Puerto Rico Coral Reef Initiative: 1999-2004

Introduction

The Department of Natural and Environmental Resources (DNER) and the Puerto Rico Coral Reef Working Groups have developed the following five-year action plan for the Island of Puerto Rico. Numerous workshops held during the last five years by the U.S Islands Coral Reef Initiative, the Puerto Rico Coastal Zone Program, and the University of Puerto Rico Sea Grant Program have identified the components of this plan. These focus on gathering the necessary information required to support science, education, monitoring, management and enforcement needs. Confident that with a better understanding of our resources and accessibility to the information, agencies, researchers, and non-government organizations will work together in the achievement of our goals for the protection of coral reefs.

In the process of updating the 1997 Puerto Rico Coral Reef Action Plan, various steps were taken. DNER established a Coral Reef Working Group, which included participation of all the divisions and programs with some responsibilities for coral reefs. A two-day workshop was held with educators and NGO’s from the entire island to develop an outreach and education strategy. Personal contacts were also made with other researchers and universities.

As previously stated, this plan maintains its objective of addressing the lack of information and its management. These have become key points in further developing a more detailed awareness, outreach, and enforcement plan. In the last two years, Puerto Rico has completed coral reef characterizations for Jobos Bay, Caja de Muerto, Guanica, Tourmaline, and Fajardo. Fifteen permanent transects have been established per site and a Coral Reef Technical Monitoring Workshop was held to enhance the establishment of a community and government based long-term monitoring program. At the same time, the Puerto Rico Coastal Zone Management Program has taken important steps in establishing an interagency Coral Reef Committee and compiling historic and new information regarding corals. A centralized data management program is being developed to facilitate the exchange and maintenance of information.

These achievements---the designation of the first Natural Reserve in Culebra that incorporates “No Take Zones,” new and revised laws and regulations for the protection of coral reefs, fisheries, and related habitats, the approval of the Non-point Source Implementation Plan, the Mapping of Coral reefs in Puerto Rico, along with all the Island’s NGO’s outreach programs---are certainly important steps in taking action for the protections of our corals. The accomplishment of the activities in this plan will certainly be an important milestone in supporting the Governor of Puerto Rico’s Initiative for the protection and stewardship of our resources.
A. Project: **Baseline Characterization**

**Lead Agency:** Department of Natural and Environmental Resources (DNER) and Private Consultants

**Priority:** High

**Start Date:** October 1998

**Duration:** Three years, 1998-2000

**USCRTF Reference:** Mapping and Information Synthesis

**Information Gaps**

- Inventory of Puerto Rican coral reefs (Cintrón and Goenaga, 1979) shows geographical distribution and provides qualitative descriptions of community structure (80 reefs), but not quantitative information from which to assess changes.

- Quantitative studies use different methodologies, include variable depths, are not recent, have incomplete characterizations of sessile-benthos (e.g., no algae, no abiotic), and few include fish surveys.

- Most recent quantitative studies (García and Castro, 1995-97) including sessile-benthos and reef fish characterizations are available for highly degraded sites (S.J. Bay, Guayanilla Bay, Mayagüez Bay), and few characterizations of our “best” coral reefs (La Parguera, Fajardo, Vieques, Culebra, Mona Is.)

**Project Description**

- Initial description of physical habitat: reef dimensions, depth range, distance from the coast, identify main coastal features (rivers, watershed uses) and potential sources of reef degradation (ports, domestic sewage, industrial/tourism activities).

- Qualitative description and photographic/video records at main reef physiographic zones (e.g., reef crest, slope, base of the reef).

- Quantitative assessment of reef community structure at each of the main physiographic zones. Follow CARICOMP protocol - determine percent linear cover by sessile-benthic biota with replicate permanent transects within narrow depth contours (5 transects/zones). Video transect documentation files.

- Quantitative assessment of reef fish and motile megabenthic invertebrate populations. Survey using belt transects centered on sessile-benthic permanent transects.

- Measurements of selected water quality parameters - turbidity, vertical/horizontal transparency, Secchi, temp/salinity, density, and fluorescence profiles, CTD

- 15 sites; 3 reefs per site; 2 depths per reef; 5 transects per depth. Add to existing database of 5 sites, 16 reefs.
Benefits

♦ Serves as the baseline for a long-term monitoring program, allowing for time-series analyses of reef community structure and vitality.

