

A Preliminary Ecosystem based Adaptation Work Plan for Puerto Rico: Opportunities for Incorporating EbA into Management

This work was supported by The Nature Conservancy under cooperative agreement award #NA09NOS4190173 from the National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Conservation Program, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA, the NOAA Coral Reef Conservation Program, or the U.S. Department of Commerce.

Ecosystem-based adaptation (EbA) integrates the use of biodiversity and ecosystem services into an overall strategy to adapt to the adverse impacts of climate change. Ecosystem-based adaptation uses the sustainable management, conservation, and restoration of ecosystems to provide services that enable people to adapt to both current climate variability and long-term change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people.

As can be seen from the “Ecosystem based Adaptation assessment findings: Summary Report” previously submitted, there are many opportunities for a variety of projects, activities and events that could be developed in relation to EbA in Puerto Rico. In the following some key topics have been identified for the initial approach in Puerto Rico.

1. EbA workshop

An initial approach to gauge interest and knowledge on local capacity would be through an EbA workshop for the DNER, academia, NGOs, and all parties interested in order to provide examples of EbA projects developed at different time and spatial scales from short to long term and from local to regional extents. In Puerto Rico, climate change issues have begun to be discussed at the DNER (A one day conference on Climate Change planned by the Coastal Zone Management Program on November 17 will be the first discussion of the topic in years) however, ecosystem based adaptation and management in the time of climate change are still topics that do not get much if any attention. A workshop to promote and involve academia and the NGO sector in Puerto Rico would be a preliminary step for further work to develop on island, and for DNER staff to become more familiar with EbA, and move from only monitoring to management in the time of climate change.

2. Sustainable management and conservation of watersheds and associated ecosystems island wide.

Integrated Ecosystem Management should be promoted Island wide. As part of this, identifying the most altered and impacted watersheds with the largest impact on coral reef communities must be a priority. An initial assessment of these watersheds has been done and 13-15 watersheds were identified island wide.

These watersheds need to be paired up with the priority sites (Table 1) from the Puerto Rico's Coral Reef Management Priorities document. Once priority reef sites and watersheds have been paired, identification of specific problems (e.g. erosion in mountains and sediment run off) and their causes (e.g. agriculture practices and urban development) are logical next steps. Additionally, topics related to sustainable land-use practices and conservation activities within the watersheds are of vital importance to guarantee the protection of coral reefs and marine environment.

Furthermore, educational and social projects directed to determine and implement alternatives to change behaviors that negatively impact watersheds and associated ecosystems must be also supported.

From the Guánica watershed experience, the Puerto Rico DNER as well as many federal agencies have recognized that a major issue in relation to coastal protection and coral reef conservation are problems located within the watershed such as unsustainable agriculture practices that produce soil erosion and sedimentation. In this regards, Integrated Ecosystem Management is greatly needed in Puerto Rico. From ridge to reef initiatives should be employed island wide in terms of management and education. Puerto Rican reefs, forests, and agriculture would benefit from projects similar to the current efforts being undertaken in the Guánica watershed.

3. Restoration projects

Presently, DNER does not have an official or an unofficial list of sites, areas, or ecosystems that are a priority for restoration efforts. In light of the partnering with NOAA to advance coral reef restoration efforts in seven United States coral reef jurisdictions, helping the Puerto Rico DNER create a list of specific priority areas or ecosystems would be a mutually beneficial endeavor, providing TNC focus areas for the Community based Restoration efforts and would help the DNER with local management.

Additionally, an assessment of the need for restoration efforts within already existing protected areas was suggested by DNER personnel to determine if restoration efforts are needed within terrestrial, coastal and marine protected areas.

4. Easement exploration

In Puerto Rico there are a few land-owners that have made the commitment to ensure the protection and conservation of their lands through the Easement law (Ley 183 del 27 de Diciembre, 2001). Additionally, NGOs like the Fideicomiso de Conservación de Puerto Rico have as a main objective acquiring land to convert into conservation easements.

