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# STRATEGIC PLAN FOR THE DEVELOPMENT OF THE COASTAL TRAINING INSTITUTE (CTI) FOR SEA GRANT PUERTO RICO

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This project report is submitted in partial fulfillment of the degree requirements of Worcester Polytechnic Institute. The views and opinions expressed herein are those of the authors and do not necessarily reflect the positions or opinions of the University of Puerto Rico, Mayaguez, Sea Grant College Program or Worcester Polytechnic Institute.

This report is the product of an educational program, and is intended to serve as partial documentation for the evaluation of academic achievement. The report should not be construed as a working document by the reader.

## Abstract

This report, prepared for the University of Puerto Rico Sea Grant program, focused on developing a strategic plan for the development of the Coastal Training Institute (CTI) in Puerto Rico. The CTI is being created in response to the need for improved coastal management and sustainable development on the island. A market analysis was performed to determine environmental and managerial needs, compile available resources related to coastal management and to identify an appropriate structure for the CTI. Twenty-one interviews and a focus group were conducted as well as related case studies analyzed to gather this information. Our suggestions based upon the collected data were then submitted to Sea Grant in the form of a strategic plan to be used as a preliminary step in the formation of the CTI.

# Authorship Page

At the time of the submission of this report, it is impossible for us to determine the specific responsibilities each member of our team attributed to this document. We have all edited the ideas and writing so that no section is clearly identifiable as belonging to any one person, and the report has truly become a unified team effort. We have worked together and traded responsibilities, which makes individual contributions no longer apparent.

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# Executive Summary

Coastal ecosystems and the resources they provide are essential to the health and integrity of the areas in which they are found. They serve as vital habitats and breeding grounds for marine and terrestrial organisms and provide revenue by attracting both recreational and commercial activity. This is especially true for small islands such as Puerto Rico, where income from these resources comprises a significant part of the economy. Despite their high value to the island, there is currently an increasing problem with the degradation of coastal and estuarine ecosystems. This is caused, in part, by over-development in coastal and watershed areas due to the growth in population and the increase in tourism. Without appropriate attention, these ecosystems and their resources may be permanently harmed or destroyed.

This attention requires trained and knowledgeable people; however, presently there is no uniform management training program in Puerto Rico for the purpose of supplying this type of training. Some coastal managers lack formal training, decision makers do not always have the necessary information, laws are not consistently enforced, and collaboration between the environmental agencies is not often present. The existence of an educational and capacity building program that has the available resources to improve upon these issues could be an effective tool in helping to conserve, preserve, and restore the coastal ecosystems of Puerto Rico.

Recognizing the need for such a program, the National Estuarine Research Reserve System (NERRS) of Puerto Rico, in conjunction with the Department of Natural and Environmental Resources (DNER), the Coastal Zone Management program(CZM), and Sea Grant, has sought and received funding to initiate a Coastal Training Institute (CTI). The CTI will be a virtual organization, providing a collection of resources presented with the objective of improving the knowledge and communication related to coastal resource management at local and regional levels. To aid in the development of the Coastal Training Institute, we conducted research to identify the current coastal management needs in Puerto Rico, the resources available to meet those needs, and the form of the CTI that would best supply those resources. From this information, we created a strategic plan for the development of the Coastal Training Institute.

**Data Collection Methods**

We utilized several different methods to gather the information necessary to create a strategic plan for the Coastal Training Institute. We performed a market analysis to assess the environmental and managerial needs of the island, identify available resources to be used for training, and aid in developing an appropriate structure for the CTI. To gather this information we conducted semi-structured and structured interviews with twenty-one individuals knowledgeable in the fields of coastal management, research, education, and social sciences. We also held a focus group with representatives from several federal organizations in the field. The focus group was conducted after we had created the proposal for the strategic plan, which allowed for us to receive the participants suggestions and feedback on our ideas. Related case studies of similar coastal management training programs also played an important role in our research for this project and aided in the formation of the final plan.

**Market Analysis Results**

In assessing the current coastal resource management approach in Puerto Rico, we identified room for improvement in the areas of education and communication. We found through our research that coastal management requires multidisciplinary knowledge for its success; however, in most cases the professionals in Puerto Rico only have expertise in specific fields, such as marine biology or oceanography. We found that the education of a coastal manager should include instruction in the areas of:

- Environmental legislation
- Resource conservation
- Natural resource economics
- Sustainability
- Strategic Planning
- Economics
- Community dynamics
- Interpersonal communication

It was also suggested that an increase in the communication among agencies on local and governmental levels could be improved through education and heightened environmental awareness on all levels. Our recommendation for the strategic plan of the CTI is based upon meeting these needs.

We then created inventories of available resources in Puerto Rico relevant to the education and training of coastal managers that could be used by the CTI. These resources are listed in Appendix F of this report and contain:

- Courses taken by current coastal managers in their education
- Literature available relevant to coastal management (books, journals, magazines, papers, web sites)
- Workshops, seminars, conferences, and courses available
- The names of current coastal management professionals able to teach in the areas of their expertise

In our assessment, we compared the list above of the suggested course of study for a coastal manager to the inventories of available resources in Puerto Rico. This analysis allowed us to identify gaps and overlaps with the supply and demand of courses and training programs in the field of coastal management in Puerto Rico.

**Recommended Key Elements for the Strategic Plan**

The last objective of our project was to create a plan for the structure of the CTI that would utilize the available resources and meet the current coastal management needs of Puerto Rico. The opinions and suggestions gathered from the focus group are also incorporated into the recommendations for our draft of the strategic plan.

From our research, we found that in order for the CTI to be effective and sustainable, there should be attainable goals that focus on these needs.

*Goals of the CTI:*

- To ensure the use of the institute by making it relevant, well-organized, and easy to use.
- To meet the current needs of the island by providing the information necessary to fill the gaps in the current education of a coastal manger.
- To improve the current coastal management situation in Puerto Rico by offering relevant knowledge and resources to those involved with coastal management.

*The Web site of the CTI:*

The CTI will most likely be in the form of a web site that presents a collection of human and physical resources, links to other organizations and universities, and describes current issues in Puerto Rico regarding coastal management. The resources and links listed in the web site could be offered to anyone interested in learning about coastal ecosystems or management. They should not be aimed at any particular age group, social class, or level of knowledge. They should contain information about present outreach programs, existing human resources, accessible facilities, current courses, seminars, workshops, and conferences being held in Puerto Rico, as well as a list of the relevant literature, publications, and other web sites relevant to coastal management.

Another section of the web site should be about present environmental and managerial issues of Puerto Rico. The web site could provide information related to these topics and suggest ways to address them. The organizations that are working towards solutions to these matters could also be listed in this segment as well as ways for people, such as other managers, the general public, teachers, or students to get involved in helping to overcome these problems.

*Outreach programs:* Although the interpersonal work involved with an outreach program contradicts with the virtual structure of the CTI, many interviewees felt that the small size of the island and the strong desire for improved coastal management would attract users. The web site for the CTI could provide and promote opportunities for students and teachers to get involved with outreach programs. The coordination of these programs might be the responsibility of the employee. They would most likely be sponsored by outside organizations and facilitated by the CTI. Research suggests that these outreach programs would be very beneficial to the education of young students and would help to attain the long-term goal of improved general knowledge and interest of coastal resources.

*Staffing:* In order for all of this information to be supplied in the well-organized and consistently updated manner necessary for the success of the CTI, the web site will need to be maintained by at least one employee. This person should be constantly updating the site with current information and issues and could eventually aid in advertising the web

site itself, participating with outreach programs, and could help organizations to communicate better by setting up meetings and conferences for them to attend.

*Ensuring motivation for the use of the CTI:* In order for the CTI to have an effect on the current coastal management situation, a high level of interest in it is necessary. A possibility for increasing motivation of people to use the CTI would be to offer certificates upon the completion of a certain number of courses in particular areas. As discussed in our interviews, these certificates would not only provide a physical document that proves the recipient's knowledge, but also could be used on résumés, and help to increase their wages. Another way to promote this program is by offering courses that are short and interesting to the participants. Many more people will be inclined to take classes that provide fieldwork and hands-on experience, as this type of education is enjoyable and different.

**Further Recommendations**

In order to further develop our strategic plan, more interviews and focus groups should be conducted with individuals of different backgrounds and qualifications. These would provide more information about coastal management in Puerto Rico, the resources available, and the views of the CTI. More related case studies should also be examined in the future to provide more insight into past efforts. The related case studies, along with the additional information collected from interviews and focus groups, will add to the strategic plan, increasing the strength of the CTI, and its chances for success.

# 1. Introduction

Coastal ecosystems and the resources they provide are essential to the health and well being of the areas in which they are found. They serve as vital habitats and breeding grounds for marine and terrestrial organisms, and provide revenue by attracting both recreational and commercial activity. This is especially true for small islands such as Puerto Rico, where these resources provide the basis for a significant part of the economy. Despite their high value to the island, the degradation of the coastal and estuarine ecosystems of Puerto Rico is increasing. This is being caused, in part, by over-development in coastal and watershed areas due to an expansion of the population and growth in tourism. Without appropriate attention, these ecosystems and resources may be permanently harmed, or destroyed altogether.

Many of the problems along Puerto Rico's coastline can be attributed to ineffective management, which is a result of a lack in education and communication on the island. Coastal decision-makers are not all formally trained, and do not always have the knowledge necessary to make decisions, laws are not consistently enforced, and collaboration among the governmental and non-governmental agencies does not always occur. Another issue that contributes to the coastal problems in Puerto Rico could be attributed to the lack of community involvement when it comes to the maintenance and respect of the coastline.

In addition to increasing education and communication in Puerto Rico, capacity building could also be used as a tool for improving the current coastal management situation on the island. Capacity building is a method that is used to strengthen the capabilities of individuals, organizations, and the linkages between them. Techniques in capacity building have been utilized in successful coastal management programs in many areas, including Ecuador and Brazil. The management initiatives of these locations made use of capacity building to train the organizations and individuals that manage the areas. The result of capacity building is that an organization's ability to perform assigned tasks in an effective, efficient, and sustainable manner is greatly improved, and many goals become more achievable.

Recognizing the need for education and capacity building, the National Estuarine Research Reserve System (NERRS) in Puerto Rico, in conjunction with the Department of Natural and Environmental Resources (DNER), Coastal Zone Management (CZM), and Sea Grant, has sought and received funding to initiate a Coastal Training Institute (CTI). The CTI will be a virtual collection of resources organized and presented with the goal of improving the knowledge and communication related to coastal resource management at local and regional levels. The objectives of the CTI are to provide the latest scientific information, tools, and techniques to organizations and individuals involved in the decision-making processes concerning the coastal resources in Puerto Rico. The CTI also intends to improve networking and collaboration among those involved in coastal management, as well as to increase the understanding of the environmental, social, and economic consequences of human activities within the coastal landscape.

At the time this project was undertaken, the Coastal Training Institute consisted of only a mission and a vision: therefore, the goal of this project was to provide Sea Grant

with a proposal for a strategic plan to be used in the development of the CTI. This plan was based upon the results gathered from a market analysis and related case studies in Puerto Rico. This includes an assessment of environmental and managerial needs, an inventory of current coastal management programs on the island, and a list of potential clientele and human resources. Sea Grant can use our recommendations in the formation of the CTI, enabling the agencies on the island to effectively train coastal resource managers, and improve the communication between organizations involved in coastal resource management.

The CTI has the potential to positively impact the current management conditions on the island of Puerto Rico. The development of this program could provide the resources necessary to increase collaboration, increase environmental awareness among students, government agencies, and the general public, and help to improve law enforcement and regulation on the island. As tourism and populations increase in Puerto Rico without a mechanism for more improved coastal management, over-development and pollution will continue to threaten its vital coastal resources. The strategic plan for the CTI might be a key step towards solving these issues.

# 2. Background

In order to propose a plan for the development of a coastal resource training program, we researched several aspects of coastal resources, capacity building and existing management programs. We begin this chapter by presenting information on the importance of coastal ecosystems and the serious consequences associated with their degradation, both in general and specific to Puerto Rico. Improved coastal management must draw upon environmental agencies in Puerto Rico, so next we provide an overview of governmental and non-governmental agencies working towards the preservation and restoration of the coasts. Other countries around the world are experiencing coastal problems similar to those in Puerto Rico, and there have been several attempts to design a training program as a solution. Therefore, to conclude this chapter, we highlight two of these programs since they can provide useful insight as to how to create a program to address the current situation in Puerto Rico.

## 2.1. Coastal Ecosystems

Coastal ecosystems such as continental shelves, the Great Lakes, estuaries, lagoons, and bays constitute less than 10% of the earth's surface (Malone and Nemazie 1996, NOAA 2002). In this small area they support over 95% of its fisheries and 25% of global biological production (Malone and Nemazie 1996). They serve as critical habitats to several types of terrestrial and marine organisms as well as support economies that depend on their resources for survival (OCRM 2002). As a result of their high biological productivity and accessibility, coastal ecosystems have become centers for human activity (World Resource Institute 2001). They support numerous species of birds and fish, which are vital to many activities such as hunting and fishing (OCRM 2002, NOAA 2002). The beauty and diversity of coral reefs attract SCUBA divers, snorklers, students, and scientists for educational and recreational purposes (OCRM 2002). They are also primary producers of fish, shellfish and seaweed, and are sources for fertilizers, pharmaceuticals, cosmetics and household products (World Resource Institute 2001). In the following section, we discuss the importance of coastal ecosystems and the problems that correspond to them both generally and specific to Puerto Rico.

### 2.1.1. *Estuaries*

Estuaries are defined as the areas along the coast where fresh water from rivers and streams mixes with salt water from oceans (SJBEP 2002). This mixture of salty and fresh water, called brackish water, provides a balanced transition from the differing water environments, and from the land to the sea (National Estuary Program 2001). Estuaries can be found in many different forms and places and can be comprised of a variety of habitats including mangroves, sandy beaches, rocky shores, marshes, tidal pools, river deltas and wooded swamps (National Estuary Program 2001). These delicate areas are influenced by the oceanic tides; however, they are protected from the harsh dangers of storms by coral reefs, barrier islands, sand, mud and fingers of land (SJBEP 2002, National Estuary Program 2001, NERRS 2002).

Estuaries are also excellent indicators of the surrounding environmental conditions because everything that will flow with water accumulates in them (U.S Dept.

Commerce, 2000). This flow of surrounding water into the estuary is called a watershed. In a watershed, water enters the system through overland flow, shallow subsurface flow, saturation overland flow and groundwater flow (Hopkinson & Vallino 1995). As the water passes over or through the land, it picks up sediments, nutrients, and other pollutants (National Estuary Program 2001, NERRS 2002). Due to this water flow, the effects of environmental changes thousands of kilometers away can be observed in estuaries (Hopkinson & Vallino 1995). The wetlands act as a filter to clean the water as it runs through the system and as a sponge to absorb excess floodwater and prevent erosion (SJBEP 2002,National Estuary Program 2001, NERRS 2002). In a healthy estuarine environment, pollutants that might enter the estuary can either be broken down by certain types of bacteria or are highly diluted and dispersed with the tides of the ocean (Sridhar 1982). If the amount of toxins entering the estuary exceeds the amount it is capable of breaking down or dispersing, the system becomes polluted which can result in serious problems.

These unique and very complex systems have high levels of productivity and economic value even though they only make up a small portion of the Earth's surface (Blaber 1999, National Estuary Program 2001). Estuaries provide education, recreation, scientific knowledge and aesthetic values, as well as natural resources for tourism, fisheries and commercial activities (National Estuary Program 2001, SJBEP 2002). They are also used for shipping harbors and ports, transportation and industry (National Estuary Program 2001). Estuaries also provide crucial habitats and nurseries for thousands of birds, mammals, fish, crustaceans, and other animals; the protected waters and high productivity provide a safe and nutrient rich environment for juveniles to mature (National Estuary Program 2001, NERRS 2002, Lipp *et al.* 2001).

### 2.1.2. *Human Impact*

Even though the importance of coastal ecosystems to our environment and quality of life becomes very apparent when all of their attributes are taken into consideration, many are currently being neglected or threatened by human activities (Blaber 1999, NERRS 2002, National Estuary Program 2001). Populations are increasing, especially in the tropics and sub-tropics (Blaber 1999), and coastal municipalities are growing three times as fast as communities in other regions (National Estuary Program 2001). Many shorelines are becoming overpopulated and overdeveloped and their natural resources are being abused or neglected (David *et al.* 1999).