♦ Standardizes methodology to provide an intercomparable database from which to analyze spatial trends of coral reef community structure in relation to physical/environmental factors.

♦ Simplifies methodology which can be reproduced in monitoring programs by technicians and other non-specific personnel.

♦ Utilizes information as criteria for evaluations of prospective coastal developments (management decisions) and/or examine relationships between reef conditions and coastal developments (research).

Budget: $120,000 ( $60,000/yr. FY 1999-00 )
B. Project: **Training of Personnel**

**Lead Agency:** Department of Natural and Environmental Resources, Private Consultants

**Priority:** High

**Duration:** One Year

**USCRTF Reference:** Ecosystem Science and Monitoring

**Project Description**

- Technical workshop on coral reef characterization and monitoring. Capacitate personnel of the Marine Resources Division.
- Initial effort includes one workshop training for 4 people.
- Expand to include identification of disease and the collection of other physical and chemical parameters.

**Benefits**

- Agencies responsible for protection and management of coral reef resources will have personnel with expertise in reef characterization and monitoring techniques.
- Characterization and monitoring programs are not included as part of any specific course or workshop at agencies or universities. These employees will be able to capacitate other personnel in the DNER in CARICOMP techniques.

**Budget:** $13,000 FY 1999
C. Project: Coral Reef Monitoring Program

Lead Agency: Department of Natural and Environmental Resources; Marine Resources Division

Priority: High

Duration: Long-term, ongoing

USCRTF Reference: Ecosystem Science and Monitoring

Project Description

♦ Establish permanent monitoring stations of reef sessile-benthos, motile megabenthic invertebrates, reef fish population surveys and measurements of selected water quality parameters at representative coral reef sites including:
  a) marine reserves (Jobos Bay, La Parguera)
  b) impacted sites under restoration (Mayagüez Bay, Guayanilla Bay)
  c) low impact sites (Mona Is, Vieques, Culebra, Desecheo)
  d) highly impacted sites (San Juan Bay, Ponce Bay)
  e) sensitive sites to future coastal development (Boqueron, Guánica, Isabela, Arecibo, Rio Grande, Carolina, Vega Baja, Guayama).

♦ Use initial reef characterization as the baseline for monitoring program.

♦ Monitoring of permanent transects at least one time per year at each site.

♦ Continuous records of temperature and turbidity at eight high priority sites (JOBANERR, La Parguera, Cordillera Keys, Mona Island, Culebra, Mayagüez Bay, Boqueron, Guayanilla)

Benefits

♦ CARICOMP the only existing, partially implemented, long term reef monitoring program in Puerto Rico, is located in La Parguera and associated to the University of Puerto Rico.

♦ This monitoring program will allow the collection of comparable data of selected reefs in Puerto Rico for management and resource protection decisions.

♦ CARICOMP is widely used by other Caribbean Islands and Worldwide.

Budget: $85,000 FY 1999; $60,000 FY 2000-04
Includes salary for two positions, acquisition of scuba gear, video camera, turbidity meters, expendable termistors, and computer.
D. Project: Data Management Center

Lead Agency: Department of Natural and Environmental Resources, Puerto Rico Coastal Zone Program

Priority: High

Duration: Long-term, ongoing

USCRTF Reference: Ecosystem Science and Monitoring; Mapping and Information Synthesis

Project Description

♦ Establish a permanent Data Management Center for Coral Reef Studies at DNER that will receive, compile, and make available results from initial reef characterizations and long-term monitoring studies.

♦ Incorporate geographic Land Use (GPS, SSS, satellite images), climatological (NOAA), biological (reef characterization and monitoring) and sociological data into a Geographic Information System (GIS) for each site. Store information in CD-ROM.

♦ Compile historic data, coral reef related documents, and education materials.

Benefits

♦ Coral reef information and data will be available and accessible for the use of resource managers, researchers, educators, and general public.

♦ The Coastal Zone Program offer decision makers and general public information regarding coastal habitats.

♦ Data will be integrated to other available data GIS layers for Puerto Rico.

Budget: $40,000/ yr. FY 1999-2004

Includes the salary of a GIS person, Computer, and software.
E. Project: **Land Use GIS Layers**

**Lead Agency:** Department of Natural and Environmental Resources, University of Puerto Rico, other agencies or municipalities.