As of yet, no official assessment has been done to determine the number and extent of possible easements and private protected areas beyond those owned by the Fideicomiso de Conservacion. The DNER has identified several specific areas to be acquired but further work needs to be done to determine more sites for acquisition. There is great opportunity to form a partnership with the Fideicomiso de Conservacion in order to take greater advantage of the easement law, and further promote this option amongst private land owners.

5. Biological Corridors

Approximately 55 protected areas exist in Puerto Rico, which correspond to 7% of the island's surface. The areas under protection comprise the majority if not all the terrestrial ecosystems present in the island. However, the continuous urban and road development is jeopardizing the natural connectivity amongst protected areas by fragmenting and reducing natural ecosystems outside protected areas. In this regards, the creation of natural corridors between protected areas or critical habitats to ensure gene flow among species is needed for the conservation of the native fauna and flora. Projects directed at creating biological corridors and landscape connectivity such as the protection and conservation of small fragments of native ecosystems and the development of artificial corridors like the creation of artificial strips of native trees along roads would be starting points as further information is needed to verify what areas would be most advantageous for protection.

6. Protected Area Zonification

Despite the large number of protected areas in Puerto Rico most of them have no zonification and physical delimitations boundaries. This lack of zonification poses a problem to protection and conservation of these areas. Management plans should include a zonification scheme such as the demarcation of buffer and core zones taking into account ecological data and the activities that people can or cannot take part within each zone. While sites with management plans do take this into consideration, the majority of protected areas are lacking a management plan.

7. Special case: Tres Palmas Marine Reserve

A special case that should be considered as a possible opportunity is the Tres Palmas Marine Reserve. The reserve's management board which is made up of community members, academics and DNER staff have been exploring the option of having an NGO help manage the reserve due to the lack of experience, personnel, and funds.

Table 1. List of Priority Sites Identified in Puerto Rico’s Coral Reef Management Priorities.
 Only the first four sites listed were selected as priorities for initial management action.

Priority Order	Name of the Area
1	Culebra
2	North East Reserves
3	Cabo Rojo
4	Guánica and Marine Extension
5	Vieques
6	Parguera – Pitahaya
7	Desecheo/ Rincon
8	Caja de Muerto/Derrunbadero
9	Mona
10	Mayagüez
11	Jobos
12	Cibuco/Vega Baja/Manati
13	Maunabo
14	Guayama Reefs
15	Isabela
16	Isla Verde

Updated Ecosystem based Adaptation assessment findings: Summary Report

About the Summary Report

The report identifies work being carried out on or related to climate change and ecosystem based adaptation in Puerto Rico. This report should also be considered a working document due to the fact that climate change is a growing issue of concern and more projects not identified here, should arise in the near future. However, the work shown here provides a comprehensive catalog on the efforts on climate change and ecosystem based adaptation in Puerto Rico.

In Addition, the need for a further understanding of what Ecosystem based Adaption is, and how it can be applied in Puerto Rico exists. As can be seen by the projects in this report, there is interest, and potential for further climate work. With the new Puerto Rico Climate Change Caucus being headed by DRNA's Coastal Zone Management program new energy, momentum, and support have created a great environment for further climate and EbA projects and initiatives.

Agency, Organization, NGO/Contact	Project Name	Project Description
The Alliance for Climate Protection	The Climate Project	<p>-A program of the Alliance for Climate Protection, The Climate Project (TCP) represents a global force consisting of specially trained climate activists who are dedicated to educating people about the urgency and solvability of the climate crisis at a grassroots level worldwide.</p> <p>-9 Presenters in Puerto Rico: Jorge Benitez, Maria Juncos, Angel Jimenez, Diana Luna, Sandrine Molinard, Kasey Jacobs</p> <p>-www.theclimateproject.org</p>

