
# A CRITICAL EVALUATION OF CHALLENGES TO MARINE PROTECTED AREAS IN PUERTO RICO

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## Executive Summary

It was not until the 1960s that the United States government became actively concerned about the degradation and depletion of its marine resources. Presently, marine protected areas (MPA) are established and used as tools for managing the ocean's resources worldwide. However, many challenges have arisen throughout the development and management of these areas. The management of common resources intrinsically involves the management of a population of resource users, causing the required considerations to be sociological before they are biological. This project sought to explore these challenges through the analysis of four case studies in Puerto Rico: Luis Peña Channel Marine Reserve in Culebra, Tres Palmas Marine Reserve in Rincón, La Parguera Nature Reserve, and the seasonal closures of Bajo de Sico and Tourmaline off the island's western coast. We gathered this information from interviews with 14 key stakeholders and literature to summarize considerations for future planning and management of MPA.

The five sites of focus differ in management, ecology, developmental approaches, and current status. The aim of our project was to outline the history of development and management at these sites, focusing on the challenges encountered and in doing so, to produce a summary of lessons learned and considerations for future MPA. Our research was comprised of formal interviews in which we asked open-ended questions about the many aspects of MPA. Our questions called for anecdotes, examples, and opinions on different management theories and challenges we had identified through literature research. Initial interview subjects were identified with the help of our liaison, Dr. Valdés-Pizzini.

Our method was to interview as many of the most experienced individuals as possible, identifying new contacts as we met with existing ones. Because of time constraints, our aim was not to obtain statistically representative interview subjects but to engage dominant members of different actor groups (managers, policymakers, researchers, and users) that have been closely involved the

planning and research of MPA in Puerto Rico and could share a wealth of diverse perspectives and experiences.

Through our research, we heard suggestions and ideals that need to be realized in order to make MPA in Puerto Rico more successful. The delineation of the site histories and the consolidation of the concerns of our interviews made it clear that there are a large number of challenges facing MPA development in Puerto Rico. Funding is the most significant challenge to managing MPA. Some of the MPA in Puerto Rico have no managers and hence, no active management. Of those that do have personnel, many lack the proper equipment for patrolling. The challenges due to lack of funds stem out into all aspects of MPA management.

There is also a significant rift between the resource users and resource managers. There is much resistance by resource users to being told how to use a common resource. A mutual lack of trust seems to exist between the parties as well. It is clear that without community support for a reserve, the reserve will fail. The support must exist from the start or be instilled through education and open communication of goals and intentions. The focus of education and outreach should be to facilitate the creation of a sense of stewardship in the people. Rather than telling them where they cannot go and what they cannot do, they need to learn how they can protect a valuable cultural, historical, and physical resource that belongs to all of them.

Public participation in MPA development is a key factor in compliance. People are most likely to respect conservation measures that they feel they are part of. Quite simply, participation leads to ownership. The problem arises when communities feel that restrictions are being dealt to them by power out of their influence or control.

We have classified our discussion of the hurdles into nine categories: funding, enforcement, education, politics, overfishing, feedback and monitoring, public participation, management planning, and coastal effects. We have evaluated the lessons learned from the process of MPA development and

management and hit upon possible responses to minimize recurring complications. We expect this summary of lessons learned will aid the U.S. and Puerto Rican governments, resource users, non-government organizations, and citizens alike to assess the reality of these problems in current MPA and to overcome them in the future using the suggestions and considerations presented.

## Abstract

This report, prepared for University of Puerto Rico Mayaguez, is an independent assessment of the challenges to the development and management of marine protect areas (MPA) in Puerto Rico. Through analysis of five established MPA in Puerto Rico and interviews with key stakeholders that were involved in the establishment of MPA, we have documented lessons learned and possible solutions for successful MPA in Puerto Rico.

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# 1. INTRODUCTION

Common natural resources are progressively exploited by increasing human populations. As numbers increase and each member continues to take a rising toll on the resource, the system becomes depleted. This has occurred countless times in history, and the threat necessitates careful resource management. When an agency is attempting to manage a resource, they are attempting to manage a population. The implications involved with modifying social behavior complicate management beyond setting rations, restrictions, and reserves. Ocean resources present a daunting management challenge, with complex ties to human actions.