**Priority:** High

**Duration:** Two years

**USCRTF Reference:** Coastal Uses

**Project Description**

- Coastal development and land use have been identified as the primary stressors on coral reef ecosystems. Managers lack critical information that can help them regulate and evaluate status and trends of reef systems and the effects of management decisions.
- This project will develop a Land Use GIS layer of all municipalities for the selected coral reefs that will be monitored.
- The project is phased in two years. The first phase will develop GIS 1999 Land Use maps for the municipalities of Ponce (topographic quadrangles: Playa de Ponce, Ponce, Punta Cuchara, Peñuelas, Santa Isabel, Rio Descalbrado), Lajas (Parguera, San German), Vieques (Vieques), Culebra (Culebra), and Cabo Rojo (Cabo Rojo, Puerto Real).
- The second phase will develop Land Use maps for the municipalities of Guayanilla (Punta Verraco, Yauco), Mona Island (Isla de Mona), Isabela (Rincon, Aguadilla, Isabela), Arecibo (Camuy, Arecibo, Baceloneta) and Vega Baja (Manati, Vega Alta).
- Prof. Linda Vélez has done GIS Land Use mapping for the following municipalities through U.S. Forest Service and the University of Mayagüez: Guanica, Mayaguez, Carolina, Rio Grande, Canovanas, Luquillo, Fajardo, Ceiba, Naguabo, Juncos and Las Piedras. These can be added to our database upon interagency agreement.

**Benefits**

- USGS prepared a 1977 Land Use Map for Puerto Rico, but most of the Coastal development stressing coral reefs has developed in the last twenty years. These maps will bring Land Use data to the same time frame as the baseline characterization data, facilitating the evaluation of management decisions.
- GIS Land Use maps can be integrated into the baseline and monitoring data to create a tool useful for research, management, and educational objectives. These maps can serve as base maps to incorporate other available data such as: coral reef monitoring, water quality, weather, point discharges, new permits, ports & marinas, hydrology, roads & transportation, etc. providing a more complete tool to user groups and government agencies.
- This program objective is also compatible with the Puerto Rico Coastal Zone Program and federal watershed management focus.
- By the end of year 2002, the DNER will have updated GIS Land Use data for all coastal areas in Puerto Rico with the exception of six quadrants.

**Budget:** $120,000 FY 1999
F. Project: Identification of “Hot Spots” and Installation of Coral Reef Signage

Lead Agency: Department of Natural and Environmental Resources, Navigation Office, NGOs, Ranger’s Corps, other Federal Agencies

Priority: High

Duration: Two years

USCRTF Reference: Coastal Uses

Project Description

♦ The DNER Ranger Corp is the main enforcement entity in Puerto Rico with responsibility for the implementation of Coral Reef laws and regulations. This enforcement entity required better tools to help them perform their task.

♦ Coral reefs are not properly identified in maps or with signs in highly used coastal areas where the majority of our reefs are located.

♦ A map will be developed in collaboration with an interagency committee and NGO groups to identify “Hot Spots” and other essential habitats for use of protection and surveillance by Rangers.

♦ Signs identifying reef areas and proper use information such as: recreational areas, anchoring buoys or areas, Jet Ski areas, diving areas, etc., will be developed and posted.

♦ High recreational use and boat traffic areas will be given priority in deploying the signs.

Benefits

♦ Provide better information tools for the DNER Ranger Corps and General Public that will facilitate the prevention and enforcement responsibilities.

♦ Create awareness regarding coral reef resources, their proper use and need for conservation.

♦ Reduce effects of human activities on coral reefs, such as anchoring and boat grounding.

♦ Enhance natural restoration of coral reefs and related habitats.

Budget: $40,000 FY 1999
G. Project: **Compile Sediment Run-off Data for Coral Reef Watersheds**

**Lead Agency:** University of Puerto Rico, Mayagüez Campus, Department of Natural and Environmental Resources (DNER), Jobos Bay Natural Estuarine Research Reserve (NERR), Graduate Students

**Priority:** High

**Duration:** Two years

**USCRRTF Reference:** Water and Air Quality

**Project Description**

♦ One of the main causes for coral reef degradation in Puerto Rico has been identified as sedimentation caused by intense coastal land use and development.