<p>The Sierra Club</p>	<p>Cool Cities Campaign</p>	<p>-Led by volunteers around the country. Collaborating between community members, organizations, businesses, and local leaders to implement clean energy solutions that save money, create jobs, and help curb global warming.</p> <p>http://www.puertorico.sierraclub.org/ciudadescool/index.html</p>
<p>U.S. EPA / Hector Velez, Teresita Rodriguez, Paul Simon, Kasey Jacobs, Rafael Mendez Tejada</p>	<p>EPA Climate Change Conference for the U.S. Caribbean / Planning in process</p>	<p>-Anticipated date – Fall 2011</p> <p>-Two-day conference: first day to discuss climate science and mitigation and second day solely devoted to adaptation.</p>
<p>U.S. Fish and Wildlife Service</p>	<p>Southeast Climate Science Service</p>	<p>-US FWS is founding 8 CSCs around the country. The Caribbean will be part of the Southeast CSC in Florida. Rollout date TBD.</p>
<p>Sea Grant Puerto Rico, Sea Grant Hawaii/ Ruperto Chaparro, Kasey Jacobs</p>	<p>Potential Linkage between Sea Grant PR and Sea Grant Hawaii – Center for Island Climate Adaptation and Policy</p>	<p>-Several departments at the University of Hawai'i established ICAP in January 2009 to facilitate a climate-conscious future and improve island resiliency. Through a core team of planners, attorneys, and coastal geologists they use a multidisciplinary approach to address island climate adaptation.</p> <p>-The PRCCC and Sea Grant Puerto Rico are working to include Puerto Rico as part of the Center for Island Climate Adaptation and Policy.</p> <p>-http://islandclimate.org</p>
<p>UPR Mayaguez and University of South Florida</p>	<p>Coastal Area Climate Change Education (CACCE) Partnership</p>	<p>-CoHemis has started a new project sponsored by the National Science Foundation (NSF) in collaboration with University of South Florida, Hillsborough County Public Schools, and The Florida Aquarium to improve the education of climate change in Florida and the</p>

		<p>Caribbean. This effort called Coastal Area Climate Change Education (CACCE) Partnership is also locally supported by the Sea Grant Program. Our group has been working since September 2010 and this forum represents the first official activity of the project in Puerto Rico. This forum will analyze the challenges and opportunities of education and research in climate change. Also, we will explain the objectives of the CACCE project to the Puerto Rican community. This is the beginning of many other initiatives in this topic that we will carry out during the next two years in this first phase.</p>
<p>North Carolina State University and Texas Tech University / Jaime Collazo</p>	<p>Climate Assessment and Conservation</p>	<p>-Partnering with many of the PRCCC members such as DNER, UPR, US FWS, USGS to statistically downscale global climate models to get higher resolution climate projections for PR and USVI. Then use Integrated Coastal Assessment, Integrated Terrestrial Assessment, Avian Models, Watershed Modeling, and other parameters to identify the vulnerable ecosystems of the U.S. Caribbean and optimal conservation strategies.</p> <p>-Started in 2010. Downscaled projections will be done by end of 2011.</p> <p>-Process might be used to create a Caribbean Landscape Conservation Cooperative</p>
<p>Interagency Effort: DRNA, USDA-NRCS, NOAA, EPA, FWS, UPR, Center For Watershed Protection/ Roberto Viqueira</p>	<p>Implementation of Guánica Watershed Management Plan</p>	<p>-The Guánica Watershed Management Plan has become a very popular document /initiative in the past 2 years. While this plan has a variety of recommendations the organizations involved are focusing on 4 of these recommendations: 1. Working with the agriculture community to switch from sun grown to shade grown coffee. 2. The creation of treatment wetlands to further reduce the nutrient load into Guánica bay from the wastewater treatment plant. 3. The removal of concrete structures in the watershed which obstruct water flow and cause massive erosion</p>