To accommodate the demands of these developing areas, channels have been dredged, marshes and tidal flats filled, and shorelines reconstructed (National Estuary Program 2001, NERRS 2002). This has resulted in several problems such as eutrophication and sedimentation as well as various forms of pollution. These issues have negatively impacted the environment, and in many cases have caused unsafe drinking water, beach and shellfish bed closings, detrimental algal blooms, unproductive fisheries, habitat loss, fish kills, or problems relating to human health (Blaber 1999, David *et al.* 1999, Hopkinson and Vallino 1995, National Estuary Program 2001). Fisheries have also had a negative impact on coastal areas, especially estuarine systems, by removing species, changing the nursery habitat, and lowering water quality (Blaber

1999). The populations of coastal fish and other species have been reduced to historically low levels of abundance and diversity (NOAA 2002).

Agriculturalization and urbanization have had negative effects on all coastal resources; however, the most disruptive impacts have occurred in watersheds and estuaries (Hopkinson and Vallino 1995). These processes of agriculturization and urbanization, which are also associated with deforestation, reduce groundwater flow and increase overland flow (Hopkinson and Vallino 1995, Lipp *et al.* 2001). This then decreases the groundwater recharge that is used to supply streams and rivers with water during the dry seasons (Hopkinson and Vallino 1995). Without the groundwater recharge, those streams that help to reduce the speed of the water flowing into larger systems and delay the movement of flood peaks dry up and are therefore unable to serve those functions (Hopkinson and Vallino 1995). Overland flow can also cause severe ecological impacts by carrying sediment, nutrients, and organic matter downstream (Hopkinson and Vallino 1995).

One of the major problems caused by overland flow is that estuaries could possibly become the waste receptacles for coastal communities (Sridhar 1982), as a result of an increase in the use of septic systems for sewage disposal by rising populations (U.S Dept. Commerce 2000). A well developed septic system functions by dispersing the wastewater through a drainage field where it can be evaporated and the nutrients and bacteria found in it can be absorbed by the soil (U.S Dept. Commerce 2000). Estuarine and wetlands are able to purify the wastewater as long as it remains within the sustainable limits of the ecosystem (Sridhar 1982). These limits depend upon the size and density of the community, development in the watershed, the type of waste disposal systems, storms water treatment and detention, and weather (Lipp *et al.* 2001). Exceeding these limits will increase nitrogen and microbe levels, causing harm to the estuaries, the animals inhabiting them, and the surrounding populations (Lipp *et al.* 2001).

This enrichment of nutrients in an aquatic system due to human activities is known as eutrophication (Havens 2001). In addition to septic systems, changes in land use and agricultural practices have also increased the amounts of nitrogen and phosphates entering estuaries and watersheds, causing an increase in eutrophied ecosystems (Bowen 2001, Haven 2001, Hopkinson and Vallino 1995). Eutrophication results in a general increase of autotrophs, which can than lead to harmful algal blooms and can work up the food web to affect primary and secondary producers (Havens 2001). For example, raised nitrogen levels allow for the rapid growth of phytoplankton and macro algae, which then use more light, thereby limiting the available light to the sea grasses below (Bowen 2001, Haven 2001). This results in the reduction of sea grasses, and consequently a decline in the organisms that rely on them for habitat and food (Bowen 2001, Havens 2001).

Eutrophication is not the only process that limits light availability. Sedimentation and erosion also create a decrease in primary production as a result of the lack of light caused by suspended particles in the water when these processes occur (Hopkinson & Vallino 1995). Land use, vegetative cover, topographic steepness, soil composition, precipitation and natural disasters all are factors that affect sedimentation (Hopkinson & Vallino 1995, U.S Dept. Commerce 2000). Areas under construction are at the most risk for sedimentation to occur; in these areas, soil and vegetation are removed and loosened, and are therefore more easily washed or blown away (Hopkinson & Vallino 1995 and

U.S Dept. Commerce 2000). The paved roads, lawns, homes, and shopping centers found in cities and towns actually help to prevent sedimentation from occurring by securing the surface of the land (Hopkinson & Vallino 1995). Development is not a positive occurrence, however, as it results in an increase of overland flow, which causes harm to the nearby ecosystems.

### 2.1.3. *Natural Effects*

Although human populations certainly have an influence on coastal ecosystems; nature can have its own negative effects on coastal resources, estuaries and watersheds. Flash flooding induced by hurricanes can cause alterations in sediment patterns, such as beach and dune erosion, and changes in salinity and water quality (Mallin *et al.* 1999, David *et al.* 1999). Floodwater containment can decrease when rivers and swamps are blocked by debris, and the reduced beaches will be unable to buffer the next storm (David *et al.* 1999). Many populations of fish and wildlife are also reduced by the strong winds and heavy rain associated with hurricanes (David *et al.* 1999).

The destruction of an ecosystem after a hurricane is usually extensive, and when combined with human presence, the degradation is significantly increased (Mallin *et al.* 1999). The amount of damage incurred by these natural storms is directly related to the degree to which the land uses affect the environment (David *et al.* 1999). Power failures from hurricanes can overwhelm sewage treatment plants, resulting in a release of raw and partially treated sewage into the water (Lipp *et al.* 2001, Mallin *et al.* 1999). Populated flood plains also increase the amount of damage done by hurricanes due to the presence of septic sewage systems and landfills (Mallin *et al.* 1999). The functions of the septic systems are compromised during storms due to the saturation of the soil in the drainage fields, causing inadequate treatment of the wastewater (Lipp *et al.* 2001).

Similar to human waste sources, animal waste lagoons can also be ruptured or overflow during hurricane conditions (Mallin *et al.* 1999). It has also been noted that uncharacteristic increases in metals found in shallow marshes have occurred as a result of natural storms (U.S Dept. Commerce 2000). These metals--copper, cadmium, zinc, lead, and silver--accumulate in estuaries and watersheds as population and industrial activity increase (U.S Dept. Commerce 2000). The metals are then re-mobilized by the winds and waves of the hurricanes (U.S Dept. Commerce 2000).

Almost all coastal ecosystems show evidence of natural and human impact in one way or another, compromising the vital resources and habitats they offer (Blaber 1999, National Estuary Program 2001). Natural disasters are capable of causing serious detrimental impacts to these systems, and society places a wide variety of demands on them for waste disposal, commercial and recreational fisheries, transportation, other recreational activities, and as locations for ports, industries, and various urban centers. This is especially apparent in Puerto Rico, where the integrity of the island's coastal ecosystems is continuously challenged.

## 2.2. The Coastal Zones of Puerto Rico

Puerto Rico is a small island, about 35 miles wide and 100 miles long, located in the Caribbean Sea (US Dept of Commerce 1978). The coastline consists of 311 miles of various types of environments, landforms, and settings (CZM 1997). Due to the

geological make up of the land and constant pressures from varying weather conditions, the coasts can range from steep cliffs, dunes and sandy beaches to mangrove forests, swamps, salt-water ponds, and rocky shores (CZM 1997, US Dept of Commerce 1978).

The coastline can be divided up into eight sectors based upon socio-economic characteristics and the types of environments found in them. These are defined as the north, the northeast, south, southeast, west, southwest, northwest, and the offshore islands, as shown in Figure 2-1. The southwest and the northeast are particularly notable for their abundant natural resources and room for development (US Dept of Commerce 1978).

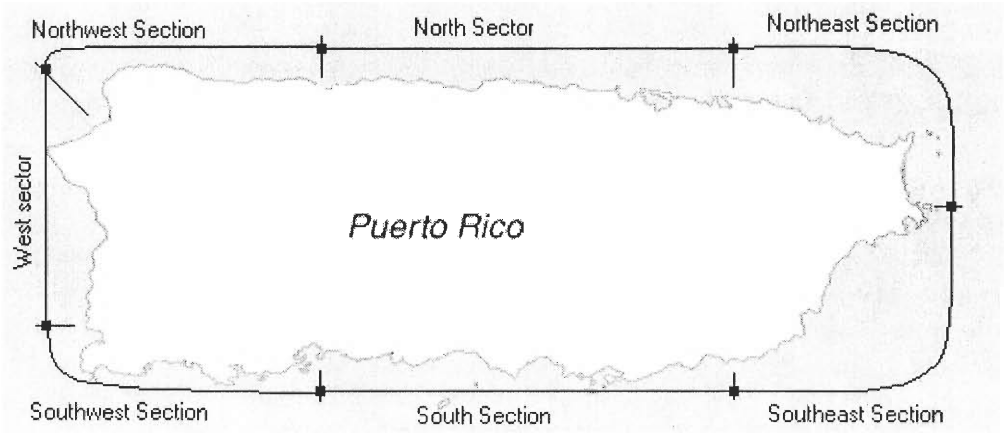


Figure 2-1: Map of the Coastal Zones of Puerto Rico
(Offshore islands not shown)

The dry southwest sector of Puerto Rico offers La Parguera Natural Reserve and the Guanica Dry Forest as well as miles of beautiful beaches, coral reefs and mangrove forests. There is a low population level in this area, which may account for the preservation of the natural systems located there. The northeast sector of the island contains the largest mangrove system in Puerto Rico, several salt-water lagoons, El Yunque rainforest, and the small islands of La Cordillera. These attractions produce a large tourist interest in the area, which in turn creates the demand for development. The nearby, highly populated San Juan metropolitan area also places pressures on the growth of the northeast. This area is in particular need of proper management in order to ensure that natural resources are not permanently damaged as a result of high expansion rates (US Dept of Commerce 1978).

Although the southwest and the northeast sectors of the island stand out due to their particularly valuable ecosystems and pressures for development, all of the coastal areas of Puerto Rico are used for recreational activities such as snorkeling, swimming, boating, fishing and surfing (CZM 1997). Since public beaches are available to persons from all levels of income, they not only serve as major tourist attractions, but are also in great demand by the residents of the island (CZM 1997). As a result of the high density of people utilizing the beaches and the appeal of coastal land to buyers, several problems arise in the management, sustainability and preservation of these areas (CZM 1997, Valdés Pizzini 2001).

A major problem affecting the coastal land of some municipalities is their disadvantaged financial positions (CZM 1997). Many of the communities in Puerto Rico are too poor to properly monitor development, aid reconstruction and make improvements with environmental areas (CZM 1997). According to Dr. Manuel Valdés Pizzini, the director of Sea Grant in Puerto Rico, high-end buyers looking to build houses or resorts are displacing the low income, local populations from their traditional homes (Valdés Pizzini 2001).

This increased pressure upon the coasts by developers also has a major impact upon the public's access to beaches (Valdés Pizzini 2001). It is the policy of the commonwealth of Puerto Rico that the maritime zone is designated as public domain (CZM 1997). The maritime zone is defined as the area in contact with the waves, as far inland as where the tide is still perceived in rivers and streams, and the point reached by the highest storm waves (Bush 1995). This policy gives the Planning Board the power to acquire any land necessary for public purposes (CZM 1997). It also designates the maritime zone as public domain and does not allow private ownership or use of this area. However, according to Ernesto Diaz, director of the Coastal Zone Management (CZM) program, these laws are not adequately enforced and consequently are not followed properly (Diaz 2002).

An example of the need for enforcement can be seen in the municipality of Río Grande. There are no access roads or pathways to the coast in the entire community, thereby forcing the locals to go to the neighboring municipality in order to enjoy the beach (Valdés Pizzini 2001). This is just one circumstance where the lack of sufficient management and law enforcement has seriously affected the community.

## 2.3 Estuaries of Puerto Rico

Due to the geographic makeup of the Puerto Rico, the coastline does not just cover the shores; it actually comprises the entire island. The estuaries and watersheds begin in the mountain range in the center of the island and expand outwards towards the coasts. Three examples of vital estuarine ecosystems in Puerto Rico are the San Juan Bay Estuary, Los Piñones Mangrove Forest, and the Jobos Bay National Estuarine Research Reserve. These key habitats will help provide insight to some of the types of problems that may be encountered on the island.

### 2.3.1. *San Juan Bay Estuary*

The San Juan Bay Estuary is an interconnected system of waterways that includes bays, channels, rivers and lagoons. The system is located along the northern coast of the island and has a watershed area of 97 square miles. It contains different habitats ranging from mangrove forests to coral reefs, and provides an irreplaceable natural, recreational, and commercial resource for humans and wildlife. The San Juan Bay Estuary generates a significant amount of revenue for Puerto Rico by supporting tourism, recreation, commercial ports, and historical sights (SJBEP 2002).

From the years of 1950 to 1990 the populations in the municipalities neighboring the San Juan Bay Estuary increased significantly, resulting in a detrimental impact on the ecosystems within the estuary (Valdés Pizzini 2001). The drainage basin is almost completely urbanized, with approximately 622,000 residents living in it (SJBEP 2002).

The land uses and activities brought on by the large number of residents in the basin have had an impact on habitat degradation and the water quality of the system (SJBEP 2002). The most pressing problems in the estuary--land development, illegal sewage discharge and aquatic debris--are all results of this human exploitation (SJBEP 2002).

To restore and protect the health of the estuary, the San Juan Bay Estuary Program was developed in April 1992 and was subsequently included in the National Estuary Program (Environmental News Service 2000, SJBEP 2002). As a result of the program, a prioritized list of problems in the estuary was developed: flushing capacity, illegal sewage discharges, nutrient and toxic contamination, aquatic debris, ecosystems management, and public awareness and participation (Environmental News Service 2000, SJBEP 2002). Local, state, and federal agencies, citizens, educators, and private entities are all part of the ecological effort to manage the San Juan Bay Estuary (Environmental News Service 2000, SJBEP 2002).

### 2.3.2. *Los Piñones Mangrove Forest*

Los Piñones mangrove forest lies very close to the San Juan Bay Estuary. It is located east of San Juan and is very well known for its beautiful beaches, historical significance, and ecological importance. The mangrove forest makes up 22 percent of all the mangroves on the island and covers most of the municipality of Loiza. The forest controls flooding, reduces erosion, eases the heat, and serves as a nursery for developing fish species as well as a critical habitat for turtles and birds. The Loiza community also has very rich historical and cultural traditions rooted in Puerto Rican culture, which adds to the significance of the forest (Ruiz 1999).

Similar to most estuarine ecosystems, Los Piñones has experienced severe damage to its ecological integrity as a result of human activities. The most apparent problems are sand extraction, sewage expulsion, and development. Millions of tons of sand were extracted from the area in the 1950s to build an international airport and to support the heightened demand for concrete in the urban boom. The removal of so much sand left Los Piñones vulnerable to erosion and storms. In addition, the area also receives sewage from five municipalities in the area, which has created severe pollution problems. Furthermore, developers have been trying to build major tourism development projects in Los Piñones (Ruiz 1999).

A non-governmental organization, the Frente Loiceños Unidos (FLU), is working towards the preservation of the scenic and cultural values of Los Piñones. They have created a proposal to develop the area using a socially and ecologically sustainable approach. The plans recommend increasing efforts towards eco-tourism, and adding trolleys, bike paths, aqueducts, sewage tubes, as well as telephones and other tourist needs. The FLU is an example of a community group that has organized to improve coastal management (Ruiz 1999).

### 2.3.3. *Jobos Bay National Estuarine Research Reserve*

Another valuable ecosystem to the island of Puerto Rico is the Jobos Bay National Estuarine Research Reserve. It is comprised of approximately 2,900 acres of mangrove forests, wetlands, lagoons, channels, salt and mud flats, dry forest vegetation,

coral reefs and sea grass beds. The area includes fifteen tear-shaped islets known as the Cayos Caribe and the Mar Negro (JBNERR).

The physical environment and benthic[1] communities of Jobos Bay have been compromised due to the lack of land management, increased sediment influx, and water turbidity. Several environmental agencies, including the National Estuarine Research Reserve System (NERRS), Coastal Zone Management (CZM) and the Department of Natural and Environmental Resources (DNER) are working together to manage this ecosystem. The effort towards the preservation of Jobos Bay is another example of the community working together to manage a vital ecosystem. Teachers, students and professionals are developing outreach and education programs as well as monitoring activities in Jobos Bay. The main goal of the reserve is to preserve the Jobos Bay Estuary for science and education (Gonzales 2002).