♦ The Puerto Rico DNER is in the process of identifying and developing a cumulative impact protocol and/or model for evaluating cumulative impacts for Puerto Rico.

♦ Coral reefs and sea grass beds are very sensitive coastal habitats whose degradation is related to water quality. There is no data being collected that can provide regulatory agencies information on sediment rates due to coastal development is high demand areas. USGS only has sediment sampling stations on mayor rivers in Puerto Rico.

♦ This project will establish erosion and runoff plots (Edwards 1992) in identified vulnerable and "control" areas to ascertain the extent and composition of nutrient outlay from the field. A rainfall simulator (Miller et al., 1987), will be used to simulate different rainfall events, including a ten year, 24 hour rainfall event (> 8 inches in 24 hours, U.S. Department of Commerce, 1961).

♦ Water and sediment samples collected will be analyzed for sediment yield and elemental composition.

♦ Jobos Bay and Guanica will be used as pilots. Data collected will be utilized to validate cumulative impact model.

**Benefits**

♦ With this equipment sediment run-off data will be collected in all the mayor watersheds with coral reef ecosystems.

♦ This data will be added to the Geographic Information Systems (GIS) being developed for each of the watersheds where coral reefs are being monitored.

♦ This information will be valuable to regulatory agencies, permitting agencies, researchers and resource managers in addressing conservation, restoration and management strategies.

**Budget:** $30,000 FY 1999
H. Project: **Acquisition of Boats for Surveillance and Enforcement**

**Lead Agency:** Department of Natural and Environmental Resources, Ranger Corps Division

**Priority:** High

**Duration:** Two years

**USCRTF Reference:** Coastal Uses

**Project Description**

♦ As identified by the majority of the CRI working groups and NGO's, most of the regulation needed to protect coral reefs is in place, but there is lack of enforcement on the ground.

♦ Most Puerto Rico Ranger Maritime Units only have one boat to fulfill surveillance and enforcement duties along extensive coastal areas. Therefore priorities are selected based on these limitations. Due to the increasing number of recreational boats and Jet Ski's on our coast, much of their effort is dedicated to enforcing navigation and safety regulations.

♦ Seven 25' Boston Whalers will be acquired to expand the Ranger's capacity to provide direct surveillance to coral reef areas. These seven boats will support the actual infrastructure of each of the seven ranger maritime units: Guayama, Ponce, Boqueron, Fajardo, Piñones, Aguadilla, Arecibo.

♦ Seven boats will be purchased on a two-year timeframe basis.

**Benefits**

♦ All seven Ranger Units will have greater capabilities to expand their surveillance and enforcement activities to include coral reef areas. This action will result in having more ranger presence on the reefs to enforce existing regulations.

♦ While patrolling coral reefs, they can deliver education materials to reef users broadening their outreach efforts.

**Budget:** $600,000 ( $300,000/ yr. FY 1999-2000)
I. Project: Coral Reefs and Related Systems
   General Public Education Program

   Lead Agency: Department of Natural and Environmental
                 Resources, Private and State Universities, Sea
                 Grant, Non-profit Organizations

   Priority: High
   Duration: Three years
   USCRTF Reference: Education

Project Description
It is necessary to gather and evaluate the existing written information related to coral
reefs and associated marine systems, since most of it has not been updated. There is a
gap on the aspects of coral reefs systems that have been documented or disseminated. In
addition, the information has not been classified by levels or stakeholders. We propose
to incorporate the gathered information in the proposed data bank that satisfies the needs
of the stakeholders. The following activities will be completed:

- Active gathering of all kind of information related to coral reefs and related
  systems.
- Use of media to stimulate producers of information on coral reefs and related
  systems to cooperate in the creation of the data bank.
- Creation of several information centers.
- Creation of an Internet Page
- Continuous updating of information bank.

Benefits
Puerto Rico will have updated, reliable, accessible and available information for multiple
uses.

Budget: $20,000.00 ($10,000.00/year)
         $28,400/yr (It is a requirement to recruit an
         environmental educator that will be working with
         the DNER during the first two years of the work
         plan coordinating of the proposed educational.)
**J. Project:** Dissemination of Information

**Lead Agency:** Department of Natural and Environmental Resources, Sea Grant

**Priority:** High

**Duration:** Ongoing

**USCRTF Reference:** Education

**Project Description**

DNER's experience in educational activities has reflected that our citizens are eager to know about our natural systems, not only to satisfy school requirements, but also because of their interest in environmental themes, particularly in coral reefs and related resources. Written information at various educational levels is continuously requested and occasionally we are not able to satisfy the demand since there is no information available.