		<p>to farmlands and the restoration/stabilization of those river banks, and finally, 4 the restoration of the Guánica lagoon.</p> <p>-From inception until today very seldom has climate change or ecosystem based adaptation been mentioned in association to the Guánica watershed management plan's recommendations even though it is clear that they directly address these issues.</p> <p>-The door is open to offer advice and guidance with these projects and to embark on similar enterprises elsewhere in the jurisdiction.</p> <p>-In March 2011 the Puerto Rico House of Reps. Committee on the Environment and Resources held a hearing on the merits of the restoration of the lagoon. Several people from various agencies, as well as the TNC contractor in Puerto Rico were asked to testify on the scientific, social, economic and cultural merits of the lagoon's restoration.</p>
<p>International Institute of Tropical Forestry, USFS/ William Gould</p>	<p>Long-term monitoring and modeling of climate change and land use change on tropical ecology and biodiversity</p>	
<p>International Institute of Tropical Forestry, USFS/ William Gould</p>	<p>Project Completed-Not yet published</p> <p>Modeling Effects of Sea-Level Rise in Puerto Rico: Environmental and Social Implications.</p>	<p>-Objective: Understand the scope of ecological and social impacts that future predictions of SLR could have on crowded coastal regions, such as the case of Puerto Rico:</p> <ol style="list-style-type: none"> 1) How will coastal land-covers be affected? 2) How will protected coastal lands be impacted? 3) To what extent will coastal populations be affected? 4) How will coastal delineation change? <p>The project was supported by the USGS BRD National Gap Program, the Puerto Rico Gap Analysis.</p>

<p>DRNA: Bureau of Coasts, Reserves and Refuges/ Damaris Delgado, Aida Medina Martinez, Idelfonso Ruiz</p>	<p>-Wetland restoration-creation in the Boqueron Wildlife Refuge.</p>	<p>-Refugio de Vida Silvestre de Boqueron: Cambio climático variables: (1) Incremento en los eventos de lluvias Ej. Lluvias como la del 23 de septiembre de 2009, donde en menos de tres horas se registraron más de 6 pulgadas de agua. (2) Huracanes de mayor intensidad, (3) cambio en la mareas. Para lidiar con estas amenazas estamos proponiendo la creación de varias charcas en área de humedal con dos propósitos: (1) minimizar la velocidad de flujo y (2) crear hábitat para la vida silvestre.</p> <p>Beneficios:</p> <ul style="list-style-type: none"> -Las charcas tendrían la capacidad de almacenar el agua que proviene de escorrentías, pozos y quebradas. -Disipación y retención de particulados (nutrientes, sedimentos), mejorando la calidad de agua que entra a la Laguna de Rincón. -Minimizar el impacto por inundación. - Nuevos hábitat para el beneficio de la vida silvestre (ej. peces).
<p>DRNA: Bureau of Coasts, Reserves and Refuges/ Damaris Delgado, Aida Medina Martinez</p>	<p>Land Acquisitions</p>	<p>-The acquisition of lands in the Northeast Ecological Corridor is key for the ecosystem to be able to adapt to change, and for continued coastal protection without major engineering.</p>
<p>DRNA: Marine Resources Division/ Craig Lilystrom</p>	<p>Research, monitoring and management of fish populations in dams.</p>	<p>-As climate changes, the current management goals will also need to change since the fish species with management objectives are traditionally from North America, and thus increasingly less appropriate for the tropics.</p>
<p>DRNA: Marine Resources Division/ Craig Lilystrom</p>	<p>Fishery Population Habitat Assessment in Puerto Rico Streams.</p>	<p>-Este proyecto provee información crítica para la formulación de “Caudales Ecológicos” en nuestros rios, entre mucho otros usos.</p>