The San Juan Bay Estuary, Los Piñones mangrove forest, and Jobos Bay are all separately managed by different entities with different management plans. According to Francisco Quintana, the coordinator for the CZM, if all of these organizations were able to communicate, effectively promote the education that they provide, and collaborate in their efforts, both the community and the estuaries would benefit.

## 2.4. Environmental Agencies of Puerto Rico

Many environmental organizations are currently working toward the goal of preserving, conserving, and restoring the coastal zone and estuaries of Puerto Rico. An essential part of comprehending the environmental agencies of Puerto Rico is to examine each organization's purpose, reach, and approach. It is also critical to assess the relationships among these agencies; how they are interconnected, how they communicate, and how they differ. Three types of managing entities are currently present in Puerto Rico: governmental agencies, both U.S. and Puerto Rican, non-governmental organizations, and local municipalities.

### 2.4.1. *Governmental Agencies*

There are two types of governmental organizations operating in Puerto Rico: federal and Puerto Rican. The major Puerto Rican governmental agencies involved in coastal management on the island are the Environmental Quality Board (EQB) and the Puerto Rico Planning Board. The federal agencies in Puerto Rico are: the National Oceanic and Atmospheric Administration (NOAA), the office of Ocean and Coastal Resource Management (OCRM), the National Sea Grant College Program (Sea Grant), the National Estuarine Research Reserve System (NERRS), the Department of Natural and Environmental Resources (DNER), and the Environmental Protection Agency (EPA). The background and objectives of these agencies as well as the influence they have in Puerto Rico is described in the following section.

**Puerto Rican Governmental Agencies**: One of the most prominent governmental agencies working in Puerto Rico is the Puerto Rico Planning Board. The Planning Board was created in 1942 and is made up of three members who are appointed

[1] Benthic: "of, relating to, or occurring in the depths of the ocean." Definition taken from Merriam-Webster Dictionary, www.webster.com

by the Governor (US Dept. of Commerce 1976). All plans for development projects must be submitted to the Planning Board for analysis and permission for the use of the land. The board then delegates these plans to the appropriate governmental agencies that should be involved in the project to either make recommendations or give the project clearance (Diaz 2002).

It is also required by the law to include the community in any decisions regarding development. This is accomplished through the use of public hearings in which the local non-governmental organizations (NGOs) and community members can voice their opinions (Diaz 2002). The Planning Board is also responsible for creating and enforcing a land management plan for the island that creates different zones to be used for various purposes, limits development, and protects environmental resources (US Dept of Commerce 1976, CZM 1997).

The Environmental Quality Board (EQB) is an organization that is of equal importance to the Planning Board and functions similarly to the EPA and the U.S. Council on Environmental Quality in the United States (US Dept of Commerce, 1976). There are both governmental and non-governmental EQBs, which work very closely together (Quintana 2002). These agencies have two major responsibilities: environmental impact statement assessment and pollution control. Environmental impact statements summarize possible changes for projects being presented for approval, and pollution control programs monitor air and water quality, create pollution standards and regulations, and manage solid waste (CZM 1997).

**Federal Governmental Agencies:** While the Planning Board and the EQB are in control of issuing permits, other governmental organizations are in charge of the actual management issues. The National Oceanic and Atmospheric Administration (NOAA) plays a large role in the coastal management of Puerto Rico by providing funding for most of the governmental agencies working on the island, with the exception of the EPA. These organizations operate independently, but must submit progress reports back to NOAA to continue receiving the grants necessary to sustain their work. The mission statement of NOAA is "to describe and predict changes in the Earth's environment, and conserve and wisely manage the nation's coastal and marine resources" (NOAA 2002). An example of a joint effort between NOAA and the EPA is the creation of a program in October of 2000 to combat polluted runoff problems in Puerto Rico. These problems were detected in approximately 3000 of the 5384 miles of rivers and streams on the island (NOAA 2000).

As a part of NOAA, Sea Grant was created in 1966 to act as an oceanic research institute, linking colleges and universities together through active marine research. The goals of the Sea Grant program are to "encourage the wise stewardship of our marine resources through research, education, outreach and technology transfer" (Sea Grant 2000). Through the University of Puerto Rico, Sea Grant sponsors research and seminars on proper resource management of the island. An example of a program created by Sea Grant was the "Beach Management Conference; 'Managing Beaches in the Caribbean: Investing in Our Future'", which occurred on May 23-24 of 2000 (UPR Sea Grant 2002).

Another agency under NOAA's control is the office of Ocean and Coastal Resource Management (OCRM). OCRM is the agency responsible for administering the Coastal Zone Management Act, passed in 1972 (NOAA 2001). This act was created to

provide financial support and training to encourage states to better manage their coastal resources. The Coastal Zone Management Act created two national programs, the National Estuarine Research Reserve System (NERRS) and the Coastal Zone Management program (CZM), to address the need for proper management. NERRS was developed to maintain and preserve the nation's estuaries while the CZM was formed to manage the coastal ecosystems. After NERRS and the CZM were created, they were taken over by the Puerto Rico Department of Natural Resources (DNER) and still remain as divisions of DNER.

As a bureau of NOAA, DNER plays an important role in Puerto Rican coastal management, as it is responsible for maintaining the coastal resources and limiting projects in coastal and tidal areas (OCRM 2002). DNER is a federal agency that is comprised of three divisions: the Coastal Zone Management program, the Natural Reserves, and the Jobos Bay National Research Reserve (Quintana 2002).

NERRS was formed by the Coastal Zone Management Act to help manage estuaries around the United States so they may be used for research, education and interpretation programs (US Dept of Commerce 2000). This program was also developed to address the sustainability, the preservation, the conservation and the restoration of these vital resources (US Dept of Commerce 2000). NERRS "helps to fulfill NOAA's stewardship mission to sustain healthy coasts by improving the nation's understanding and stewardship of estuaries" (NEERS 2002).

NERRS is very actively involved with many research and restoration projects in Puerto Rico. Jobos Bay, an estuarine ecosystem located on the island, was designated as one of the national estuaries in 1981 and has been closely managed by DNER since that time (US Dept of Commerce 2000). As part of a nationwide evaluation of estuary status, NERRS also conducted an in-depth review of polluted runoff in Puerto Rico. This identified problem sources as well as their impacts upon the estuaries, and concluded that sedimentation and human waste are the largest issues that need to be addressed. NERRS and Sea Grant are also working to implement the Coastal Training Institute (CTI) to "develop a comprehensive training and capacity building program for resource management professionals, decision makers, and community organizations..." (NERRS 2001).

The second program created by the Coastal Zone Management Act and administered by DNER was the CZM. The CZM is defined as "a federal-state partnership for protecting, restoring, and responsibly developing the nation's important and diverse coastal communities and resources" (OCRM 2002). The CZM handles all permits pertaining to construction along the coastlines, which extend 1 km inland from the shore and 9 nautical miles seaward from the coast (Diaz 2002). This national program is responsible for administering funding to thirty coastal states and four territories, including Puerto Rico (US Dept of Commerce 1978). These funds can account for 80 percent of the costs necessary to implement coastal management programs in those areas. The CZM operates on a national level and is given the central responsibility for the development of these management programs (CZM 2002). The local governments and other federal agencies, however, are required to play a key role in this process (CZM 2002).

One of the only governmental agencies in Puerto Rico that is not under the control of NOAA is the Environmental Protection Agency (EPA). The EPA has also had a significant influence in Puerto Rico, although more with clean up and restoration rather than coastal management. Their goal is "to protect human health and to safeguard the natural environment — air, water, and land — upon which life depends" (EPA 2001). They are currently working in conjunction with DNER, NERRS, the EQB, and the local government to repair and preserve the San Juan Bay Estuary (EPA 1999). This is one of many projects aimed at reversing some of the more devastating effects of human impact upon the environment.

### 2.4.2. *Non-Governmental Organizations*

Non-governmental organizations (NGOs) also play a large role in the maintenance and preservation of coastal resources in Puerto Rico. Unlike the federal and commonwealth organizations, these agencies are often comprised of unpaid volunteers, including environmentalists, businessmen, students, homemakers and teachers (Ciudadanos del Karso 2001). They represent the general public, and bring together concerned citizens trying to make a difference in their communities. Examples of these organizations include the Ciudadanos del Karso (CDK), Fideicomiso de Conservacion de Puerto Rico, and the Frente Loiceños Unidos (FLU).

The Ciudadanos del Karso (CDK) is dedicated to preserving the karst region, an area located along the north coast of the island and well known for its limestone deposits, caves, and underground rivers. The CDK has been instrumental in initiating development of legislation to protect this area, and has been working with the US Forestry Service to declare the site a National Forest and Reserve. They have also been involved in the physical cleanup and maintenance of the area, and have heightened public awareness through informational videos and educational programs (Ciudadanos del Karso 2001).

Another NGO that is working on environmental protection in Puerto Rico is the Frente Loiceños Unidos (FLU). The FLU is a grassroots organization that fights against over development and helps organizations create alternative, less environmentally damaging plans for construction on the island. They have recently been involved in a struggle to stop four major tourism development projects in Los Piñones. According to Carmelo Ruiz, author of *Fighting to Keep the Mangrove Forest*, the vital mangrove forest and rich cultural heritage found in Los Piñones would be lost if the FLU did not intervene.

A third NGO working on the island is the Fideicomiso de Conservacion de Puerto Rico. This organization functions as a trust by donating money to various causes to aid in environmental protection. They support ecological education programs in schools, collaborate with other agencies, and provide funding for programs and groups with similar goals. Fideicomiso de Conservacion de Puerto Rico helped to rebuild the island after Hurricane Hugo by planting many trees to replace those lost in the storm. They also have been working on the reforestation of the island in conjunction with the Botanical Gardens of the University of Puerto Rico.

Although the influence of non-governmental organizations is very apparent, the NGOs are not the only agencies working at community-based levels in Puerto Rico.

Each of the municipalities that the island is divided into contains its own local governing entity that controls the planning and management within that area (Quintana 2002).

### 2.4.3. *Local Municipalities*

There are 78 municipalities in Puerto Rico, 43 of which are considered coastal counties (Quintana 2002). An elected mayor whose power depends on the status of the community leads each municipality. With the passing of the Commonwealth Autonomy Law in 1992, each municipality gained the option of applying to the Planning Board for autonomy. In order to seek approval for autonomy, the mayor must submit an application that discusses the reasons why the municipality requests it, along with a description of the community's capabilities. With the status of autonomy, the municipality has the power to control regulations regarding the management of environmental and economic issues in its area. The municipality is still required to present any development plans to the Planning Board for approval, and is also delegated responsibilities from the government (Diaz 2002).

Currently nine municipalities in Puerto Rico have been designated as autonomous. According to Ernesto Diaz, the director of the CZM, these include wealthier, better-developed communities such as Ponce and Carolina that are very capable of operating under this status. Diaz believes that some of the smaller communities in Puerto Rico benefit from government control and have no desire for autonomy as they receive money from the government along with guidance and direction concerning environmental regulations (Diaz 2002).

## 2.5. Coastal Management

Many problems exist with the coastal management in Puerto Rico for a variety of reasons. According to Francisco Quintana, these problems exist due to the deficiency in the communication and collaboration among agencies. There are several different organizations working to restore, conserve, and protect the various ecosystems found in Puerto Rico. Depending on their geographical and societal settings, the specifics of coastal structures vary slightly and therefore can change the type of program needed to manage it. The reaction that the differing ecosystems have to the pressures from human activities, however, can be very similar to one another (Olsen and Christie 2000, Good *et al.* 1999). The protection of the resources found in these coastal areas often conflicts with societal needs, leading the CZM to identify estuary and coastal wetland management as a central issue (Olsen and Christie 2000, Good *et al.* 1999). The design of an appropriate coastal management program benefits from knowledge in the history of coastal management, capacity building, and related coastal management case studies. In this chapter we present our research on these three topics in order to establish a base of knowledge necessary to the positive development of this project.

### 2.5.1. *History and Approach*

In the last thirty years there have been many successful and unsuccessful attempts around the world to properly manage coastal resources effectively and sustainably (Arriaga *et al.* 1999). There are several common approaches to the implementation of a management program for estuary conservation. The Coastal Resources Center (CRC) at

the University of Rhode Island held an international workshop on the topic in Sarasota Florida in 1996; this workshop provided the attendants with the latest available information and methods for managing the estuaries and coastal wetlands specific to their locations (Good *et. al.* 1999). The ideas of the CRC, the concepts of Integrated Coastal Management (ICM), Coastal Zone Management, and programs like the Coastal Resources Management Project (CRMP) all entertain the theory that an effective management program can be adapted to show positive results in any specific location (Needham 1998, Good *et. al.* 1999).

The general procedure for Integrated Coastal Management, as described by B. Needham, the author of *An Innovative Approach to Training and Capacity Building for Integrated Coastal Management*, is as follows:

- The first step is to discuss the demands and concerns of the community in relation to their coastal environment and to assess the programs that are currently in effect.

- Step two involves problem identification through environmental research and existing knowledge. This research consists of identifying the causes, effects, and future development of the problems. It also includes an analysis of the required professional profile for involved individuals based on skills, knowledge, and attitudes. The problems should then be prioritized and the surrounding environmental effects must be accounted for.

- The third step calls for strategy formulation based on collected data, available resources and the study of similar existing strategies. An effective approach would include ways of obtaining the favor of the public and stakeholders. This step would also include discussing the use of funding supplied through donations and by the government and non-governmental organizations. (Needham 1998; Glasgow and Burkholder 2000; Reis *et al.* 1999; Arriaga *et al.* 1999)

In Needham's opinion, the organizations must carefully plan the balance of power on a national and local level, in conjunction with adapting these three steps, in order for a management program to remain in effect. One strategy for the effective balance of power is co-management, a technique that requires the participation of different groups. In terms of coastal resource management, co-management is defined as the sharing of responsibilities in managing natural resources and protected areas (Valdés Pizzini *et al.* 2001). Successful coastal management requires the design of a process in which the distribution of power can be effectively modified to make possible progress toward the goal of coastal management (Olsen and Christie, 2000).

This "harmonization" process of combining authority is a procedure that relies heavily on the specific situation of the location and must be appropriately applied for the particular environment of interest (Olsen and Christie, 2000). It is important that this process be followed using a step-by-step approach that remains focused on the priorities

of the specific location (Olsen and Christie, 2000). The main challenge in implementing an effective and sustainable coastal management program lies in balancing the power utilizing the co-management strategy (Olsen and Christie, 2000; Arriaga *et al.* 1999; Bush *et al.* 1995). An example of an effective co-management strategy can be observed through the theories of Integrated Coastal Management (ICM).

ICM focuses on improving quality of life in communities that depend on coastal resources, while maintaining the biological diversity and productivity of coastal ecosystems (Olsen and Christie 2000). As stated above, in order for this goal to be effective, a unity between government and community must exist. ICM states that for a coastal management program to remain in effect, the interest and involvement of the public and the stakeholders must be maintained (Needham 1998). According to the authors Olsen and Christie, simply establishing new laws and regulations concerning waste disposal and fishing techniques will have little impact on the problem; lasting change only occurs when a considerable portion of a society wants it, increasing the need and desire for a program.

Another possible aspect for an effective management program might be the presence of properly trained professionals in the field of coastal resources available to act as trainers. Preferably these professionals should have worked in environmental fields and have experience with coastal areas. The knowledge that these experts have could be important in solving the coastal problems in Puerto Rico (Valdez Pizzini *et al.* 2001). One possible approach to training these managers for ICM is through capacity building (Needham 1998; Valdez Pizzini *et al.* 2001).

### 2.5.2. *Capacity Building*

According to Needham, an effective training program used for coastal resource management should include capacity building in order to strengthen the bonds between authorities on a national and local level. Needham argues that capacity building could also boost interest in coastal management and might be used to assess the capabilities of individuals and organizations in terms of finances and what they can physically accomplish.

Capacity building can be defined as a process by which individuals, organizations, and institutions strengthen their ability to carry out their functions and achieve desired results over time (Allen 2000). By strengthening the capabilities of individuals, organizations, and the linkages between them, their ability to perform in an effective, efficient, and sustainable manner is greatly improved (Allen 2000). The capacities of an organization can be placed into four categories: financial, physical, human, and organizational (Allen 2000). These capacities must be assessed to understand the organization's strengths and weaknesses before an appropriate developmental plan can be established (Allen 2000).

