conditions and to its own experience. In other words, the practice of coral reef management must be grounded in a process of learning and adaptation. Adaptive management is not reactive management whereby the practitioner simply responds to the unexpected. It is rather a conscious process of examining the course of events as they unfold at larger, or smaller, spatial and temporal scales, and being cognizant of future projections and developing adaptation options in consideration of these dynamics. In other words, in the face of uncertainty, this includes being able to change or redirect decision-making based on the evolving outcomes

Actions: Projects, procedures or techniques intended to implement an objective as defined in the priority setting documents.

Best Management Practices: Management measures or practices that are established and widely accepted as meeting the intent of coral reef conservation in a variety of disciplines (fisheries management, watershed management, biophysical monitoring, etc.)

Capacity: The overall ability of the individual or group to perform their responsibilities for coral reef management. It depends not only on the capabilities of the people (their knowledge, abilities, relationship and values), but also on the overall size of the task, the resources which are needed to perform them, and the framework within which they are discharged.

Capacity Building: Programs that are designed to strengthen the capacity (knowledge, abilities, relationship and values) to reach the goals as defined in the priority setting documents. This includes strengthening the institutions, processes, systems, and rules that influence collective and individual behavior.

Capacity Development: A widely recognized definition of capacity development was published by the United Nations Development Programme in 1997 as: “the process by which individuals, organizations, institutions and societies develop abilities (individually and collectively) to perform functions, solve problems and set and achieve objectives.” We expand this definition to put greater emphasis on the strategic role of a facilitator in helping this process in an uncertain and changing environment. Our suggested definition is: “Externally or internally initiated processes designed to help individuals and groups to manage coral reefs and to enhance their abilities to identify and meet coral reef management challenges in a sustainable manner.”

Capacity Strengthening: Capacity strengthening is part of the capacity development process and is set within a dynamic context and involves individuals, networks, organizations and even societies who have a stake in functioning coral reefs. It involves such processes as continuous learning, adaptation and innovation in dealing with unanticipated problems or issues. A central feature of capacity strengthening is assessing and reacting to current and future needs in order to improve the ability to learn and solve problems in the long-term.

Commitment: In the case of coral reef management and governance, commitment often refers to governmental commitment to the policies of a program and expressed by the delegation of the necessary authorities and the allocation of the financial resources required for long-term program implementation. When commitment is used in a different context it will be defined.

Conservation Action Plans (CAPs): The Nature Conservancy’s process for “helping conservation practitioners develop strategies, take action, measure success, and adapt and learn over time.” From Conservation Action Planning: Developing Strategies, Taking Action, and Measuring Success at Any Scale--Overview of Basic Practices. The Nature Conservancy 2005. Available in English and Spanish at: http://conserveonline.org/workspaces/cbdgateway/cap/resources/1/TNC_CAP_Basic_Practices.pdf/download

Constituencies: While constituencies can be broadly defined, we use the word to define active support of the coral reef management program by a core group of well-informed and supportive people composed of stakeholders in the private sector, civil society and government agencies.

Coral Reef Management Priorities: Those goals and objectives that have been defined by a core group of coral reef managers and stakeholders in each of the seven jurisdictions and identified through a voting process as those that require immediate attention over the short term of 3-5 years. For the purposes of the capacity assessment, the term goals will refer to the highest-level results the jurisdiction seeks to achieve (e.g., stable, sustainable coral reef ecosystems), as articulated in the jurisdictional priority setting documents. These goals in general refer to efforts to understand and address the three major threats to reefs; impacts from climate change, fishing, and land-based sources of pollution as well as other identified jurisdictional priorities.

Coral reef resilience: According to the Reef Resilience Toolkit (<http://www.reefresilience.org/>) website, resilience is more than being able to recover from a major disturbance, surviving bleaching, or resisting bleaching. For a coral community to be resilient, it must also be able to continue to thrive, reproduce, and compete for space and resources. For example, coral communities that have experienced bleaching but not mortality may be weakened and less able to thrive, grow, and reproduce in the competitive reef environment. Multiple factors contribute to resilient coral communities, some of them known and others to be discovered. Scientists are working to identify important factors (biological,

physical and ecological) that managers can evaluate to determine the health or resilience of a coral community. It is important that managers build the capacity to be able to identify and better understand these factors, so management strategies can be focused on maintaining or restoring communities to more optimal conditions to maximize coral survival after stressful disturbances.