<p>DRNA: Coastal Zone Management Program/ Ernesto Diaz</p>	<p>Redesign recommendations to urban waterfronts to reduce coastal communities risk and vulnerability.</p>	<p>-Recomendaciones para el rediseño de “urban waterfronts” como estrategia para la reducción de la vulnerabilidad de comunidades, residencias, infraestructura y comercios a los riesgos costeros y a los cambios climáticos.</p>
<p>DRNA: Coastal Zone Management Program/ Ernesto Diaz</p>	<p>Conservation strategy, management and wetland restoration opportunities throughout Puerto Rico.</p>	<p>-Estrategia de Conservación, Manejo y Restauración de Humedales (lo cual visualizamos como posibles áreas de refugio y conectores a corredores riparios que provean oportunidades de migración de especies impactadas por cambios en salinidad o temperatura).</p>
<p>DRNA: Coastal Zone Management Program/ Ernesto Diaz</p>	<p>Coastal Communities Resiliency: Updated wetland and coastal barrier inventories.</p>	<p>-En el área de “Coastal Communities Resiliency” trabajamos en la actualización de los inventarios de humedales y sistemas de barreras costeras (rasgos geomorfológicos costeros). Estas áreas constituyen en muchos casos elementos atenuadores de marejadas, inundaciones y posiblemente de impactos asociados al incremento del nivel del mar y su magnificación de los impactos de los eventos antes referidos.</p>
<p>DRNA: Coastal Zone Management Program/ Ernesto Diaz, Kasey Jacobs</p>	<p>-Sea level Rise and Coastal Hazards Vulnerability Assessment as part of the Puerto Rico Island-wide Climate Change Adaptation Strategy.</p> <p>This work is to be done by the NOAA Coastal Management Fellow</p>	<p>-Identify coastal communities vulnerable to coastal hazards and sea level rise at 44 municipalities.</p> <p>-Identify key geomorphic features and wetlands currently providing flood and coastal hazards protection.</p> <p>- Establish the basis for the Island-wide strategy to retreat, accommodate or protect structures potentially affected by sea level rise.</p> <p>- From 2010-2012 conducting a climate vulnerability assessment for all the islands of Puerto Rico in addition to drafting an</p>

	<p>-Puerto Rico Climate Change/Cambios Climáticos Caucus (PRCCC)</p>	<p>adaptation strategy for Puerto Rico. Using existing literature from PR and the international community. Creating Coastal vulnerability Index (CVI) and corresponding mapping to identify most vulnerable communities and ecosystems. Through stakeholder workshops identifying vulnerable areas and potential adaptation strategies (projects, policies, actions, etc).</p> <p>-Over 108 project partners to date and more added every day. Steering committee members are CariCOOS, NOAA National Weather Service, University of Puerto Rico, Sea Grant Puerto Rico, Coastal Hazards Center, and DNER.</p> <p>- Puerto Rico climate listserv (PR-CC-L) created to keep the PR climate community connected.</p>
<p>DRNA: Coastal Zone Management Program/ Ernesto Diaz</p>	<p>-An Indicator species guide to show coastal-terrestrial delineation and transition in the “Zona Marítimo-Terrestre” (ZMT) Finished - Updated transitional coastal-terrestrial vegetation line.</p>	
<p>DRNA: Coastal Zone Management Program/ Ernesto Diaz</p>	<p>Develop Official Coastal Delineation Reference System</p>	<p>-Desarrollo del Sistema de Referencia Oficial para deslindes de Zona Marítimo Terrestre el cual constituye una de las herramientas para establecer “setbacks” de las áreas potencialmente afectadas por inundaciones costeras.</p>
<p>DRNA: Coastal Zone Management Program/ Ernesto Diaz</p>	<p>Finished Products:</p>	<p>-A coastal flooding scenario with an increment of 1 meter above sea-level.</p> <p>-An evaluation on sea-level rise trends in Puerto Rico.</p>

		<p>-Evaluación de tendencias de incremento del nivel del mar basado en los records de los mareógrafos con más datos históricos de mareas y nivel del mar (La Puntilla y Magueyes)</p> <p>-A Public perception study on climate change and coastal risks.</p>
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Worth Mentioning

During the previous administration (04-08) a Commission on Global Warming was created with the purpose of addressing climate change issues. This commission began to developed a draft action plan “Estrategias Recomendadas para la Mitigación del Calentamiento Global y Adaptación al Cambio Climático.”

The action plan does have brief recommendations on water resources, natural reserves, biodiversity and ecosystems, as well as on agriculture, energy, fisheries, health, transportation, tourism and infrastructure and construction.