### 2.5.3. *Coastal Management Case Studies*

In this section we show how the general principles of coastal management and capacity building have been applied in currently existing programs. The reasons behind the successful programs can then possibly be applied and used as a framework for the one

that is being developed. Two relevant examples of coastal management programs that are successfully functioning can be found in Ecuador and Brazil.

**Ecuador:** An Integrated Coastal Management program is in operation for the Bahia de Caraquez zone and Chone River estuary of Ecuador. According to Arriaga, the author of *Integrated Management Perspectives of the Bahia de Caraquez Zone and Chone River Estuary, Ecuador*, this program remains in effect as a result of the careful planning and execution of the project. This program sought to improve coastal management along the estuary, by increasing the amount collaboration among environmental organizations, and by integrating local entities into the decision-making process associated with it.

One of the key elements of Ecuadorian coastal management has been the development of an approach to Integrated Coastal Management where specific zones are used (Arriaga *et al.* 1999). This program uses Special Management Zones (SMZ) that are classified geographically, and are comparable to the eight coastal zones of Puerto Rico (Arriaga *et al.* 1999). The conditions in each zone vary slightly, but they allow for the separation of the coastal resources resulting in the possibility for more efficient management of the estuary.

Arriaga believes in the fact that the ICM is conducted on a local, institutional level and focuses on the self-management of the environment contributes to the success of the program as well. He believes that another part of the reason for the success in Ecuador is due to the appropriate integration of the responsible authorities of the administration. These authorities act jointly with the local ones when applying management laws and regulations. According to Arriaga, without the interest and participation of these local groups and the organization of the project as a whole, no effective Integrated Coastal Management plan would exist for the Chone River today. In Ecuador, the effective communication between the users of the coastal wetlands also plays a key role in facilitating the actions of training and in guiding the development of self-management (Arriaga *et al.* 1999).

There are commissions and working groups that concentrate on the more important problems with the estuaries such as pollution, aquaculture, and the mangroves (Arriaga *et al.* 1999). Organization of coastal resources, user groups, and training programs help to encourage participation in the integrated coastal management also, and is very important in achieving the management goals.

The study of this program promotes the idea that there are many aspects to coastal management that must be addressed in order for a successful plan to remain in effect (Arriaga *et al.* 1999). The approach to ICM discussed in this section is an example of what is necessary for a sustainable and effective coastal management program.

**Brazil:** In Brazil, there is a proposal for an integrated coastal management program referred to as the Train-Sea-Coast Program. The objectives of this program are to strengthen the capabilities of existing educational and training facilities in Brazil (Reis *et al.* 1999). According to E.G. Reis *et. al.*, authors of *Building Human Capacity of Coastal and Ocean Management – Implementing the Train-Sea-Coast Program in Brazil*, the goals of the Train-Sea-Coast Program will be reached by means of training courses held in priority areas of coastal and oceanic development. The Train-Sea-Coast Program is supported by the federal government in Brazil and by an organization called the

Interministerial Commission for the Resources of the Seas (ICRS). The ICRS has the responsibilities of expanding the program nationally and improving communication between the different geographic regions in Brazil (Reis *et al.* 1999).

To develop training courses that result in more qualified personnel involved with coastal and oceanic management in Brazil, the Train-Sea-Coast program employed a four-step strategy (Reis *et. al.* 1999). These steps included: the assessment of problems along the coastal areas in Brazil, the identification of problems resulting from an inadequate development of human resources, the assessment of training needs both nationally and locally, and the proposal of a training course that focuses on these coastal problems (Reis *et. al.* 1999).

To gather information regarding the coastal problems in Brazil, a questionnaire was sent to the representatives of governmental and non-governmental organizations, as well as environmental institutions, universities, and financing agencies associated with the coastal and oceanic development of Brazil (Reis *et. al.* 1999). The questionnaire was designed to obtain personal information about the recipient and also technical data concerning the coastal and oceanic problems of their regions (Reis *et. al.* 1999). To analyze the data received, a workshop on "Coastal and Ocean Management in Brazil: Analysis and Perspectives" was conducted (Reis *et. al.* 1999). As a result, the main problems associated with the coasts of Brazil were identified, including pollution, coastal erosion, inappropriate occupation of coastal areas, inadequate agricultural practices, management indecision, deforestation, irrational exploitation of living resources, occurrence of conflicts, and absence of environmental education (Reis *et. al.* 1999). The issues were then categorized by importance and assessed at the workshop (Reis *et al.* 1999).

The Train-Sea-Coast program utilizes the Train-X methodology to implement its project (Reis *et. al.* 1999). The Train-X methodology consists of three distinct phases: analysis of training need, development of training, and an evaluation of the training (Reis *et. al.* 1999). The training course is then carefully designed to be instructor-independent, making use of modules that build the capability in the trainee to form a strategy for the development of the coastal zone as an integrated system (Reis *et al.* 1999). Reis *et. al.* states that the Train-X network represents a coordinated effort toward human resource development by improving the quality of training while building better capacity to recognize and satisfy priority training needs in a cost-effective way.

The objective of this program in Brazil is to build capacity in personnel and organization regarding the management of the coastal and oceanic zones there (Reis *et. al.* 1999). The program was also designed to effectively train individuals to manage the problem areas of the Brazilian coast. These trainees were all required to have sufficient background in the field of coastal management, and would partake in this training program to: expand their capacities as managers, improve their knowledge and use of strategy to manage, and to help them understand the importance of integrated coastal management in terms of communication and collaboration (Reis *et. al.* 1999).

Ecuador and Brazil are examples of successful coastal resource management programs. Their theories and ideas may be very helpful in providing a basis to formulate the strategic plan for the Coastal Training Institute in Puerto Rico. The background in coastal ecosystems, capacity building, and environmental agencies involved in coastal

management will also provide helpful information for the creation of the proposal for the strategic plan for the Coastal Training Institute.

# 3. Methodologies

We utilized several methods to obtain the data necessary for the development of a strategic plan for the Coastal Training Institute. In this chapter, we will present these methods in more detail, focusing on our objectives throughout. We first performed a market analysis in order to identify the pressing managerial and environmental issues and needs on the island. We also sought to assess the current resources available to help educate and train persons involved in coastal resource management. These resources included; available training programs, courses, workshops, outreach programs and facilities, relevant literature to coastal management, persons capable of training, and potential clientele in Puerto Rico. The market analysis was also used to gather ideas about the structure of the CTI that could be successful on the island. We also analyzed related case studies of existing coastal management programs and initiatives in order to learn from their past successes, procedures, and results. We conclude this chapter by describing how we used the market analysis results and related case studies to create a draft of the strategic plan for the CTI.

## 3.1 Market Analysis Objectives

Three objectives provided the framework for our market analysis. The first objective was to assess the managerial and environmental needs on the island. This was used to determine the coastal resources most in need of management, areas of knowledge required of training personnel, and possible solutions to the current situation. To accomplish this objective, we focused on identifying the knowledge necessary for effective and sustainable coastal management, as well as the ways coastal management in Puerto Rico might be improved, and whether or not a coastal training institute could be an appropriate solution. The background education of present coastal managers on the island was also assessed in order to gain an overall understanding of the formal training these coastal managers had received. An important aspect of this objective was to understand how management training programs are currently operating in Puerto Rico. We sought insight into how government organizations such as NERRS, DNER, NOAA, CZM, and the EPA, as well as local non-governmental organizations (NGOs) and the individual municipalities are managing coastal problems. Their individual strengths and weaknesses, as well as their levels of cooperation with one another, were identified as part of this objective.

The second objective was to create an inventory of current coastal management programs, training services, and human and physical resources available to support coastal management in Puerto Rico. We also considered the capabilities, techniques, knowledge, and the communication between the agencies present on the island to assess the available training facilities and human resources that could be utilized for the CTI. We evaluated the current programs and capacity building courses related to coastal management in Puerto Rico in terms of similar goals as well.

The final objective was to identify the most appropriate form the CTI should take in order to positively effect coastal management in Puerto Rico. The success of the CTI will be determined by the amount of interest in it; therefore, several different aspects of the CTI's structure were examined, including appropriate age groups and vocations of the

potential clientele, possible format for the seminars, courses, and workshops it will offer, and ways to promote interest in the institute to ensure its use.

### 3.2 Market Analysis Procedure

To gather the information necessary to attain these three objectives, we conducted interviews with representatives from several organizations associated with coastal resource management. The following section discusses the procedures used for the interviews and an explanation of their relevance to the project goal.

We sought information from people such as government officials, management professionals, trainers, and scientists because we believed that these individuals had the most knowledge of the current coastal management situation in Puerto Rico, and the most experience in management training. The participants for interviews consisted of members of federal and commonwealth agencies, NGOs, education professionals, and researchers, selected for reasons including their areas of expertise and their affiliations with agencies or communities. The list of interviewees was created through our research, suggestions by Tamara Acosta of UPR Sea Grant, and the word-of-mouth recommendations of previous participants.

The method we used to gather the data necessary to make an appropriate recommendation was through semi-structured and structured interviews with the above participants. We used interviews because of the specific type and amount of information that we wanted. These interviews were used to gather data pertaining to potential clientele, available human resources, current training programs, existing organizations and institutions, and the identification of environmental needs. The interviewees were contacted by telephone one week prior to the meeting and the location and time of the interview were then determined. In total we interviewed 21 professionals with different qualifications associated with coastal management; a listing is provided in Appendix G.

A protocol for all interviews was developed and followed as a guide so that we could better organize the gathered information and identify any trends or patterns. The standardized questions pertained to coastal management needs in Puerto Rico, available resources and programs, and ideas and suggestions for the CTI. A sample of the questions that were used in conducting these interviews is included in Appendix E of this document. Also incorporated into our interviews were questions relevant to a strengths, weakness, opportunities, and threats (SWOT) analysis. Conducting a SWOT analysis allows for the identification of problems, the reasons they occur, and areas for improvement within an organization. This analysis was utilized to provide us with insight into different organizations involved in coastal management, and helped us to recognize how they could be involved with the CTI. It was also used to help discover any gaps or overlaps in the structures and focuses of the agencies.

### 3.3 Evaluation of Related Case Studies

As another part of our research, we examined several related case studies and incorporated the information into our recommendations for the CTI. These case studies included two examples of current coastal management programs in Ecuador and Brazil. Articles describing these programs were obtained from the *Journal of Ocean and Coastal Management*. These case studies gave us insight into the entire procedure of such a

project from start to finish and also helped make us aware of any gaps we may encounter in the research and development of the CTI so they might be avoided. Research techniques were described and evaluated in these articles, and methods such as integrated coastal management and coastal zone management were introduced. These case studies were very useful in the preliminary steps of this project by establishing a place to begin, and presenting previously successful research and organizational methods to us.

We also reviewed sample strategic plans and the implementation plan for a CTI in Massachusetts. The implementation plan for the CTI was useful to our research because it presented the guidelines for interviews, focus groups, and questionnaires that were used to gather information for that project. This plan also displayed a general outline for the entire research process taken in Massachusetts. This study was helpful in identifying a direction for us to follow in our research.

We also examined several strategic plans for the implementation of Sea Grant projects in three different states. These documents were primarily used to identify the common format for a strategic plan. They helped us to better organize and present our strategic plan for the creation of the CTI in Puerto Rico.

### 3.4 Development and Presentation of the Strategic Plan

Using the data from our market analysis, we developed inventories of environmental needs, human resources, available facilities, potential clientele for the CTI, and examples of existing training programs. Through our research, we also sought to receive ideas and suggestions for possible future strategies for the initiative as well.

The collection of contacts and the lists of coastal management courses, available facilities, workshops, conferences, seminars, and literature were organized into tables by category to allow for easy review. We also created tables to identify the educational backgrounds of persons in differing agencies involved with coastal resource management. This enables readers to get a perspective of the overall education of coastal managers in Puerto Rico. The list of opinions from the interviewees concerning the knowledge that is necessary for effective management was compared with the list of currently available courses, workshops, seminars, and conferences. This analysis was used to evaluate the relevance of these resources and helped to identify any gaps or overlaps in the available training services. Using the information collected, the results of the market analysis, and the observations that we made while comparing the resource lists, we created proposal for a strategic plan for the future Coastal Training Institute in Puerto Rico.

Once the preliminary draft of the strategic plan was developed, we presented it to a focus group that we conducted in order to receive feedback on its content, structure, and relevance. The participants in the focus group included individuals representing several government-sponsored agencies in Puerto Rico. These agencies included the National Weather Service, the Caribbean Fishery Management Council, and the United States Geological Survey. An ideal number of participants would have been four to six people; however, as a result of time conflicts, only three were able to attend.

There were six areas of questioning for the focus group. The first part pertained to the demographic information of the individual and their organization. Information such as the location of the agency and their mission statements were discussed. Although

the focus group questions were designed for the purpose of receiving suggestions on our draft, the first question also identified the resources, such as training facilities and programs each agency had to offer. The second question was concerning the individual's opinions of inter-agency communication and collaboration currently in Puerto Rico. This question was useful in getting the participants to evaluate the current level of communication between agencies on the island while in the presence of other representatives. The remaining questions focused on the CTI and its structure. Also discussed were techniques to be used for maximizing interest in the CTI and identifying who the eventual users would be. This line of questioning presented us with some background information for understanding the representatives and helped to reinforce the need on the island for the CTI. These questions were also beneficial as we were able to receive feedback on our ideas and visions for the program.

This report contains all information concerning general and site-specific issues of estuarine and coastal management, and also includes the tables and results of the field research performed during the extent of this project. The strategic plan for the CTI is comprised of the mission and vision of the CTI, the background information necessary to understanding the need for the institute, analysis of our findings, the strategic goals of the CTI, the proposed structure of the program, and our further recommendations for the success and sustainability of the CTI. The results from the focus group were also incorporated into the draft of the strategic plan as modifications.

# 4. Results and Analysis

In order to develop a recommendation for a strategic plan for the Coastal Training Institute, our research focused on three separate areas concerning coastal management in Puerto Rico. These areas included the current coastal environmental and managerial needs of the island, the resources available to meet those needs, and the form of the CTI that would best supply those resources. Using the information obtained throughout this research, we discovered distinct patterns in the opinions of the many different aspects related to coastal management and capacity building. We also used our data to identify gaps and overlaps in existing training programs and knowledge that the CTI might possibly address. The information gathered pertaining to each of the topics mentioned above, as well as the available resources and themes that emerged, are discussed in this chapter. Also presented in this chapter is the structure of the CTI we felt was most appropriate for the island. We have also included the opinions and recommendations from the focus group about our ideas for the drafted strategic plan.

## 4.1 Coastal Management Needs

To create our proposal for the strategic plan, we first established the environmental and managerial areas that were most in need of attention, identified the knowledge necessary for effective and sustainable coastal management and established the topics in coastal management education that were most appealing to the interviewees. The strengths and weaknesses of the existing coastal resource management programs on the island were then assessed and the appropriate methods for improving the current management situation were decided on. We then determined whether or not a coastal training institute would be capable of utilizing these methods to achieve more effective and sustainable coastal management in Puerto Rico.

Through our interviews, we were first able to identify the aspects of coastal resource management that are in the greatest need of attention through capacity building and improved training methods. The most common of these topics are listed and underlined below. The number of interviewees that considered the topic a critical area in need of improvement is represented by the number in parentheses.

- Community involvement and education (10): According to Javier Saracho, a professor at UMET, cosatal management in Puerto Rico could be improved if the universities were in contact with the communities through education and involvement.
- Knowledge and enforcement of laws and regulations (8): Roy Armstrong, an associate professor at UPR, feels that some of the coastal management problems on the island result from the lack of education and enforcement of the law.
- Interagency collaboration (6): Beatriz Riesco, a fishery and sea food manager for Sea Grant, believes the importance of cooperation among agencies that deal with the marine and coastal environment should be promoted through education.
- Interpersonal communication (6): Dr. Juan Musa, director of the School of Environmental Affairs, argued that coastal management in Puerto Rico could be improved by offering courses in interpersonal skills.