Core managers group: This term refers to the agencies/organizations involved in management of coral reefs in a jurisdiction not just a geographic site within a jurisdiction. Most locations have a core group like this and will be the central focus of the capacity assessment process.

Ecosystem approach: According to the COMPASS Scientific Consensus Statement, Ecosystem-based Management emphasizes the protection of ecosystem structure, function and key processes; is place-based in focusing on a specific ecosystem and the range of activities affecting it; explicitly accounts for the interconnectedness among systems, such as between air, land and sea; and integrates ecological, social, economic and institutional perspectives, recognizing their strong interdependences.

Local Action Strategy (LAS): LAS's are a U.S. Coral Reef Task Force led initiative to identify and implement priority actions needed to reduce key threats to valuable coral reef resources in each U.S. coral reef jurisdiction. In 2002, the Task Force adopted the "Puerto Rico Resolution" which calls for the development of three-year LAS by each of the seven U.S. jurisdictions containing coral reefs: Florida, Puerto Rico, the U.S. Virgin Islands, Hawai'i, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands. These LAS's are locally driven roadmaps for collaborative and cooperative action among federal, state, territory, and non-governmental partners.

Marine Protected Areas (MPAs): Any area of the marine environment that has been reserved by federal, state, territorial, tribal or community law, mandate, regulation or declaration to provide lasting protection for part or all of the natural and cultural resources therein. As noted in the following section of [NOAA Marine Protected Areas website](#): "The Department of Natural and Environmental Resources of Puerto Rico (DNER) is responsible for the management of 25 areas with marine components including Natural Reserves, a Commonwealth Forest and a Marine Reserve. The Natural and Marine Reserves are managed by the Natural Reserves and Commonwealth Forests Divisions of the Bureau of Reserves, Refuges, and Coastal Resources of DNER whereas the Commonwealth Forest is administered by the Forestry Division (DNER). Additional sites are administered and managed by the Puerto Rico Conservation Trust. All of the sites included in the MMA Inventory have been designated by the Puerto Rico Planning Board, except Isla Desecheo Marine Reserve and Seven Seas Natural Reserve which was designated by the Puerto Rico Legislature. Most sites have year-round protection, excluding three Red Hind (*Epinephelus guttatus*) Spawning Aggregation Sites, which have a temporary fishing ban (December to February), designated by a joint effort between DNER and the Caribbean Fisheries Management Council."

Nested Systems: Thinking in terms of nested systems is essential because issues of coral reef management impact upon, and are impacted by, conditions and actions at both higher and lower levels in an ecosystem and governance hierarchy. Some issues of coral reef management can be addressed more effectively at one level, and less effectively at another. The choice of the issue or set of issues to be addressed must therefore be made in full knowledge of how responsibility and decision making authority is distributed within a layered governance system. Planning and decision making at one scale, for example within a jurisdiction, should not contradict or conflict with planning and management at another – for example, at the scale of the nation. The reality is that such contradictions and conflicts are common across the world. A major challenge for the coral reef manager is to recognize these differences and work to either change them or select goals and strategies that recognize that such contradictions must be accommodated or resolved. In practical terms this means that a central feature of ecosystem approach is that all planning and decision-making must recognize and analyze conditions, issues and goals at least at the next higher level in the governance system. Thus, the ecosystem approach at the jurisdictional scale must – at a minimum – be placed within the context of governance at the smaller scale of the village or municipality while governance at the scale of a state/territory – at a minimum – be analyzed with an eye to governance at the scales of the village/municipality as well as that of the nation.

Objectives: The environmental, social, and institutional outcomes the jurisdiction must achieve to reach the end goal, generally actionable within a three to five-year time frame.