To satisfy our citizens' request on environmental themes at various levels, particularly on coral reefs and related systems, the following activities are proposed:

- Preparation of educational material
- Preparation of a glossary
- Reproduction of information
- Distribution of information in places of tourist interest
- Utilization of the fishing and navigation license issuing process to disseminate information
- Distribution of information in the country's educational centers

**Benefits**

Puerto Rico will have a permanent and available wealth of information.

**Budget:** $40,000.00 (10,000.00 /year)
K. Project: **Teacher and Student Training**

**Lead Agency:** Department of Natural and Environmental Resources, Department of Education, Sea Grant, Superior Education Council

**Priority:** High

**Duration:** Three years

**USCRTF Reference:** Education

**Project Description**

Puerto Rico does not have a formal obligatory education curriculum that responds to the need of transferring information about the condition and characteristics of marine resources, particularly coral reefs and related systems. This project proposes to:

- The incorporation of Puerto Rico’s coral reefs and related systems in the formal teachers’ guide.
- To promote as a requirement a coastal environmental course in the Faculty of Education and in the educational curriculum of the Department of Education.
- To establish a committee to prepare a teacher’s guide to incorporate a course on coral reefs and related systems into courses of elementary, junior high, and high school level.
- To design a marine biology course at high school level.
- To train teachers through guide.

**Benefits**

That education college students, teachers and students of the three educational levels (elementary, junior high, and high school) have the formal and systematic opportunity of learning about coral reefs and related systems.

**Budget:** $15,000.00 ($5,000/yr)
L. Project: **Coral Reefs and Marine Related Systems Laws and Regulations Education Guide**

**Lead Agency:** Department of Natural and Environmental Resources

**Priority:** Medium to High

**Duration:** One Year

**USCRTF Reference:** Education

**Project Description**

It is important that groups of interest which can potentially impact coral reefs have knowledge about the related laws and regulations to obtain a better enforcement of these provisions and, therefore, less degradation on these resources. The following objectives are:

♦ To educate groups of interest which can potentially impact coral reefs on related laws and regulations in order to prevent further damage to these systems.

♦ To contact agencies concerned with the management and use of the resource and which administer laws and regulations related to this resource.

♦ To prepare a document incorporating information on related laws and regulations.

♦ To distribute the document among groups of interest identified through interagency workshops and seminars.

**Benefits**

Negative impact on natural resources and associated systems will be reduced.

**Budget:** $10,000.00 FY 1999
Summary of Puerto Rico’s Coral Reef Activities

Coastal Uses
♦ Land use GIS Layers……………………………………$ 120,000 FY 1999

♦ Identification of “Hot Spots” and
  Installation of Coral Reef Signage…………………………$40,000 FY 1999

♦ Acquisition of Boats for Surveillance
  and Enforcement ……………………….$600,000 ( $300,000/ yr. FY 1999-2000)

Ecosystem Science and Monitoring
♦ Training of Personnel ……………………………$13,000 FY 1999

♦ Coral reef Monitoring Program ……….$85,000 FY 1999 ; $60,000 FY 2000-04

♦ Data Management Center ……………………………$40,000/ yr. FY 1999-2004

Mapping and Information Synthesis
♦ Baseline Characterization …………………$120,000 ($60,000/yr. FY 1999-00)

♦ Data Management Center ……………………………$40,000/ yr. FY 1999-2004

Water and Air Quality
♦ Compile Sediment Run-off Data for
  Coral Reef Watersheds ……………………………$30,000 FY 1999

Education
♦ Coral Reef’s and Related Systems General Public Education
  and Awareness Program …………………$20,000.00 ($10,000.00/year); $28,400/yr

♦ Dissemination of Information ………………………$ 40,000.00 (10,000.00 /year)

♦ Teacher and Student Training ……………………………$15,000.00 ($5,000/yr)

♦ Coral Reef and Marine related Systems Laws
  and Regulations Education Guide ……………………………$10,000.00 FY 1999