- Strategic planning (5): Chaparro, an employee at Sea Grant, UPR stated that increasing training of planning on the island will better the coastal management situation.
- Environmental impacts (5): According to Ernesto Diaz, Director of the CZM, one way to improve coastal management is through a better understanding of how the environment is impacted by nature and humans

Topics also mentioned:

- Economics (3): Damaris Delgado, the director of Bureau Coasts, Reserves and Refuges, believes training in coastal natural resource valuation including socio-economic needs should be increased.
- Ecology (3): Curt Grove, a research coordinator for Sea Grant UPR, considers it necessary to create more outreach programs for coastal zone processes in order to help the coastal management situation in Puerto Rico.
- Coastal hazards (3): According to Avrelio Mercado, a professor at the marine sciences department of UPR, one problem with coastal management in Puerto Rico is the lack of knowledge in the area of coastal hazards.
- Sustainable development (2): Delgado also feels that creating more courses in effective and efficient project development will positively affect coastal management on the island.
- Water quality (2): Francisco Quintana, coordinator for the CZM, considers water contamination as an area in need of more education on the island.

The topics listed above show the areas in need of more sufficient training, or the gaps in the formal education of coastal management professionals. In our research, we discovered both similar and differing views on what areas of knowledge a coastal manager should be educated in to do their job effectively. It was determined through our interviews that most managers are not formally trained in the wide range of knowledge necessary for effective and sustainable coastal management. According to Delgado, the coastal managers are experts in specific fields such as biology or oceanography; however, they are not always familiar with topics such as sustainability, social sciences, planning, conservation and economics. Kurt Grove agreed with Delgado, stating that coastal managers should have a basic understanding of management skills; however, he also thought that coastal managers should have specialties in specific areas. As an example of this, Carlos Padin, a professor at UMET, believes that a coastal manager should have a strong background in environmental science and a major degree in economic and social science education. In Chaparro's opinion, the ecological aspect of coastal managemtn is the most important training a manager could have in order to properly care for a certain area, the managers need to have a thorough understanding of that ecosystem: the animals that inhabit it, the impacts it has upon other systems, and how other systems affect it. These opinions, in addition to the suggestions of other interviewees, determined several areas of general knowledge that our interviewees believed coastal managers should have. They are:

- Ecology
- Politics
- Economics
- Marine resources
- Community dynamics
- Conflict resolution
- Regulations
- Social sciences

Understanding the areas of knowledge our interviewees deemed necessary for effective coastal management is only a part of recommending the appropriate courses for the CTI. We also had to determine the most interesting areas of capacity building through the interviews in order to identify the courses that people would be the most likely to attend. The course topics that were the most appealing to the interviewees were:

- Sustainable development
- Coastal zone planning
- Coastal resource management
- Tourism
- Urban sprawl
- Coastal zone sociology

Current training resources in these areas should be incorporated into the CTI as they will provide critical information regarding coastal management as well as promote interest in the institute.

Providing courses is only one way the CTI could improve coastal management in Puerto Rico. There were several other suggestions from the interviews on how the management issues of the island can be improved. According to the majority of the interviewees, an increase in communication among the governmental and non-governmental agencies as well as the individual municipalities could significantly help the present situation.

In the research of related case studies in Brazil and Ecuador, the benefits of good inter-agency communication were presented, and proved valuable to the success of the projects in those countries. Communication was crucial to the efficiency and productivity of coastal management in Brazil and Ecuador because it familiarized the agencies and organizations with the importance of adequate cooperation and helped to recognize strategies to improve this collaboration.

The deficiency in the communication and collaboration among agencies on a governmental and local level in Puerto Rico is the cause of many of the problems with coastal management, according to Francisco Quintana. Quintana argues that their efforts are not combined due to conflicts between the government and the community. Ernesto Diaz stated that the interest is generally present on the local levels with the NGOs and in the municipalities. Diaz believes that the managers get discouraged in presenting proposals to the planning board, because the economic concern of the government results

in the denial of many projects; however, for effective coastal management in Puerto Rico, this correspondence issue between local and governmental authorities should be addressed. In the opinion of both Diaz and Robert Matos, the director of the Wildlife Refuge Service, improving the knowledge of policy and implementation processes on a local level, while better understanding the importance of preservation of the coastal environments on the governmental level, might help to improve the collaboration.

In addition to communication, the involvement of the government is a very important aspect to coastal management in Puerto Rico. Not only do they make important decisions regarding the future of coastal ecosystems, but they also provide funding to the organizations involved with coastal resource management. According to the majority of the interviews, inadequate funding has created problems in coastal management on the island. We found through our research that fluctuating funds and decisions dependent on congress were described as weaknesses in several of the programs. Chaparro believes that an appropriate budget is necessary in order for an improvement in coastal management to occur. Diaz also believes that there is room for improvement in funding for the coastal management programs on the island as well. Chaparro stated that an increase in the funds provided by the government could lead to the purchase of more equipment, an increase of programs designed to raise public awareness, a possible improvement in law enforcement, and an increase in wages of law enforcers and officials, all of which could positively influence coastal management.

The improvement in law enforcement and regulations was also identified as an area in need of improvement in Puerto Rico. According to Riesco, the laws are not being properly enforced as a result of the lack in training the park rangers receive. Chaparro agrees, stating that the rangers in Puerto Rico still need more education in order to adequately perform the job of protecting the resources. Chaparro believes that there are problems occurring in the areas they manage as a result of the lack of enforcement present there. These problems include over fishing, construction in the maritime zone, and unsafe recreational activities.

In addition to the need for improved education, communication and law enforcement, among the different organizations and communities, the professionals we interviewed identified the strengths and weaknesses of their programs through a SWOT analysis, as described in the section 3.2. Although there seem to be many constraints in the coastal management agencies and organizations in Puerto Rico, there are several strong points among their individual programs that could be very helpful to the CTI.

There are many unique programs on the island, such as Fundación Martí Coll and the UMET School of Environmental Affairs that have much to offer to coastal management. Fundación Martí Coll is the only ecological tourism organization located in Puerto Rico. According to Alexis Molinares, the director of this NGO, the program can be quickly adapted in order to meet the necessities of the changing world.

Through our research we also realized that many of the agencies recognize the problem with coastal management and are eager to participate in developing a solution. These organizations are enthusiastic about providing the resources that they have available, and want to help with training and education. Saracho of UMET stated that one of the strengths of his program was their willingness to travel around the island in order to support their cause.

Delgado believes that one strength of the Bureau of Coasts, Reserves and Refuges is their expertise and their independence from state funds. According to Diaz, the strengths of the CZM are its integrated, comprehensive approach to training, and its innovative approach to support decision-making. They are credible organizations with resources, including professionals, facilities, programs and knowledge to share. According to Armstrong, the marine sciences department of the University of Puerto Rico, Mayaguez, is able to offer the best tropical field lab and very modern techniques and technologies. The most common strengths of all the agencies we interviewed are that they are comprised of dedicated workers and have technical knowledge to offer. Most of these agencies are also able to provide outreach and educational programs to the public as well as integrate fieldwork into their courses to promote interest. All of the resources they are capable of providing are vital to the creation and success of the CTI.

Although each agency is able to offer these valuable resources to improve coastal management, there are still areas for improvement in their programs that may be addressed by the CTI. It was concluded in our interviews that the strengths of some agencies could be the weaknesses of others, and therefore can be used to balance one another out. According to Matos and Susan Salander, the project leader for the U.S. Fish and Wildlife Service, even though each organization is willing to collaborate with one another, they usually only focus on their specific responsibilities, which restrains them from combining their efforts and utilizing each other's resources. As a result of this, one organization may be in need of a certain resource that is abundant in another agency. Another example of an area in need of improvement is in the marine science department of UPR. Although they have one of the best labs on the island, Armstrong stated that they have limited relevance to current issues and problems and they do not offer any resource management course. An apparent problem in the Sea Grant Fisheries program, according to Ojeda, is that they do not have the power to make decisions. Salander also believes that her program could use improvement in the area of interpersonal skills, and could use more staff. The areas for improvement among different agencies that were most predominant include:

- Time constraints
- Lack in human resources
- Lack of facilities
- Poor or insufficient equipment
- Inadequate interpersonal communication
- Need for continuous training of personnel.

To summarize our interviews, we concluded that through increasing education and enforcement of the laws, expanding upon the levels of involvement and communication between organizations, providing human and physical resources, improving upon the weaknesses of the agencies, and utilizing their strengths; the CTI could help to improve the coastal management situation in Puerto Rico. According to the information we gathered, the CTI might be capable of addressing the above needs in several different ways. These issues could be improved if the program:

- Promotes communication between the government and the community
- Offers education to decision makers and law enforcers
- Provides courses and workshops that are interesting, short, and specific to Puerto Rico
- Focuses on children through outreach and school-related programs.
- Promotes capacity building in government and non-government agencies

The term capacity building was presented in the interviews as an option to be used as part of the CTI in Puerto Rico. For our project, capacity building was defined as:

> "The process by which people, organizations, institutions, or agencies get practical and specific knowledge to get involved in different areas of resource management. This is achieved through workshops, practices, uses of audiovisual and technological equipment, the development and the strengthening of skills in the areas like: monitoring techniques of natural resources, organization of communities, public education, volunteer work, participation in research, identification of principal actors in resources, among others."

Most of the participants agreed with this definition, deciding that it was appropriate to the project and should be considered as an important step to the improvement of coastal resource management on the island.

### 4.2 Available Resources

The second part of our research was to identify the available resources that could be used to help with some of the problems with coastal management in Puerto Rico, as well as aid in the process of capacity building as described above. These resources were mainly identified from the data collected in our interviews; however, the focus group we conducted was also able to provide some general information about the resources of each organization that attended. These resources included:

- Training courses
- Workshops, seminars, and conferences
- College programs and degrees
- Qualified trainers and trainees
- Relevant literature (texts, journals, magazines, articles)
- Web pages

The majority of the courses we found in our interviews were offered by government agencies or the universities located in Puerto Rico. Examples of the course topics and the workshops offered pertain to areas such as environmental legislation and education, natural resource management, and coastal development control. Many of the interviewees considered themselves capable of teaching courses that could help to improve the understanding of coastal management. The two most common courses that people were qualified to teach were in the areas of coastal zone management and natural and marine resource management. We also discovered that the staff from other agencies

and institutions usually attended these courses; however, resource managers and community members were likely to be present as well. These workshops, seminars, and courses are not offered regularly throughout the year. The times they were offered depends upon the cost to the agency that is holding them and whether or not they are relevant to the current situation on the island. Due to the fact that the courses are not on a schedule, most of them are revised every time they are offered. These courses will form the core of the CTI, as they will be used to increase the knowledge of coastal management in Puerto Rico. In addition to the information about the courses offered, a list of the relevant literature, publications, and web pages was also compiled to be used by the CTI. The full detailed lists of all these resources can be found in Appendix F.

Although these resources were mostly compiled from the date collected in our interviews, the participants also helped to identify some available resources. Tmain purpose of our focus group, however, was to receive feedback on our proposal. The organizations that attended; the National Weather Service (NWS), the U.S. Geological Survey (USGS), and the Caribbean Fishery Management Council, were able to provide general information about their available training facilities and training programs.

The NWS offers training within their program through courses, computer modules and tele-training, or a form of distance learning. Their training is primarily focused on meteorologists; however, the programs are offered at no cost to anyone who is interested and qualified to take them. If it is determined that the NWS needs additional training in a specific area, they hire people to teach seminars for their employees in these subjects.

USGS does not provide training for their employees in Puerto Rico, but instead sends them to the United States to educate them. They do, however, often have students working at the offices in Puerto Rico and offer training to them at no cost. Only these students and the USGS employees are invited to attend the workshops and seminars held in Puerto Rico.

The Caribbean Fishery Management Council also offers workshops to their employees, however, they do often enter into partnerships with DNER and the local governments to hold seminars and workshops concerning fisheries issues. Information about the workshops and classes of these organizations could be incorporated into the CTI to provide training opportunities and facilities to the people who qualify for them.

Although most of these resources are only offered to the employees of the agencies, the CTI could promote the agency itself by advertising the programs they offer. This would benefit these organizations by creating interest in them for possible future employees, sponsors, and other agencies.

### 4.3 Gaps and Overlaps

After analyzing the coastal management resources we collected, we were able to identify the gaps and overlaps among them and organize them into the following tables. These tables reveal the areas of coastal management that are in need of improvement and the areas that currently have the resources that could be used to help address them.

Table 4-1 shows that resources do exist to address the areas most in need of capacity building according to our interviews; community involvement and education, and knowledge and enforcement of laws and regulations. This table also reveals that

although technical and environmental courses are offered quite frequently, there is a need for more social science based courses on the island. Other areas that are in need of more courses, workshops or seminars are law enforcement, interagency communication, and community involvement.

**Table 4-1 Management Needs and Resources Available**

| Areas in need of improvement | Related courses | Provider |
|---|---|---|
| Community involvement and education | Environmental Education Basic Concepts Workshop | UMET |
| | Tsunami Threats to Communities | Sea Grant |
| Knowledge and enforcement of laws and regulations | Laws and Regulations on Coral Reefs Workshop | DNER |
| Interagency collaboration | * | * |
| Interpersonal communication | * | * |
| Strategic planning | Planning Session and Technological Tools Workshops | UMET |
| | El Proceso de Planificacion Workshop | JBNERRS |
| | Several broad courses in Integrated Coastal Management | See Appendix F.3 |
| Environmental impact | Accumulation Impacts Workshop | DNER |
| | Several courses in environmental issues and coastal management | See Appendix F.3 |

* None found throughout our research

Table 4-2 identifies the areas that coastal managers should have knowledge in for effective and sustainable coastal management and the resources available to provide this information. This table shows a similar pattern to Table 4-1; topics in ecology, economics, and marine resources are readily available; however, there is a distinct lack of training in areas such as politics, community dynamics, and general social science skills.

**Table 4-2 Necessary Knowledge for Coastal Managers and Resources Available**

| Topic | Related courses | Provider |
|---|---|---|
| Ecology | Ecology and Development: the Urban Site Fieldtrip | UMET |
| | Interpretation of Puerto Rican Ecosystems Course | Fundacíon Marti Coll |
| | Wetlands workshop | DNER |
| | Many courses offered | See Appendix F.3 |
| Politics | * | * |
| Economics | Eco-tourism Alternatives for Communities and Managers workshop | DNER |
| | Eco-tourism | Fundacíon Marti Coll |
| | Eco-tourism Development Indicators Workshop | JBNERRS |
| Marine resources | Many courses offered | See Appendix F.3 |
| Community dynamics | * | * |
| Conflict resolution | Mitigation of Environmental Conflicts Course | Fundacíon Marti Coll |
| Regulations | Laws and Regulations on Coral Reefs Workshop | DNER |
| General social sciences | * | * |

* None found throughout our research

Table 4-3 shows the areas of education that were the most appealing to our interviewees, and existing courses and human resources that could provide training in those topics. The table reveals that there are many existing resources, both human and physical, to provide education in these areas. Available resources in the topics such as urban sprawl and coastal zone sociology were not found in this study.

**Table 4-3 Areas of Interest and Available Resources**

| Desired Topics | Courses Available | Provider | Human Resources |
|---|---|---|---|
| Sustainable development | Many courses offered in resource management and planning | See Appendix F.3 | Ernesto Diaz |
| Coastal zone planning | Many courses offered in coastal planning | See Appendix F.3 | Damaris Delgado |
| Coastal resource management | Many courses in coastal resource management | See Appendix F.3 | Carlos Padin<br>Ernesto Diaz<br>Damaris Delgado |
| Tourism | Eco-tourism Alternatives for Communities and Managers Workshop | DNER | Ruperto Chaparro<br>Alexis Molinares |
| | Eco-tourism: Alternatives to Traditional Tourism I and II (Conferences) | Fundacíon Marti Coll | |
| | Implementation of Tourism and Trails | DNER | |
| | Ecotourism Development Indicators Workshop | JBNERRS | |
| Urban sprawl | * | * | * |
| Coastal zone sociology | * | * | * |

* None found throughout our research

## 4.4 Considerations for the CTI

The final objective of our research was to use the opinions and resources we identified in our interviews, as well as the data we collected from our gaps and overlaps analysis, to develop a recommendation for a strategic plan for the CTI. The considerations necessary for the creation of the institute include; the virtual structure, the format of courses, workshops, seminars, and outreach programs, the potential clientele, the staff of the CTI, and the promotion of the CTI.

From the data we collected, we concluded that the best possible form of the CTI would be as a virtual web site. The available resources related to coastal management in Puerto Rico, college and university programs and links to other coastal management organizations could be part of the site. The site could also connect users to available online courses and provide information about outreach opportunities. A section on the current management and environmental issues found in Puerto Rico could also be included in the CTI web page. The site should provide information related to these topics and suggest ways to address them as well as list the organizations that are working towards solutions to these matters. The site could also list ways for people, such as other

managers, the general public, teachers, or students to get involved in helping with these problems.