Participation: One of the defining characteristics of the practice of the ecosystem approach is its emphasis on participation and its relevance to the people affected by its practice of coral reef management. The ecosystem approach recognizes that the support of those whose collaboration is needed if a program is to be successfully implemented must be won by involving them in the processes of defining the issues that the program will address and then selecting the means by which goals and objectives will be achieved. Both individuals and members of institutions are more likely to comply with a management program when they feel that it is consistent with their values, responds to their needs and to their beliefs of how human society should function. Voluntary compliance by a supportive population lies at the heart of the successful implementation of a program. A participatory approach helps stakeholders and the public to see the efforts of a program as a whole.

Site managers: A person or persons designated with authority to manage a marine reserve or natural reserve at any level be it community, agency, state or federal.

Situation Analysis: A preparatory document for the priority setting process that summarized coral reef threats, condition and trends, key management issues, and goals of management agencies.

(Key) Stakeholder: A person, group, or organization that has direct or indirect stake in an organization that is involved with managing coral reefs.

Stewardship: Where equitable and sustainable forms of development are the ultimate goals of ecosystem approach, the practices of stewardship is the path to that destination. Ecosystem stewardship is an ethic practiced by individuals, organizations, communities and societies that strive to sustain the qualities of healthy and resilient ecosystems and their associated human populations. Stewardship takes the long-term view and promotes activities that provide for the wellbeing of both this and future generations.



Law #274 featured in the environmental section of the Puerto Rican newspaper El Nuevo Día. (Photo credit: Glenn Page, SustainaMetricx.)

Appendix C: For More Information

Climate Change

- Aaronson, D. and M. Manuel (2008). Conservation Easements and Climate Change. Sustainable Development Law and Policy, Winter 2008. <http://www.goldbergkohn.com/assets/attachments/110.pdf>
- Allison, E.H. et. al. 2005. Effects of climate change on the sustainability of capture and enhancement fisheries important to the poor: analysis of the vulnerability and adaptability of fisherfolk living in poverty. Summary Report Project No. R4778J. Fisheries Management Science Programme Department for International Development. http://www.fmsp.org.uk/Documents/r4778j/r4778j_1.pdf
- Bethke, L., J. Good and P. Thompson (1997). Building capacities for risk reduction. Disaster Management Training Programme. United Nations Department of Humanitarian Affairs. <http://www.pacificdisaster.net/pdnadmin/data/documents/635.html>
- Caribbean Disaster Mitigation Project. Hazard-resistant Construction. Organization of American States. <http://www.oas.org/cdmp/safebldg.htm>
- Daw, T., N. Adger, K. Borwn and M. Badjeck. Paper 2: Climate Change and Capture Fisheries – impacts, adaptation, mitigation, and the way forward. University of Newcastle upon Tyne, WorldFish Centre. http://www.fao.org/fileadmin/user_upload/foodclimate/presentations/fish/Daw.pdf
- Deutsche Bank Research (2008). Climate Change and Tourism: Where Will the Journey Lead? <http://www.dbresearch.com/> (search title)
- Food and Agriculture Organization (FAO) (2006). Building Adaptive Capacity to Climate Change- Policies to sustain livelihoods and fisheries. New Directions in Fisheries – A series of Policy Brief on Development Issues, No. 08. Rome. 12 pp. www.fao.org/hivaid/publications/Policy_Brief-Final_En.pdf
- Simpson, M.C., S. Gossling, D. Scott, C. M. Hall and E. Gladin (2008). Climate Change Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practices. UNEP, University of Oxford, UNWTO, WMO: Paris, France. <http://www.unep.fr/scp/publications/details.asp?id=DTI/1047/PA>
- UNWTO, UNEP and WMO (2008). Climate Change and Tourism: Responding to Global Challenges <http://www.e-unwto.org/content/kk9027/?p=c9070dafc494bd39462e4d3431e84e4&pi=0>
- The Worldfish Center: Adapting to Climate Change: <http://www.worldfishcenter.org/>