The coastal waters of Puerto Rico contain rich communities of life that are the "rainforests of the ocean." The value of the coral reefs goes far beyond their aesthetic beauty. The coral formations provide refuge for numerous species of fish and other animals, a fact that humans have learned to exploit. Although life is plentiful in these systems, the energy contained is efficiently recycled in a process that may be disrupted by mass export for human use. However, the bounty of the reef is known to be plentiful and the livelihoods of many coastal populations in the Caribbean depend on it for nutrition and income. Reef habitats are being threatened by pollution, coastal erosion, diseases, direct physical damage, and overfishing. As coastal populations grow and fishing efforts increase, the reef systems may reach a state far beyond sustainable, causing a collapse of the reef ecosystem and loss of its local species.

Overuse and abuse of these systems are being felt not only by nature, but also by the fishing communities whose lives depend on them. Fishing pressures have continued to increase as total catch and fish sizes have decreased. Overfishing and loss of coral-cover has led to the loss of larger fish species and further destruction of the coral. It is apparent that measures for protecting this resource must be practiced. However, the sensitivity of the coral and the numerous relationships it has to human populations has complicated its conservation.

The conservation tactics applied to fisheries elsewhere have proved difficult to implement in the predominately artisanal and subsistence fishing communities of Puerto Rico (Burke *et al*., 2004). The highly variable fish populations of the reefs and the fishing efforts of relatively poor developing populations have complicated the implementation of regulations designed for temperate commercial fisheries (ISRS, 2004). Marine protected areas (MPA), specifically "no-take zones," have been established and are being investigated as an alternative to catch limitations and gear restrictions. Unfortunately, lack of long-term financial support and local involvement has hindered the effectiveness of MPA, many of which are poorly managed or enforced (Burke *et al.*, 2004).

Communication between those that are attempting to manage and conserve and those that are using and depending on the resources is critical to their preservation. Ideally, conservation efforts would be made by all stakeholders, and the needs, knowledge, traditions, and legitimacy of all would be assessed and made part of the decision-making process. A cooperative public shift of focus from the short term to the long term use and conservation is necessary in order to gain local support. The educational, economic, and social needs of affected populations must also be taken into account.

This project focused on those parties involved in the use and conservation of the reefs. The social implications of MPA were investigated through interviews with key stakeholders, thus allowing us to summarize the challenges to implementing and managing these MPA. We feel that the key stakeholders chosen represent members of the main groups involved in coral reef conservation in Puerto Rico including members of NGOs, the government, and fishers. Through analysis of these lessons learned we were able to make suggestions for the future in order that these hurdles be avoided and MPA be made more effective.

# 2. BACKGROUND

In this chapter, we study the socioeconomic implications of MPA, the problems in and around the coral reef ecosystems, several other examples of effective and ineffective MPA, and current management policies and practices in the U.S., respectively. From there, we shift our focus to coral reefs in Puerto Rico. These topics form the background for our study. From this, we hope to help improve the status of the coral reef ecosystems by evaluating the perspectives of the stakeholders in Puerto Rico.

## *2.1 Tragedy of the Commons and Open Access*

Unlike resources such as coal or oil, fish are a public resource that can be harvested and used by any person. The problem with public resources, such as fish, is that they are easily overexploited. This problem was compared to the 18$^{th}$ century village grazing commons by Garrett Hardin in 1968, and henceforth, the problem has been referred to as the 'tragedy of the commons'. In these villages, there was a field or set of fields in which any farmer could place his cattle to graze. This led to overexploitation because the more cattle one put in the commons, the more money one was able to make through sale of the cattle. However, the commons degraded faster even though each individual acted rationally and used only a portion of the commons. With many people using this rationalization, the wealth of the community was diminished because once the commons was degraded, fewer cattle could graze on it. Hence, fewer people could profit from it (Butler *et al*., 1993). This concept applies to fishing because it consists of the same basic flaws that the grazing commons did:

- "The commonly held public resource (fish) is replenished at a limited rate;
- there is gain to be made by exploiting the resource;
- increasing demand for the resource leads to increased intensity of use;

- the resource can be used excessively (each fisher thinks that if he does not catch fish, someone else will);
- there is the possibility of irreversible damage;
- dividing the resource into private property is difficult;
- regulating the use of the resource is difficult" (Butler *et al.*, 1993).