In our research, we also addressed the type of courses the CTI will offer. The officials that we interviewed suggested that the format for the courses be short seminars or workshops that are interesting, enjoyable, and involve hands-on work to accompany the lessons. According to Armstrong, combining the courses with activities will make the institute more appealing to possible users. Otero agreed, stating that a way to promote the use of the CTI is through active participation and short-term courses. Otero believes that these short-term courses can also help to involve community groups with managers to increase collaboration as well. Salander also feels that in order for the CTI to be successful, the courses it offers have to be very relevant to the current situation on the island and cannot be very lengthy.

Providing outreach programs and educational opportunities to schools, teachers, and students was also discussed throughout our research. We found that offering information about these opportunities could contribute greatly to the success of improving coastal management in Puerto Rico. According to most of the interviewees, the outreach programs will bring the concepts of coastal resource management into classrooms around the island, creating a heightened public awareness of these issues to younger age groups.

Identifying the appropriate age groups or the potential clientele is another critical aspect to be addressed in the plan for the CTI in Puerto Rico. Through our interviews and the focus group, it was suggested that the CTI offer courses to anyone interested in utilizing them. Padin believes that the CTI will be most effective if its courses are available to all people on the island. This includes the personnel of governmental organizations, NGOs and local municipalities, decision makers, teachers, students and the general public.

Educating the representatives of governmental organizations will improve coastal management in Puerto Rico, according to Ojeda. He believes that training personnel with more power will positively influence the people underneath them. Padin also feels that by providing courses to government agencies, coastal management will be improved. Riesco agrees with Ojeda, stating that more training is necessary for the people who have the decision making power on the island, as they do not always have experience or knowledge of the field that is necessary to make appropriate recommendations. Matos also believes that reelecting government officials every four years has an effect on the decision making process and should be taken into consideration when developing a coastal management training program. In order for the resources of Puerto Rico to be properly conserved, much more respect from the legislature is necessary, argued Matos. Mercado and Grove state that if the CTI is a program that is presented to legislative officials, and if it could increase the basic knowledge of groups making decisions about coastal management, it will have a positive impact on the coastal resource situation in Puerto Rico.

The majority of the interviewees agree that not only increasing the knowledge of government agencies and decision-makers, but also that of fisherman and boating captains could improve coastal resource management in Puerto Rico. Edgardo Ojeda, a marine advisor for Sea Grant, believes that educating fisherman on the ways to harvest

fish without harming the environment would be beneficial to those ecosystems in Puerto Rico. Ojeda also feels that fisherman need to be educated on safety and navigation and on the fishing regulations of the island.

In addition to those listed above, the general public was also listed as potential clientele for the CTI. Saracho believes that establishing more programs for the general public will benefit to improve coastal management in Puerto Rico. Armstrong agreed, stating that summer programs and the combination of courses with interesting activities would be very effective in providing training to the public. Both Diaz and Raul Santini, the director of the Puerto Rican Coastal Non-Point Pollution Control Plan, agree that educating the public about coastal resources should begin at a relatively young age. Diaz feels that coastal resource education should begin in elementary school and continue through college. Santini also considers training low-income communities to manage their own resources and get involved is very important to coastal management in Puerto Rico. According to Santini, courses in environmental law would be beneficial to citizens, as it would help them to protect themselves and prevent laws from being broken in their communities.

In addition to collecting opinions about the users of the CTI, we also needed to research information about whether or not staffing the program was necessary. After conducting our interviews, we concluded that in order for all of the information the CTI will offer to be supplied in the well-organized and up to date manner necessary for the institute's success, the web site will need to be consistently maintained. We also found that the success of the outreach programs the CTI will offer could be greatly increased if there was an employee available to promote them. Other responsibilities could include coordinating the efforts of organizations involved with coastal management and advertising the site.

One of the most important aspects to recommending a proposal for the CTI is finding a way to ensure that it will be used. We presented to interviewees the idea of making some of the CTI's courses mandatory to the interviewees as an option of guaranteeing participation. For example, we discovered that one of the problems in coastal management is a result of the lack in education of boat operators. An option for the CTI would be to have a course that the boat captains would be required to take in order to renew their boating licenses. This idea did not receive encouraging reviews by many people. The majority felt that by making courses mandatory, there would not be positive feedback from the boating captains, and the motivation for people to attend other courses offered in the CTI would be decreased.

A way of improving the attendance of the classes and workshops for the CTI could be offering a certification for the participants after the completion of a course that shows they are knowledgeable in that area of coastal management. This certificate could be used by students and professionals for their resumes and could possibly be a reason for organizations to increase the wages of their employees. With appropriate courses and the adequate motivational techniques to create a demand for people to attend them; however the CTI could become a very effective tool for the improvement of coastal resource management in Puerto Rico.

## 4.5 Development and Refinement of the Strategic Plan

After we created the draft of the strategic plan for the CTI from the information collected in our market analysis and related case studies, we utilized our focus group to gather feedback and recommendations on the proposal. As stated above, representatives from the NWS, USGS, and the Caribbean Fishery Management Council attended the meeting. These participants helped to identify more training programs and facilities as described in section 4.2. They also clarified any uncertainties about the project, such as methods that could help to increase collaboration among agencies and incorporate outreach programs into the CTI. They also offered opinions on whether or not the CTI needed an employee, and discussed ideas about how to motivate people to attend the institute. The last function of the focus group was to gather ideas and suggestions about the actual draft of the strategic plan. This chapter discusses the opinions and suggestions obtained from this focus group.

After discussing the demographics of each agency and the training opportunities each of them offer, we were able to dedicate the second part of the focus group to gathering recommendations about any problems we encountered in our research. The two main issues we discovered in the development of our strategic plan were how the CTI could encourage the collaboration among agencies and how it could promote the use of outreach programs.

The representatives of all three organizations agreed that the need for more improved collaboration among agencies was an issue that the CTI could help to resolve. An employee of the NWS thought that conducting an annual meeting for the agencies and organizations to give briefing about their current status would be an effective way of increasing communication. In his opinion, the CTI could possibly be used to organize this meeting. This representative also believed that the agencies under NOAA's control should meet more than once a year to discuss their progress. An employee from the Caribbean Fishery Management Council felt that courtesy e-mails were also a very effective way for agencies to cooperate. These e-mails would give people interested in the efforts of these agencies current information and an opportunity to get involved. The representative from USGS agreed with this idea, adding that this e-mail system would allow for the people with common interests to collaborate their efforts on more projects.

The second problem that we encountered in drafting the proposal for the CTI was how to incorporate outreach programs into its structure. All three agency representatives agreed that outreach programs should be included in the CTI as they are an effective way of motivating people to learn about the current issues and involving more people in coastal management. They also stated that one way to increase the use of these outreach programs is by providing links to outside outreach program providers and the contact information of people involved in coastal management. They stated that in Puerto Rico, people want to have the option of talking to someone if they believe it is necessary. The contact information will provide them with the names, phone numbers, and email addresses of persons knowledgeable in the area of coastal resource management. They also believe that in order to make the outreach programs more effective, they should involve the Department of Education and the programs should be focused on high school and elementary school students.

All focus group participants agreed that although the CTI could serve as the center for obtaining information about these programs, a successful outreach program should have at least one employee working to promote it. They feel that the salary of this employee could come from funding or donations from other agencies. This employee should also be in charge of several duties aside from promoting outreach programs, such as dealing with the web site maintenance and increasing collaboration among agencies, and outreach programs. This person should be constantly maintaining the web site so that it will provide the most up-to-date information for its users and should also be helping to coordinate the efforts of the agencies involved in coastal management through the CTI. The employee should also have the capability of promoting the web site. This advertising could be done through traveling to different organizations and attending conferences, meetings, or seminars, as well as utilizing the media.

According to the focus group participants, this advertisement is critical to the success of the CTI, as they believe that the CTI has to become a well-known entity to remain effective and sustainable. This can be accomplished through the use of television, mailing lists, e-mail, newspapers and through word-of-mouth. Links to and from the web site to other agencies and organizations will also help to promote the site. According to the representatives, advertising a way for agencies to become a partner in the CTI or to contribute to it, will increase their interest in the site. They felt that as long as the CTI was not focused on any one sponsor in particular, this list of partners would increase the collaboration among them and the use of the program. Another option, given by a representative of the NWS, was to start the CTI off as a very small web site and expand upon it once people become more involved. An employee of the Caribbean Fishery Management Council felt that putting the web site in both English and Spanish would also help promote its use.

Overall, we received very positive feedback on our proposal for the strategic plan. The representatives thought that the CTI should work very well in Puerto Rico as long as it is advertised and that it is not specifically focused on one particular agency or organization: This will prevent issues of agencies getting involved as a result of another organization. All representatives felt that the CTI will be widely accepted and used throughout the island once it is established and it could positively impact the coastal management situation in Puerto Rico.

Through our research we were able to make recommendations that will form the basis upon which the CTI will be built. Due to the time restrictions involved with our work on this project, we were able to conduct a limited amount of interviews and one focus group. In order to gather a more well rounded opinion of coastal management in Puerto Rico, the available resources, and views of the CTI, Sea Grant should conduct more interviews and focus groups. Politicians and more government officials as well as local boat operators and fisherman could provide a broader representation of those involved in coastal management. These interviews could provide more resource and many other opinions and feelings about the proposal for the Coastal Training Institute that we were unable to collect.

# 5. Recommendations and Conclusions

The conclusions and recommendations for this project are presented in the form of a strategic plan for the Coastal Training Institute in Puerto Rico. The following chapter contains our strategic plan to be viewed as a separate document.

# Coastal Training Institute (CTI)

Jobos Bay National Estuarine Research Reserve
University of Puerto Rico Sea Grant
Department of Natural and Environmental Resources
Coastal Zone Management Program

## Strategic Plan 2002

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**CONTENTS**



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### Mission

The mission of the CTI is to improve several aspects related to coastal resource management at local and regional levels on the island of Puerto Rico through the use of education and capacity building.

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### Vision

The vision of the Coastal Training Institute is to provide the appropriate and necessary training required to effectively and sustainably manage the coastal areas in Puerto Rico, as well as to increase the collaboration among the existing organizations working towards this cause and to improve the general environmental awareness on the island.

The CTI should be able to:

- Increase the overall understanding of coastal resources and their importance to the island and people of Puerto Rico through improved education.
- Help to improve the communication between governmental and non-governmental organizations as well as the communities involved with the coastal ecosystems on the island by providing information about current issues, events and contact information associated with coastal management.
- Provide coastal managers with a more extensive education in the variety of technical and non-technical fields that is necessary for effective management.
- Supply related available references such as: literature, publications, web sites and pamphlets regarding coastal resource management.
- Provide relevant courses, workshops, and seminars available to educate coastal decision-makers.
- Offer lists of the human resources available to train, existing outreach programs, and college degrees in the field of coastal management.
- Properly inform coastal decision makers of current issues pertaining to the coastal resources on the island, allowing for more informed choices to be made concerning these resources
- Supply facilities, equipment, publicity, and continuous training opportunities for the coastal managers, decision-makers, and the general public of Puerto Rico.
- Promote the use of capacity building in the training programs of environmental organizations in Puerto Rico.

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**Background**

Coastal ecosystems and the resources they provide are essential to the health and integrity of the areas in which they are found. They serve as vital habitats and breeding grounds for marine and terrestrial organisms and provide revenue by attracting both recreational and commercial activity. This is especially true for small islands such as Puerto Rico, where the entire island is a coastal zone and these resources make up a significant part of the economy. Despite their high value to the island, there is currently an increasing problem with coastal and estuarine degradation. This is being caused, in part, by over-development in coastal and watershed areas due to an expansion of the population and a growth in tourism. Without the appropriate attention, these ecosystems and resources may be permanently harmed or destroyed altogether.

Presently, there is no integrated management training program on the island with the purpose of providing the necessary attention to these resources. Decision-makers do not always have necessary information, laws are not consistently enforced, collaboration

of the differing agencies is not often present, and coastal managers are not all formally trained. The existence of an educational program that has the available resources to improve upon these issues might be effective in helping to conserve, preserve and restore the ecosystems found in Puerto Rico.

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**Summary of Market Analysis**

After identifying the available coastal management resources in Puerto Rico, we compared them to the management needs, necessary knowledge for coastal managers, and areas of interest on the island. We were able to identify the gaps and overlaps among them and organize them into the following tables. These tables reveal the areas of coastal management that are in need of more resources and those that currently have the resources available to help address them.

Table 4-1 shows that there are resources able to address the areas most in need of capacity building in Puerto Rico, including community involvement and education, and knowledge and enforcement of laws and regulations. This table also reveals that although technical and environmental courses are offered quite frequently, there is a need for more social science based courses on the island.

**Table 4-1 Management Needs and Resources Available**

| Areas in need of improvement | Related courses | Provider |
|---|---|---|
| Community involvement and education | Environmental Education Basic Concepts Workshop | UMET |
| | Tsunami Threats to Communities | Sea Grant |
| Knowledge and enforcement of laws and regulations | Laws and Regulations on Coral Reefs Workshop | DNER |
| Interagency collaboration | * | * |
| Interpersonal communication | * | * |
| Strategic planning | Planning Session and Technological Tools Workshops | UMET |
| | El Proceso de Planificacion Workshop | JBNERRS |
| | Several broad courses in Integrated Coastal Management | See Appendix F.3 |
| Environmental impact | Accumulation Impacts Workshop | DNER |
| | Several courses in environmental issues and coastal management | See Appendix F.3 |

* None found throughout our research

Table 4-2 identifies the areas that coastal managers should have knowledge of for effective and sustainable coastal management, and the resources available to provide this information. This table shows a similar pattern to Table 4-1. Topics in ecology, economics, and marine resources are readily available; however, there is a distinct lack of training in areas such as politics, community dynamics, and general social science skills.

**Table 4-2 Necessary Knowledge for Coastal Managers and Resources Available**

| Topic | Related courses | Provider |
|---|---|---|
| Ecology | Ecology and Development: the Urban Site Fieldtrip | UMET |
| | Interpretation of Puerto Rican Ecosystems Course | Fundacíon Marti Coll |
| | Wetlands workshop | DNER |
| | Many courses offered | See Appendix F.3 |
| Politics | * | * |
| Economics | Eco-tourism Alternatives for Communities and Managers workshop | DNER |
| | Eco-tourism | Fundacíon Marti Coll |
| | Eco-tourism Development Indicators Workshop | JBNERRS |
| Marine resources | Many courses offered | See Appendix F.3 |
| Community dynamics | * | * |
| Conflict resolution | Mitigation of Environmental Conflicts Course | Fundacíon Marti Coll |
| Regulations | Laws and Regulations on Coral Reefs Workshop | DNER |
| General social sciences | * | * |

* None found throughout our research

Table 4-3 shows the areas of education that were the most appealing to our interviewees, and existing courses or human resources that could provide training in those topics. The table reveals that there are many existing resources, both human and physical, to provide information in these areas. Available resources in the areas such as urban sprawl and coastal zone sociology were not found in this study.

**Table 4-3 Areas of Interest and Available Resources**

| Desired Topics | Courses Available | Provider | Human Resources |
|---|---|---|---|
| Sustainable development | Many courses offered in resource management and planning | See Appendix F.3 | Ernesto Diaz |
| Coastal zone planning | Many courses offered in coastal planning | See Appendix F.3 | Damaris Delgado |
| Coastal resource management | Many courses in coastal resource management | See Appendix F.3 | Carlos Padin<br>Ernesto Diaz<br>Damaris Delgado |
| Tourism | Eco-tourism Alternatives for Communities and Managers Workshop | DNER | Ruperto Chaparro<br>Alexis Molinares |
| | Eco-tourism: Alternatives to Traditional Tourism I and II (Conferences) | Fundacíon Marti Coll | |
| | Implementation of Tourism and Trails | DNER | |
| | Ecotourism Development Indicators Workshop | JBNERRS | |
| Urban sprawl | * | * | * |
| Coastal zone sociology | * | * | * |

* None found throughout our research

The gaps identified in these tables should be investigated further to recognize if new training programs should be developed, or whether appropriate programs already exist elsewhere on the island.