Coastal Governance

- Cambers. G. (1998). Coping with Beach Erosion. Environmental Development in Coastal Regions and in Small Islands. UNESCO. <http://www.unesco.org/csi/pub/source/ero1.htm>
- Encora. 2008. Coastal and Marine Wiki. Internet encyclopedia of information pages for and by coastal professionals providing up-to-date high quality Coastal and Marine information http://www.encora.eu/coastalwiki/Category:Coastal_management
- McConney, P., R. Pomeroy and R. Mahon (2003). Guidelines for coastal resource co-management in the Caribbean: Communicating the concepts and conditions that favour success. Caribbean Coastal Co-management Guidelines Project. Caribbean Conservation Association, Barbados. <http://www.dfid.gov.uk/r4d/Output/54318/Default.aspx>
- Olsen, S. ed. 2003. Crafting Coastal Governance in a Changing World. Coastal Resources Center, University of Rhode Island, Narragansett, RI. http://www.crc.uri.edu/download/Crafting_Coastal_Governance.pdf
- Olsen, S., K Lowry and J. Tobey (1999). The Common Methodology for Learning: A Manual for Assessing Progress in Coastal Management. Coastal Resources Center, University of Rhode Island, Narragansett, RI. http://www.crc.uri.edu/download/SEL_003F.PDF
- Parish, F. (2006). Coastal Greenbelt Initiative: Development of green belts to protect coastal communities and resources. Global Environment Centre. <http://www.fao.org/forestry/media/12692/1/0/>
- Rambaldi, G., M. L. Fernan and S.V. Siar (1998). Participatory Methods in Community-based Coastal Resource Management: Volume 2 Tools and Methods. International Institute of Rural Reconstruction (IIRR), Silang, Cavite, Philippines. <http://www.iapad.org/cbcrm.htm>

Marine Conservation

Coral Reef Alliance (CORAL). Guidelines and Best Practices http://www.coral.org/resources/guides_best_practices

General Approaches to Addressing Mariculture as an Element of Integrated Coastal Management programs <http://www.crc.uri.edu/index.php?themeid=1>

Global Water Partnership (GWP). Toolbox for Integrated Water Resources Management. <http://www.gwptoolbox.org/>

IUCN World Commission on Protected Areas (IUCN-WCPA) (2008). Establishing Resilient Marine Protected Area Networks – Making it Happen. IUCN-WCPA, National Oceanic and Atmospheric Administration and The Nature Conservancy. Washington, D.C. http://cmsdata.iucn.org/downloads/mpanetworksmakingithappen_en.pdf

Knowledgebase for Lessons Learned and Good Practices in the Management of Coral Reefs. GEF Lessons Learned, the ReefBase Project. <http://gefll.reefbase.org>

The Nature Conservancy (2008). Marine Conservation Agreements: A Practitioner's Toolkit. <http://www.mcatoolkit.org/>

Pomeroy, R.S., Parks, J.E. and Watson, L.M. (2004). How is Your MPA Doing? A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Areas Management Effectiveness. IUCN, Gland Switzerland and Cambridge, UK. <http://www.mangrovesforthefuture.org/RTC-documents-resources.htm>

Reef Resilience. Building Resilience into Coral Reef Conservation. The Nature Conservancy. <http://www.reefresilience.org/>

Organizational Behavior

Bolman, L. G. (2008). Reframing Organizations: Artistry, Choice And Leadership (Wiley Desktop Editions) Author: Lee G. Bolman, Terrence E. Deal.

Bolman, L. G., & Deal, T. E. (2011). Leading with soul: An uncommon journey of spirit (Vol. 381). Jossey-Bass.

Fullan, M. (2006). Turnaround leadership. San Francisco: Jossey-Bass.

Fullan, M. (2011). The six secrets of change: What the best leaders do to help their organizations survive and thrive. Jossey-Bass.

Fullan, M. (2013). The new meaning of educational change. Routledge.

Kotter, J. P., & Cohen, D. S. (2002). The heart of change: Real-life stories of how people change their organizations. Harvard Business Press.