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**Strategic Goals**

Several strategic goals were identified as key aspects to ensuring the success of the Coastal Training Institute in Puerto Rico. These goals will have to be met in the development of the CTI in order for the program to remain effective and sustainable after its implementation.

The implementation plan for the CTI should:

- ***Ensure the use of the institute.*** To achieve this goal, the programs offered will have to be enjoyable and interesting to their participants. The resources should be presented in a well-organized manner and should have the ability to be used by a variety of audiences in many different areas of training. There should be several different courses available to any age, social, or economic class of people interested. There should also be upper level courses focused on furthering the education of existing managers. This information should remain current and relevant to Puerto Rico. To measure the success of this goal, the participation level of workshops, seminars, and other related courses in coastal management could be monitored over time. The frequency of people visiting the site could also be monitored to measure the use of the institute. Also, if the attendees of these training services became more diverse in the future, it might indicate that the CTI is effective.

- ***Meet the current needs of the island.*** The CTI should focus on the present management and environmental issues facing Puerto Rico. The program should address the appropriate areas of training that are currently necessary and provide them to the users. The potential clientele of the institute should be evaluated on a regular basis as well. The program itself will also have to be consistently updated to provide the most relevant information possible. To measure the success of this goal, a similar study to the one that we performed in completing this project could be conducted to examine the gaps and overlaps in coastal management training. This would ensure that the CTI addresses the needs that it was intended to target, and would also identify new issues.

- ***Improve coastal management.*** The purpose of the CTI is to improve the coastal resource conditions in Puerto Rico; therefore the institute should have the capabilities of changing the current situation. It should be able to provide a place where agencies can communicate, educate decision-makers, and aid in the restoration, conservation and protection of the coastal ecosystems on the island. The evaluation of the success for this goal would be a similar process to that of the previous goal, where a similar study to the one that we conducted would be done, discussing with coastal managers their opinions of the current management situation on the island. These opinions compared with previous ones from our study would indicate any improvement in coastal management.

**Important Considerations for the CTI**

***The Web Site*:** The CTI will most likely be a collection of resources organized and presented in the form of a web site with the goal of improving the knowledge and communication related to coastal resource management at local and regional levels. The web site should have links to and from the web pages of NOAA, Sea Grant, NERRS, DNER, the CZM, and other coastal management related agencies. The CTI should not; however, be associated with any one particular entity. We strongly recommend that the CTI be a cumulative result of all environmental agencies, organizations, and institutions, and should be available to everyone in order to alleviate any gaps and overlaps in coastal management. The web site will contain the lists of resources available on the island that have the capability to help educate people in areas of coastal management. These lists should contain information about:

- Current outreach programs
- Existing human resources
- Accessible facilities
- Current courses
- Seminars, workshops, and conferences
- Relevant literature and publications
- Other related web sites

The Coastal Training Institute's web site should also be capable of connecting users to college and university programs, such as UPR and UMET, in order to view the classes and degree programs that they offer. This would also allow for the possibility of making on-line courses available. The web site could also provide a link to the Coastal Studies Center web page in order to supply the most recent and pertinent publications and research regarding coastal management on the island.

***Outreach programs offered through the CTI:*** One way to increase the use of the CTI is by providing outreach programs and educational opportunities to schools, teachers, and students. Providing information about these opportunities could contribute greatly to the success of the program due to the small size of the island and the strong desire for improved coastal management present on it. This portion of the web page could contain information about teaching workshops, field trips, and other outreach programs offered by different organizations. This will bring the concepts of coastal resource management into classrooms around the island, creating a heightened public awareness of these issues to younger age groups.

***Potential Clientele for the CTI:*** We conclude from our market analysis that the potential users of the CTI should include a variety of clientele such as; environmental management officials, legislative officials, professors and teachers, students, community groups, environmental employees, and anyone interested in the field. To accomplish short-term goals associated with improved law and regulations enforcement, the initial clientele

should consist of coastal management officials, law enforcers, and decision-makers. With a goal of increasing the knowledge of and interest in coastal management issues island-wide, the potential clientele for the CTI should include all the people of Puerto Rico.

***Current Coastal Management Issues and Training Offered by the CTI:*** The CTI's web page should also include a section on the current management and environmental issues found in Puerto Rico. Currently it was found that the two major environmental problems on the island are over-development and pollution. The web site could provide information related to these topics, suggest ways to address them, and have links to the web sites of organizations that are facing them. The organizations that are working toward solutions to these matters could also be listed in this segment, along with a list of ways for people, such as other managers, the general public, teachers, or students to get involved in helping to overcome these problems.

***Employees:*** In order for all of this information to be supplied in the well-organized and consistently updated manner necessary for the success of the CTI, the web site will need to be maintained. It is important that an employee be hired who is capable of creating and updating this site. The employee hired for this purpose should not only be finding new information on relevant resources that the CTI could use, but they could also help in coordinating the efforts of the different agencies. The responsibilities should also include organizing outreach programs and advertising for the site. We suggest that the money required for the maintenance of the site and the salary of the employee be supplied by the donations of the contributing agencies, or through government grants.

***Motivation:*** In order for the CTI to have an effect on the current coastal management situation, there needs to be a high level of interest in it. Several options to increase motivation to attend were discovered through our market analysis. It was suggested that some courses be mandatory for certain people. The opinions of the officials however, state that mandatory courses would not have a positive effect on the motivation of people to attend. It was suggested that positive reinforcement be utilized instead of this mandatory technique.

A possibility for increasing motivation for people to attend the CTI would be to offer certificates upon the completion of a certain number of courses in certain areas. According to our interviews, these certificates would not only provide a physical document that proves the owner's knowledge, but could also be used on résumés and help to increase wages. The second way to promote this program is by offering courses that are short and interesting to the participants. Many more people will be inclined to take classes that provide fieldwork and hands-on experience, as this type of education is different and more enjoyable.

## Further Recommendations

In order to gain a more complete understanding of the coastal resource management situation in Puerto Rico, a more in-depth examination should be performed targeting the gaps in the current coastal management education. This further assessment could encompass similar topics to those listed in this strategic plan, such as management and environmental needs, resources available, and the most successful form of the CTI, but should remain focused on the areas of:

- Community dynamics and involvement
- Sustainability
- Planning
- Interpersonal skills
- Social sciences

In order to collect these opinions, more interviews and focus groups should be conducted and more related case studies need to be considered. Our interviews and focus group were targeted to government officials, researchers, professors and personnel working in coastal management. In order to understand the needs of the entire island, interviews should be conducted with:

- Fisherman
- Boat Operators
- Legislative Officials
- Teachers and Students
- Community Groups

For each of the interviews that we conducted, only one protocol was used. In order to get the most information possible out of each of these interviews listed above, a different protocol should be created for each of their different perspectives.

In addition to conducting more interviews and focus groups, more relevant case studies should be examined. Related case studies provide insight as to the reasons behind the success or failure of a program. They are especially useful in developing new projects, as those reasons can be studied and either used to help make a framework for the project or avoided so that past mistakes are not repeated. There is currently a Coastal Training Institute being developed in Massachusetts. The development and implantation of this project should be followed in order to establish a possible direction for the CTI in Puerto Rico. These related case studies, along with the additional information collected from interviews and focus groups will help by adding to this plan and increasing the strength of the CTI and its chances for success.

This proposal for the strategic plan of the Coastal Training Institute could be used by the sponsors of this project as an initial step toward the creation of this program. By expanding on our research, and using our recommendations to further develop the plan, we consider the implementation of the CTI to be feasible in Puerto Rico. We also believe that the CTI has the potential to positively impact current coastal management conditions on the island.

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# Appendix A

The National Sea Grant College Program, better known as Sea Grant, was created in 1966 in response to the need for an oceanic research organization, a "Wet NASA" as it was referred to at the time (National Academy Press, 2000). This organization was originally founded as a part of the National Science Foundation, but was moved to be under the control of the National Oceanic and Atmospheric Administration (NOAA) in 1970. The goals of Sea Grant program are to "encourage the wise stewardship of our marine resources through research, education, outreach and technology transfer" (Sea Grant, 2000).

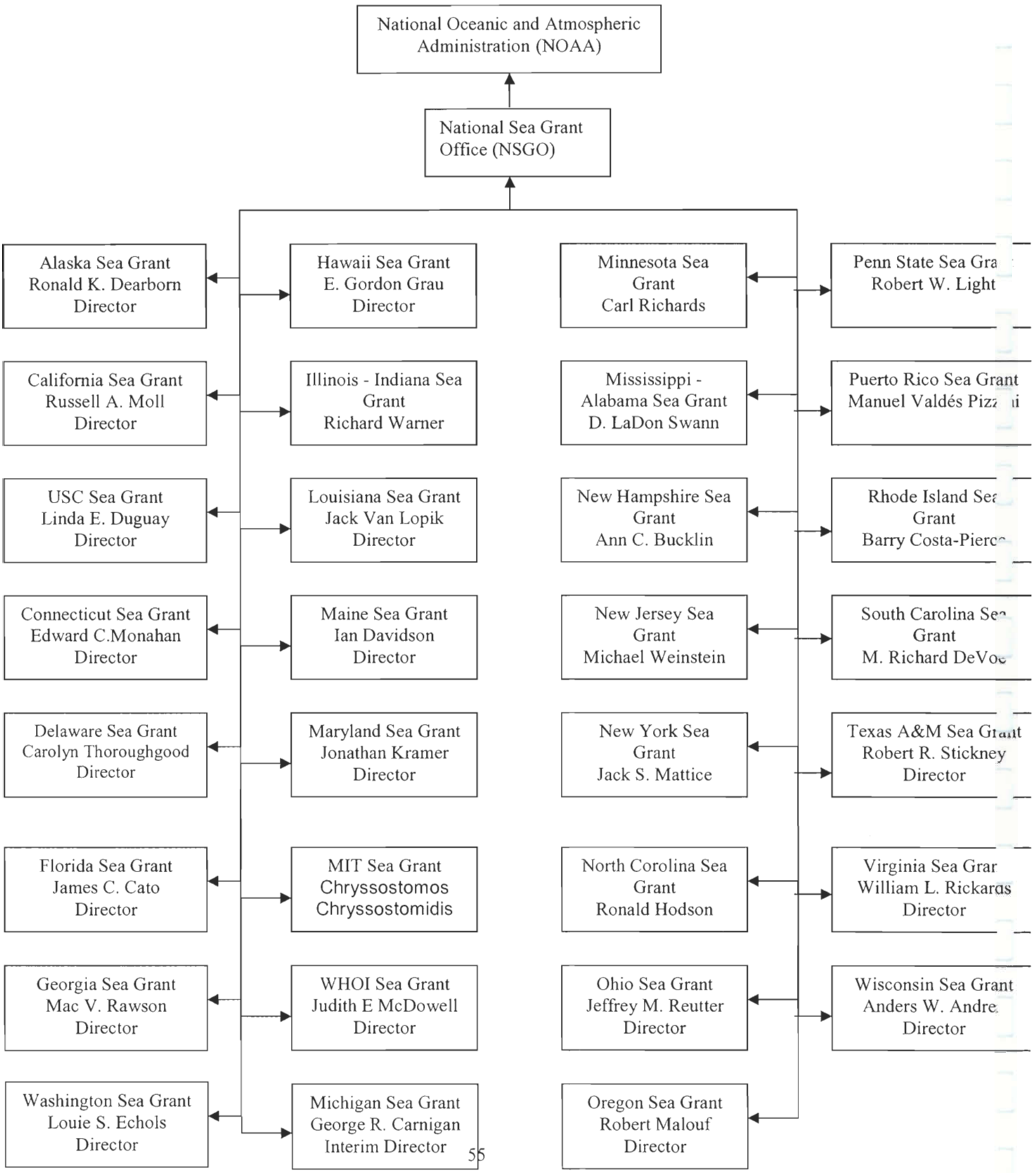
There are 31 colleges and universities currently participating in the National Sea Grant College Program, located in the coastal and Great Lakes states, as well as in Hawaii and Puerto Rico. The National Sea Grant Office (NSGO) is located in Silver Spring, Maryland, and is lead by current Director Ronald C. Baird. An organizational chart is attached.

Sea Grant provides funding to marine and coastal research projects through a yearly appropriation from Congress, currently approximately $108 Million in Federal and Matching Funds (Congressional Record, 2001). The application for this funding is very competitive, with an acceptance rate of 22% of the over 2200 applications submitted over the last two years.

Sea Grant Policy and Procedures are set by the NSGO, in conjunction with the National Sea Grant Review Panel and the Sea Grant Association, which is made up of representatives from the Sea Grant Colleges, as well as other people interested in the Sea Grant Program. All of this is reported to and reviewed by the National Sea Grant Director and then NOAA.

# Appendix B

## Sea Grant Organizational Chart



# Appendix C
## Notification Fax and Release Form

**NERRS, CZM, DNER,**
**Sea Grant,**
**WPI**

P.O. Box 9066600 pta. Detierra station
San Juan, PR
00906-6600

April 30, 2002

Dear Sir or Madam:

We are students from Worcester Polytechnic Institute in Massachusetts and are currently working in Puerto Rico to complete our Interdisciplinary Qualifying Project (IQP). For our IQP we are working in collaboration with the National Estuarine Research Reserve System (NERRS), with Coastal Zone Management (CZM), the Department of Natural and Environmental Resources (DNER), and the Sea Grant college program to develop a strategic plan for the creation and implementation of a Coastal Training Institute (CTI) in Puerto Rico. The CTI will focus on the training of managers, through the use of capacity building, to effectively manage the coastal resources of the island. In order to recommend an appropriate plan we will conduct a market analysis that will contain an inventory of current coastal management programs on the island, an assessment of the environmental needs, and a list of potential clientele and human resources. We are looking to gather some of the necessary data for this analysis by utilizing focus groups. This information will help us to better understand the most common techniques used, to assess the need for improved collaboration among agencies, and to explore any room for improvement in the field of coastal management training.

We would like to invite you to participate in helping to create a way to protect these vital resources. Your input will play a key role in developing the CTI which will improve decision making regarding coastal resources. The names of the participants in the focus groups will remain confidential, with only the names of the contributing agencies being exposed.

The focus group will be held on the date of April 19, 2002 at 10am, and will be held in the third floor conference room of the DNER Central Office in Old San Juan. It will last for approximately one hour. For your review we have attached a list of the topics that will be addressed and will be used as the basis of the focus group. We will contact you with a telephone call two days prior to the focus group to answer any question that you might have and to confirm your participation. We have also attached is a release form concerning the use of the information that is gathered. We ask you to please sign and return this form to the address above.

Thank you very much for your time.

Sincerely,

Ben Alesbrook
Stacy Burdick
Jeff Fortin

## Release Form for Focus Group

I, _____, agree to participate in this focus group on the date of __, concerning the development of the Coastal Training Institute (CTI). I understand that all of the information gathered through this focus group will be used by Worcester Polytechnic Institute and the Sea Grant college program in their research toward the development of the CTI. It is also understood that the names of the participants will remain confidential in the presentation of the data for the final report, although the names of participating organizations may be disclosed.

_____ _____

Participants Signature Date

## Appendix D

### Focus Group Questions

Questions for the Focus Groups

1) Demographics
    a. Which coastal region are you from?
    b. Primary mission of your organization
    c. How many people have been trained for coastal management in the past.
    d. Who did you train
2) What are the most common theories used in coastal management training
3) Where do you see room for improvement in coastal management training
4) Is there a need for improved collaboration among agencies in the field of coastal management training? Why or why not? How could the communication be improved? Who should this include?
5) What use do you think you or your agency would have for the CTI?
6) What are ways we could encourage people to attend CTI program? Do you see this being a possible problem?
7) Any other advice or input for the coastal training institute initiative?

# Appendix E

## Interview Questions

Coastal Training Program
**Survey for Programs on Agencies**
Jobos Bay National Estuarine Research Reserve
Coastal Zone Management Program, DNER
Sea Grant College Program, University of Puerto Rico

1. Name of the Agency:_____
2. Name of the Program:_____
3. Name of the Director:_____
4. Postal Address, Phone, and Fax Numbers:_____
   _____
   _____
5. E-Mail:_____

6. What knowledge is necessary for effective and sustainable coastal management?
   _____
   _____
   _____

7. In what ways can the coastal management of Puerto Rico be improved? _____
   _____
   _____

8. Do you feel that coastal management in Puerto Rico would be improved if there were an official training program? In what ways would it be improved? _____
   _____
   _____
   _____

For the purpose of this study, we define capacity building as:

"The process in which people, organizations, institutions, or agencies get practical and specific knowledge to get involved in different areas of resource management. This is achieved through workshops, practices, use of audiovisual and technological equipment, the development and the strengthening of skills in areas like: monitoring techniques of natural resources, organization of communities, public education, volunteer work, participation in research, identification of principal actors in resources, among others."

9. How do you rate your position towards this definition? (Please circle the number that represents your answer).

| **Strongly Disagree** | | **Neutral** | | **Strongly Agree** |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

10. How would you modify or what would you add to this definition?

_____
_____
_____
_____
_____
_____

11. Have you received any formal training in relation to coastal resource management?

___ Yes ___ No

12. If you answered "Yes" to question 11, please indicate:

| Title of the Course | Institution or Agency that offered the Course | Year |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

13. Do you consider yourself qualified to offer some of the courses mentioned in the last question?

___ Yes ___ No

Which?

_____
_____
_____
_____
_____
_____

14. Do you offer classes in which you have not received formal training?

___ Yes ___ No

Please mention them:

_____
_____
_____
_____
_____
_____

15. Do you think that there's a need for additional courses or workshops in relation to the management of coastal resources?

___ Yes ___ No

16. In which of the following areas of capacity building would you like to take a course? (You can select more than one option).

___ Coastal Resource Management
___ Tourism
___ Coastal Zone Planning
___ Coastal Zone Sociology
___ Marine Recreation
___ Sustainable Development
___ Urban Sprawl
___ Resource Quality

Others: _____
_____
_____
_____

17. Does your program actually offer courses, workshops and/or conferences in coastal resource management or related course?

___ Yes ___ No

18. If you answered "Yes" in the last question, please mention the title of the courses, workshops and/or conferences, the date of the program, and the cost to attendees.

| Course Title | Date of Course | Cost |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

19. What kinds of people take these courses, workshops and/or conferences? (You many choose more than one alternative).
    - ___ Undergraduate Students
    - ___ Graduate Students
    - ___ Staff from other Agencies or Institutions
    - ___ Resource Managers
    - ___ Park Rangers
    - ___ Others: _____

20. How many times are the courses, workshops and/or conferences are offered?
    - ___ Once a year
    - ___ Twice a year
    - ___ More than twice a year
    - ___ Other: _____

21. How often are these courses revised?
    - ___ Once a year
    - ___ Twice a year
    - ___ More than twice a year
    - ___ Other: _____

22. Do you have any references from texts, journals, magazines, or the internet that are used as part of the courses, workshops and/or conferences? Please indicate them below.

    _____
    _____
    _____
    _____
    _____
    _____
    _____

23. Which capacity building courses do you deem necessary in Puerto Rico, and who would be the potential beneficiaries?

| Course | Beneficiaries |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

24. What strengths do you find in your program?
    1. _____
    2. _____
    3. _____
    4. _____
    5. _____

25. What weaknesses, if any, do you see in your program?
    1. _____
    2. _____
    3. _____

26. According to your knowledge, mention five aspects of coastal resource management in greatest need of capacity building or formal training.
    1. _____
    2. _____
    3. _____
    4. _____
    5. _____

Comments:

_____
_____
_____
_____
_____
_____

# Appendix F

## Resource Lists

### F.1. Background Education of Managers Interviewed for this Project

| Course Name | Offered by | Year |
|---|---|---|
| Technology and education | UMET | |
| Air Pollution Control | EPA | 1980 |
| Beach Management Conference | Sea Grant | 2001 |
| Physical Planning | P.R. Planning Board | 1978 |
| Natural Resources Public Policy | Yale | 1991 |
| Coastal and Estuarine Natural Resources | Yale | 1991 |
| Wetlands Ecology | Yale | 1991 |
| Natural Resources Economy | Yale, UPR | 1991,1987 |
| Environmental Laws | UPR | 1986 |
| Landscape Ecology | Yale | 1992 |
| Land Use Planning | UPR | 1989 |
| Puerto Rico Ecology | UPR | 1986 |
| Natural Resource Problems | UPR | 1988 |
| Water Resources | UPR | 1988 |
| Soil Sciences | Yale | 1992 |
| Geology | UPR | 1987 |
| Environmental Education | | |
| Natural Resources Management | Dominica | 1987 |
| Environmental Impact Statements | Dominica | 1987 |
| Coastal Zone Management | Costa Rica | 1998 |
| Wetland Enhancement | US Fisheries and Wildlife | |
| Wetland Restoration | US Fisheries and Wildlife | |
| Coastal Biology | | |
| Coastal Resource Management | UMET | |
| Co-Management of a marine reserve in the island of St. Lucia | | 1998 or 1999 |
| Watershed Management | Center for Interamerican Development | 1990 |
| Strategic Planning | DNER | 2000 |
| Marine Protected Areas | Organization of American States | 1991 |

| | | |
|---|---|---|
| Coastal and Marine Areas Management | Organization of American States | 1989 |
| Population Dynamics | | |
| Coastal Erosion | UPR | |
| Oil impacts on Mangroves | Yale | |
| Air Pollution | UPR | 1989 |
| Marine Protected Areas | | |
| Environmental Legislation | DECEP | 1998 |

**F.2. Available Human Resources**

| **Name** | **Agency** | **Courses that could be taught** |
|---|---|---|
| Damaris Delgado | DNER | Natural Resource Public Policy |
| Damaris Delgado | DNER | Coastal and Estuarine Natural Resources |
| Damaris Delgado | DNER | Puerto Rico Ecology |
| Damaris Delgado | DNER | Natural Resource Problems |
| Damaris Delgado | DNER | Water Resources |
| Dr. Juan Musa | UMET | Environmental Education |
| Dr. Juan Musa | UMET | Environmental Cleaning (OSHA)<br>Coastal Resource Management |
| Carlos Padin | UMET | Coastal Zone Management |
| Francisco Javier Saracho | UMET | Environmental Education and Outreach |
| Francisco Quintana | CZM | Beach Management and Coastal Resources |
| Ernesto Diaz | CZM | Coastal Zone Management |
| Ernesto Diaz | CZM | Marine and Coastal Resources Management |
| Ernesto Diaz | CZM | Integrated Coastal Watersheds Management |
| Ernesto Diaz | CZM | Environmental Quality Control |
| Ernesto Diaz | CZM | Marine Resources Management |
| Aurelio Mercado | UPR-RUM | Threats of Tsunamis |
| Edgardo Ojeda | UPR-RUM | Environmental Law Enforcement – Rules and Regulations |
| Ruperto Chaparro | Sea Grant | Natural and Marine Resource Management |
| Ruperto Chaparro | Sea Grant | Marine Recreation |
| Ruperto Chaparro | Sea Grant | Coastal Tourism |
| Ruperto Chaparro | Sea Grant | Extension Services |
| Alexis Molinares | Fundacíon Marti Coll | Eco-Tourism |
| Alexis Molinares | Fundacíon Marti Coll | Mediation of Environmental Conflict |

## F.3. Courses/ Workshops/Seminars Offered

| Name | Date Last Offered | Offered by | Cost to Attendees |
|---|---|---|---|
| **Coastal Management and Technical Courses** | | | |
| Marine Resources and Environmental Management Workshop | | UMET | none |
| Integrated Coastal and Ocean Management Concepts and Practices Workshop | | UMET | none |
| Several Graduate Courses in Environmental Management Issues | 2002 | UMET | none |
| Puerto Rico Coastal Management Program Workshop | 1997-99 | DNER | none |
| Coral Reef Management Workshop | 1997 | DNER | none |
| Planning Session and Technological Tools Workshops | 2001 | UMET | none |
| Resource Management Workshop | | UPR | |
| Coastal Management Course | | UMET | |
| Environmental Management Course | | UMET | |
| Beach Management Conference | | Sea Grant | $150.00 - 200.00 |
| Integrated Coastal Zone Management Workshop | | CZM | none |
| Coral Reef Monitoring Training Workshop | 2001 | DNER | none |
| Laws and Regulations on Coral Reefs Workshop | 2002 | DNER | none |
| Eco-tourism Alternatives for Communities and Managers Workshop | 2000 | DNER | none |
| Maritime Zone and Public Domain Delimitation Workshop | 1997 | DNER | none |
| Non-Point Pollution Control – Agriculture Workshop | 98-99 | DNER | none |
| Accumulation Impacts Workshop | 1998 | DNER | none |
| Inquiry Processes and Elementary Teaching Workshop | 2000 | UMET | none |
| Ecology and Development: the Urban Site Fieldtrip | 2001 | UMET | none |
| Marine Recreation Workshop | | Sea Grant | none |
| Eco-tourism: Alternatives to Traditional Tourism I and II – Conferences | | Fundacíon Marti Coll | $150.00 |
| Interpretation of Puerto Rican Ecosystems - Course | | Fundacíon Marti Coll | $150.00 |

| | | | |
|---|---|---|---|
| Mitigation of Environmental Conflicts - Course | | Fundacíon Marti Coll | $200.00 |
| Water Quality Workshops | | Sea Grant | none |
| Reef Monitoring Seminars | | Sea Grant | none |
| Seafood Handling and Safety Courses | | Sea Grant | none |
| Implementation of Tourism and Trails | | DNR | none |
| Caribbean Tsunami Conference | 1997 | Sea Grant | none |
| Coastal Dry Forest Restoration | | Fish and Wildlife service | none |
| Coastal Lighting Effects on Sea Turtles | | Fish and Wildlife service | none |
| Eco-tourism Development Indicators Workshop | | JBNERR | none |
| Capacitation on SIG/SPG Workshop | | JBNERR | none |
| Integrated Marine Protected Areas Workshop | | CZM | none |
| Evaluacion de las Estrategias para la Restauracion y el Manejo de la Contamination Precisa y Dispersa en la Cuenca de Bahia de Jobos Workshop | 6/8/01 | JBNERR | none |
| El Proceso de Planificacion Workshop | 9/27/01 | JBNERR | none |
| Orientacion Sobre el Potencial para el Desarollo de Empresas Econimicas y Ecotouristicas del Area Natural del Sur Centro de Visitantes, Reserva Bahia de Jobos Workshop | 4/6/00 | JBNERR | none |
| Oportunidades de Desarollo en la Implementation de la Ley de Ecotourismo Workshop | 8/99, 10/24/99 | JBNERR | none |
| Desarrollando Letreros Interpretativos con Recursos Limitados Workshop | 7/29/00 | JBNERR | none |
| Uso de GPS Workshop | 5/17-5/19/00 | JBNERR | none |
| Como Desarrollarun Plan de Impretacion Natural Workshop | 6/15/00 | JBNERR | none |
| Desarrollando un Destino Ecotouristico Workshop | 6/8/00 | JBNERR | none |
| | | | |
| **General Environmental and Public Education** | | | |
| Wetlands Workshop | 1995 | DNER | none |
| Eco-geography of Puerto Rico Archipelago; Maps and Life Zones Workshop | 2000 | UMET | none |
| Dry Life Zone; Guanica Xerophytic Forest Fieldtrip | 2000 | UMET | none |

| | | | |
|---|---|---|---|
| Diurnal and Nocturnal Experience in El Yunque Forest Fieldtrip | 2000 | UMET | none |
| Science of Everyday Life; Water as a Natural Resource Workshop | 2000 | UMET | none |
| Environmental Education Basic Concepts Workshop | 2000 | UMET | none |
| Estuarine Systems: San Juan, Piñones, Loiza Fieldtrip | 2001 | UMET | none |
| Science of Everyday Life: Soil, Rocks and Sand Workshop | 2001 | UMET | none |
| Thematic Cycles: Science and Language Workshop | 2001 | UMET | none |
| Creative Approaches to Environmental Education Workshop | 2001 | UMET | none |
| Lajas Mangrove Channels and Coral Formations Fieldtrip | 2001 | UMET | none |
| Basic Biology and Ecology Courses | | UPR | |
| Marine Ecology Workshop | | UPR | |
| Diving Safety | | Sea Grant | none |
| Fisherman Social Skills | | Sea Grant | none |
| Tsunami Threats to Communities | 10/01 | Sea Grant | none |
| Water quality Workshop | | JBNERR | none |
| Environmental Education Workshop | | CZM | none |
| Gestion ambiental de la poblacion y del entorno territorial de JOBANERR Workshop | 8/31/01 | JBNERR | none |
| Gestion ambiental y protecion de areas naturales costernas Workshop | 5/3/00 | JBNERR | none |

## F.4. Literature and Web Page Resources

| Web Pages: | | | | |
|---|---|---|---|---|
| http://inlet.geol.sc.edu/JOB/index.html | | | | |
| www.nsgo.seagrant.org | | | | |
| http://rmocfis.upr.clu.edu/morelock | | | | |
| http://seagrant.uprm.edu/seagrant | | | | |
| | | | | |
| **Books (Alphabetically by author) :** | | | | |
| **Author (s)** | **Title of Book** | **Publishing Information** | **Pages** | **Year** |
| Gillian Cambers | Coping with Beach Erosion | Unesco Publishing, France | 117 | 1998 |
| Gillian Cambers | Managing Beach Resources in the Smaller Caribbean Islands | Unesco Publishing, UPR Sea Grant. Puerto Rico | 270 | 1997 |
| Ruperto Chaparro | Public Policy Position Papers | Sea Grant Puerto Rico | 51 | 2000 |
| DNER | Puerto Rico and the Sea | Ramallo Bros. Printing, Inc. Hato Rey, Puerto Rico | 112 | 1999 |
| Junta de Planificacion | Zoning Regulation for the Coastal Zones and the Access to the Beaches and Coasts of Puerto Rico | Puerto Rico | 136 | 1983 |
| Ana Navarro, Eduardo Navarro | Guia Ambiental para Puerto Rico | UPR Sea Grant, Puerto Rico | 40 | 2001 |
| Bonnie J. McCay, Carolyn F. Creed | Fish or Cut Bait: How to participate in the Fisheries Management System | New Jersey Sea Grant | 27 | 1999 |
| Rodney V. Salm, John R. Clark | Marine and Coastal Protected Areas: A guide for Planners and Managers | International Union for Conservation of nature and Natural Resources. Switzerland | 302 | 1984 |
| Webb | Living with the Puerto Rican Coast | Sea Grant Puerto Rico | | |

| **Other References** |
| --- |
| Arrecife de Coral, Una guia para nautas, pescadoresy buzos - UMET |
| UMET course catalogue |
| UPR course catalog |
| Journal of Coastal Zone Management |
| Management of sand dunes in developed areas |
| Coastal Lighting manuals |
| DIALOG – Extensive online journal Collection that UMET belongs to |
| Dry Forest Restoration Manuals |

# Appendix G

## Interview Participants

| Name | Agency | Title |
|---|---|---|
| Damaris Delgado | DNER, Bureau of Coasts, Reserves, and Refuges | Director |
| Robert Matos | DNER, Reserves and Wildlife Refuges Service | Director |
| Elsie Martinez Irizamy | DNER, Environmental Education | Director |
| Raul Santini | DNER, Non-Point Pollution Program | Director |
| Ernesto Diaz | CZM | Director |
| Francisco Javier Quintana | CZM | Coordinator |
| Carlos Padin | UMET | Professor |
| Francisco Javier Saracho | UMET, INEDA | Director |
| Alberto Rivera | UMET | Professor |
| Manuel Valdés Pizzini | UPR Sea Grant | Director |
| María Beatriz Riesco | UPR Sea Grant | Marine Extension Coordinator |
| Ruperto Chaparro | UPR Sea Grant | Marine Recreation Extension Coordinator |
| Curt Grove | UPR Sea Grant, Research Coordination | Director |
| Edgardo Ojeda | UPR Sea Grant, Advisory Section | Director |
| Roy Armstrong | UPR, Marine Sciences Dept. | Professor |
| Ernesto Otero | UPR, Marine Sciences Dept. | Professor |
| Aurelio Mercado | UPR, Marine Sciences Dept. | Professor |
| Pedro Robles | Jobos Bay NERRS | Scientific Investigation Coordinator |
| Martiza Barrato | UPR – Rio Piedras, Coastal Studies Center | Director |
| Susan Salander | National Fish and Wildlife Service | Project Leader |
| Alexis Molinares | Fundacíon Marti Coll | Director |