Kouzes, J. M., & Posner, B. Z. (2006). The leadership challenge (Vol. 3). Jossey-Bass.

Pascale, R., Milleman, M., & Gioja, L. (2001). Surfing the edge of chaos: The laws of nature and the new laws of business. Crown Business.

Pfeffer, J. (2007). What were they thinking?. Ohio University Center for International Studies.

Pfeffer, J., & Sutton, R. (1999). The knowing-doing gap: How smart companies turn knowledge into action. Harvard Business School Press.

Senge, P. M. (2006). The fifth discipline: The art & practice of the learning organization. Crown Business.

Stacey, R. D. (1992). Managing the unknowable: Strategic boundaries between order and chaos in organizations. Jossey-Bass.

Stacey, R. D. (1996). Complexity and creativity in organizations. Berrett-Koehler Publishers, Inc.

Stacey, R. D. (2007). Strategic management and organisational dynamics: the challenge of complexity to ways of thinking about organisations. Prentice Hall.

Wheatley, M. J. (2007). Finding our way: Leadership for an uncertain time. Berrett-Koehler Publishers.

Sustainable Development

Bien A. (2007). A Simple User's Guide to Certification for Sustainable Tourism and Ecotourism Center or Ecotourism and Sustainable Development. 3rd Edition. <http://www.iadb.org/IDBDocs.cfm?docnum=1028822>

UNESCO (2007). Sustainable development in Coastal Regions and in Small Islands. <http://www.unesco.org/csi/index.htm>

The World Bank. Best Practices in PES [Payment for Ecological Services] Design. [http://web.worldbank.org/WBSITE/EXTERNAL/ TOPICS/ENVIRONMENT/EXTTEEI/0,,contentMDK:20487921~isCURL:Y~menuPK:1187844~pagePK:210058~piPK:210062~theSitePK:408050,00.html](http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTTEEI/0,,contentMDK:20487921~isCURL:Y~menuPK:1187844~pagePK:210058~piPK:210062~theSitePK:408050,00.html)

Terrestrial Conservation

International Union for Conservation of Nature (IUCN). Establishing Payments for Watershed Services. IUCN Water and Nature Toolkit Series. <http://www.iucn.org/about/work/programmes/water/resources/toolkits/?4914/Pay--establishing-payments-for-watershed-services>

The Nature Conservancy. Private Lands Conservation: Conservation Easements. <http://www.nature.org/aboutus/privatelandscconservation/conservationeasements/>

SERVIR Regional Visualization & Monitoring System. Regional modeling and visualization for Latin America, Caribbean, and Africa. <http://www.servir.net/index.php?lang=en>

Appendix D: Interviews

Date	Name / Event	Institutional Affiliation	Method
PRE-SITE VISIT			
07/12/2012	Antares Ramos	NOAA CRCP	Phone
07/12/2012	Damaris Delgado	DNER	Phone
07/30/2012	Tracy Parsons	NOAA CRCP	Phone
08/02/2012	Dana Wusinich-Mendez	NOAA CRCP	Phone
08/29/2012	PR J-CAT Meeting #1		Phone
09/13/2012	PR J-CAT Meeting #2		Phone
09/18/2012	Anthony Hooten	AJH Environmental Services	Phone
09/20/2012	Leo Miranda	USFWS	Phone
09/25/2012	Tracy Parsons	NOAA CRCP	Phone
09/25/2012	Antares Ramos	NOAA CRCP	Phone
09/25/2012	Nilda Jiménez	DNER	Phone
10/01/2012	Craig Lilyestrum	DNER	Phone
10/02/2012	Nilda Jiménez	DNER	Phone
10/03/2012	PR J-CAT Meeting #3		Phone
10/15/2012	Lisamarie Carruba	NOAA	Phone
10/18/2012	Paul Sturm	Center for Watershed Protection	Phone
SITE VISIT			
10/24/2012	Richard Appeldoorn	UPR Mayaguez	In Person
10/24/2012	Lisamarie Carrubba	NOAA	In Person
10/25/2012	Miguel (Menquí) Canals	Manager of Guánica	In Person
10/25/2012	Jorge (Rení) García	UPR Mayaguez	In Person
10/25/2012	Jorge Corredor	UPR Mayaguez	In Person
10/25/2012	Michelle Scharer	UPR Mayaguez	In Person
10/25/2012	Michael Nemeth	UPR Mayaguez	In Person
10/26/2012	Idelfonso Ruiz	Manager of Cabo Rojo	In Person
10/27/2012	Mary Ann Lucking	Coralations	In Person
10/27/2012	Ana Román	USFWS	In Person
10/27/2012	Abbie White	Ecological School in Culebra	In Person
10/27/2012	Misael Feliciano	DNER Rangers	In Person
10/29/2012	Humberto Rigueroa	Manager of the Northeast Reserve	In Person
10/29/2012	Marcos Ramos	Manager at the Northeast Reserve	In Person
10/29/2012	Rosalie Ramos	DNER	In Person
10/30/2012	Carmen Guerrero	Initiative for Sustainable Development (now DNER)	In Person
10/30/2012	Lynn Ríos	NOAA Office of Law Enforcement	Phone
10/30/2012	Craig Lilyestrom	DNER Marine Resources	In Person

Date	Name / Event	Institutional Affiliation	Method
SITE VISIT (CONT.)			
10/31/2012	Carlos Diez	DNER	In Person
10/31/2012	Jaime López	EPA	In Person
10/31/2012	Aida Rosario	DNER, Terrestrial Resources Division	In Person
10/31/2012	Vance Vicente	Vicente & Associates Inc.	In Person
11/01/2012	Ruperto Chaparro	Sea Grant	In Person
11/01/2012	David Cuevas	EPA	In Person
11/01/2012	Ricardo Laureano	VIDAS	In Person
11/01/2012	Paco López	NOAA PIRO	In Person
11/01/2012	Samuel Suleimán	UPR	In Person
11/01/2012	José Norat	UPR	In Person
11/01/2012	Pablo Méndez Lázaro	UPR	In Person
11/02/2012	Puerto Rico J-CAT Meeting #4		In Person
11/02/2012	Alejandro Torres-Abreu	Environmental Sociologist	In Person
11/02/2012	Miguel García	DNER	In Person
POST-SITE VISIT			
11/16/2012	Antares Ramos	NOAA CRCP	Phone
11/16/2012	John Christensen	NOAA	In Person
11/16/2012	Jenny Waddell	NOAA	In Person
11/16/2012	Eileen Alicea	NOAA	In Person
01/17/2013	Puerto Rico J-CAT Meeting #5		Phone
02/04/2013	Damaris Delgado	DNER	Phone
02/21/2013	Michelle Pico	NFWF	In Person
03/04/2013	William Gould	CLCC/USDA Forest Service	In Person
03/04/2013	Constance Carpenter	CLCC/USDA Forest Service	In Person
03/04/2013	Kasey Jacobs	CLCC/USDA Forest Service/NOAA/DNER	In Person
03/04/2013	Jaime Collazo	North Carolina State University	In Person
03/04/2013	José Cruz	CLCC/USFWS	In Person
03/04/2013	Kathleen McGinley	USDA Forest Service	Phone
03/04/2013	Susan Silander	CLCC/USFWS	Phone
03/04/2013	Pedro Ríos	USDA Forest Service	Phone
03/05/2013	Puerto Rico J-CAT Meeting #6		In Person
03/05/2013	Carmen Guerrero	Secretary DNER	In Person
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Appendix E: Portfolio of Training Modules

Long-term capacity building requires an explicit focus on systematic learning. While there are a wide range of potential training modules, a defined set of in-person training courses, distance learning modules, and methods to cultivate local leaders are suggested below to focus on current and emergent topics. A key feature of these trainings and continuing education courses should be the building of a common management framework built around the Management Cycle and the Orders of Outcome framework.

Standard Puerto Rico Coral Reef Management Training Course

On-site training courses are recommended to be conducted every two years, to respond to the staff turnover rate, including the following modules:

- Modules on the causes and drivers of reef decline, including land-based sources of pollution, fisheries impacts and effects of climate change and ocean acidification;
- Modules on the management cycle, marine spatial planning, building political will, developing social media campaigns, and improving the quality of fisheries landings data;
- Modules on sustainable financing and coordination of funding across agencies, managing federal grants;
- Modules on fostering high quality collaboration that includes essential elements of effective meetings, including effective dialogue, conflict resolution and decision-making;
- Modules on codification of good practices for coastal zone management, marine protected areas etc. that are made available to staff and the subject of mini-courses and trainings (e.g. Code of Conduct for Responsible Fisheries (FAO, 2007)); and,
- Modules on dealing with persistent administrative barriers such as staff turnover, improved collaboration, and integration across agencies, and writing SOPs (standard operating procedures).

Routine trainings are a well-established practice for building knowledge and skills for effective coral reef management and could feature a formal process for new staff (at all levels) to build a basic understanding of coral reef management issues and convey current knowledge and lessons learned so as to retain institutional knowledge. There are many sources available for building a custom curriculum and lessons learned for structuring training modules. For example, the Coastal Resources Center at the University of Rhode Island is developing a set of modules for the certification of professionals involved with MPAs. Custom modules for three levels of participants (field operations, management staff and policy and decision makers) have been prepared, applied and tested in East Africa. The CRC/WIOMSA certification program is only one source of training materials, there are many others that may be more appropriate for Puerto Rico.

Produce Modules For Distance Learning

A set of pre-produced modules and resources are available from a wide variety of sources including Sea Grant, NOAA's Coastal Services Center, Center for Watershed Protection, Caribbean Sea Large Marine Ecosystem, International Waters Learning Exchange and Resource Network (IWLEARN), and UN Train

Sea-Coast. There are a growing number of publications that would be useful in developing these modules to build capacity and therefore do not bear repeating here.¹

Strategies for Cultivating Local Leaders

To more effectively practice the ecosystem approach, the following six core competencies are necessary for practitioners:

- Competency in facilitation, mediation, stakeholders engagement, and public education;
- Competency in strategic design/improvement of stewardship initiatives;
- Competency in design and implementation of monitoring and evaluation in support of adaptive learning and acting;
- Competency in analysis of long term changes in condition and use of ecosystems;
- Competency in analysis of governance structures and processes; and,
- Competency in building leadership required to influence political will.

Traditional approaches of peer-to-peer exchanges, learning journeys, and further investment in professional development is a worthwhile investment for leadership development. We recommend specific criteria to guide, encourage and reward emerging leaders. While a wide range of literature exists, the following set of leadership characteristics is useful to consider (NRC, 2008):

- Critical and reflective thinking and a willingness to challenge the status quo and invite inquiry into potential new ways of doing and seeing;
- Ability to see the big picture, as well as the parts and their interrelationships;
- Skillful and honest communication, including listening skills and the ability to speak and write with clarity, vision and purpose;
- Openness to the diversity of world views and perspectives and ability to make choices, especially when a decision goes against popular thought or opinion; and,
- Ethical foundation of word and action to navigate the political arena without susceptibility to corruption.

¹ Reef Resilience Tool Kit, How's My MPA Doing, Healthy Reefs Healthy Communities, International Waters Experience Notes, World Fish Centers Lessons Learned 1804, Great Barrier Reef 2009 Baseline, GEF's International program

Appendix F: Collaboration Evaluation and Improvement Framework (CEIF) for Improving High Quality Collaboration

Phase #1 Operationalize Concepts of Collaboration: Collaboration can be characterized by specific attributes and variables to better observe, measure and document the existence, development, quantity, quality and contextual effects of collaboration in support of improved coral reef management. These attributes include essential pre-requisite of a shared purpose of improved coral reef management in Puerto Rico. Collaboration for improved coral reef management is developmental, evolves in stages over time, and varies in terms of level and degree of integration. Building literacy on collaboration across the coral reef community can be done by building a simple library of relevant literature within the library at DNER (or other locations), to build a source for print and electronic copies of literature that relates to the development of high quality collaboration. Printed in both Spanish and English, and distribute widely, the principles and meaning of concepts associated with high quality collaboration (described in more detail below) that includes the levels of integration, stages of development, and cycles of inquiry. Develop a mapping tool that shows the many different meetings, forums and locations for where coral reef management takes place in a collaborative fashion.

Phase #2 Identify and Map Communities of Practice of Coral Reef Management: For more effective management, it's important to gain a more accurate picture of high-leverage groups working together. Specifically what teams, committees, federal partners, state agencies, local governments, NGOs, university projects, legislative groups etc. are carrying out the tasks and activities most central to coral reef management. A simple inventory and mapping product can be generated to reveal:

- Teams and committees that make up key strategic alliances within the coral reef management community;
- The purpose and primary task of each group;
- The members of the group and any criteria for membership;
- How often, where, and through what medium each group meets;
- How long each group has been in existence; and
- Relative importance of the group to the purpose of coral reef management in Puerto Rico.

Phase #3 Monitor Stages of Development: Collaboration moves through predictable stages of development. One stage may go faster than another, or a group can get stuck in one stage for a long time. A team may find itself moving in and out of one stage. Knowing the stages and how to navigate and emerge from each stage of development is critical to building higher quality collaboration. Partnerships first assemble and then develop norms for how they act together as an early stage. Success often hinges on how well they are able to invoke clarity of purpose and then define the decision-making structures, strategies, leadership roles and clear tasks. A code of conduct with clear roles and responsibilities as well as defining what high quality dialogue, decision-making, action and reflection really looks like is extremely useful at this stage. Once the group has assembled and begins to wrestle with purpose and governance, the next stage in development is typically marked by enthusiasm centered around the shared purpose which tends to evoke feelings of urgency, defining the resources, establishing turf boundaries, understanding where the expertise

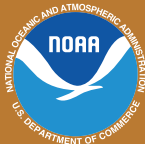
resides and who's really willing to take on tasks. A third stage is the transition to actually performing, often marked by implementing toward the common purpose as well as building and safeguarding resources, strengthening the validity of the collaboration, and infusing energy in pursuit of the shared purpose. A final stage of collaboration is marked by an end of the current collaboration or transformation to another form of collaboration. This typically happens after some milestones have been reached and the group has faced a series of both planned and unplanned events moving to a decision of how to refine, reconfigure or dissolve their collaboration. Knowing where collaborations are in the stages of development is a high leverage capacity that could be applied to coral reef management in Puerto Rico to improve the overall quality of collaboration.

Phase #4 Define Levels of Collaboration: A fundamental principle of collaboration is that there are levels of integration that exist between and within organizations. More integration is not necessarily better. Better integration is better and the degree should vary according to the purpose and goals. A simple rubric has been developed to gauge integration over time that is based on a total of five levels that moves from no integration to fully integrated and unified toward a common goal. These levels range from independent (no integration) to networking (lowest level of integration such as exploring shared interest) to cooperating (working together rarely simply to ensure that tasks are done) to partnering (using shared resources to address common issues and to reach common goals) to unifying (merging resources to create something new – often requires commitment over long term period to achieve short- and long-term outcomes).

Phase #5 Model and Identify High Quality Collaboration: The characteristics of the four core elements of collaboration (dialogue, decision-making, action and reflection) can each be defined through using low, medium or high quality levels. Each collaborative alliance should define what they consider to be the ranges of each. This information is used to inform decisions about how to further develop and strengthen the collaborative process.

SustainaMetrix supports innovation and adaptation in the complex and dynamic realm of ecosystem change. We believe that building adaptive capacity is the most pressing challenge of our time and is a long-term process that requires clear goals, supportive and informed constituencies, and formal commitment. It is our mission to work collaboratively across sectors to conceptualize, design and test new approaches to build the enabling conditions for adaptive response to ecosystem change.

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