These flaws are what cause the overexploitation of fish stocks. Fishers may primarily see the short term benefits of overexploiting the stocks because if they do not catch extra fish, someone else will and make the extra profit. When everyone uses this line of reasoning, the resource is overexploited very quickly and the profit everyone makes is largely diminished. However, the distinction needs to be made that the tragedy of the commons would not necessarily be a problem without the existence of a market for the public resource. The market is what drives users of the resource to overexploit it. The market drives the desire to use a resource. Without the motivation of profit there would not necessarily be as many users and the quantities taken might be smaller.

Another problem that arises especially with fishing is the inability to measure the amount of the resource. Unlike fields, there is no way to know precisely how many fish are left. Sampling methods exist, but coral fish populations are subject to complex cyclic changes and heterogeneous distributions. Therefore, the problem becomes not just a tragedy of the commons, but a tragedy of open access. This compounds the problem because without the ability to see how much is left users have less motivation to conserve the resource because by the time they realize there is a problem it is already too late. The problem also arises that without the ability to divide the ocean into private property, there is a distinct lack of responsibility for it. Since the resource belongs to everyone, the mental state arises that it is someone else's responsibility to fix the problem. This results in a lack of accountability for the damage caused. There have been a number of places where the tragedy of open access has been realized and attempts have been made to avert the disastrous consequences that

can follow. One very good example of this is the area of Georges Banks in New England.

### 2.1.1 Georges Bank Case Study

Georges Bank is an example of a type of marine managed area called a fishery reserve, an area that prohibits fishing activity on some or all species to look after critical environment, rebuild stocks, protect against overfishing, and help increase the overall yield for fishers (National Research Council, 2001). It is a marine protected area with emphasis solely on regulating fishing in order to protect the groundfish. Tragedy of the commons was present here with the exploitation of valuable commercial fish, with some species verging on the brink of extinction.

Georges Bank is located 120 km off the coast of New England and is larger than the state of Massachusetts. It is a large plateau situated in relatively shallow ocean waters. Like the coral reefs off the coasts of Puerto Rico in the Caribbean, Georges bank has a location and environment that are ideal for marine animals. It gives shelter to more than 100 species of fish and is home to more than half of the commercially valuable species (BioBulletin, 1998). Presently in Georges Bank, fishing is strictly regulated all year round and it is absolutely prohibited during seasonal closures.

Many fish species that were once abundant on the Bank were at one time on the edge of extinction because they were overfished, there were no regulations set, and no one knew of the severe depletion and harm they were causing. Beginning in the 1970's, catch quotas were implemented, limiting the amount of fish the fishers could haul in. Also in 1970, seasonal closures were established, prohibiting fishing from March through May (Stone *et al.*, 2004). Management plans were put into place, such as setting a minimum fish size to catch, mandatory reports by the fishers detailing their yield, trip limits, and annual quotas. These plans caused much controversy between the fishers, scientists, and government officials. The fishers felt that overfishing was only a temporary damage and need

not be regulated, while scientists were pushing for regulations because of their knowledge of the actual long term effects overfishing has on an ecosystem. Fishers were concerned because they were making less money at the time, not thinking about the long-term damage they were causing: "Conservation and long-term planning have almost always taken a back seat to short-term profit, putting economic interests ahead of the health of natural resources" (BioBulletin, 1998).

There were many recent amendments and changes made to the U.S.A. Multispecies Fishery Management Plan which was set up to protect fish species from being exploited. Among these amendments were year-round Closed Areas I and II on Georges Bank and minimum mesh sizes of nets. More gear restrictions were set and there was full time dockside monitoring of catches. These restrictions lowered the fishers' income and left some out of jobs when the closures took place but they are essential to the fish environment and will keep fishers with jobs in the long run. These management plans have already proved to increase the fish survival of once, almost extinct, overfished species and fish populations of Georges Bank are rebuilding rapidly.

Many environmentalists and government officials have learned from the near disastrous exploitation of a common resource at Georges Bank. The bank is now better managed; the fish stocks have been replenished and the amount of fishing versus the time available for the fish to restock is better balanced. One of major damages done to the coral reefs of the Caribbean is directly linked to overfishing and the tragedy of the commons. We feel that the lessons learned from this case study of Georges Bank are valuable and pertinent to the problem we are facing with the coral reefs in Puerto Rico.

## *2.2 Marine Protected Areas*

Before we discuss the specific problems of MPA and of the coral reefs, we will discuss what a marine protected area means. The term "marine protected area" is an international application and comes in many forms. The official international definition provided by International Union for the Conservation of

Nature and Natural Resources (IUCN) is "any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment" (Kelleher and Kenchington, 1992). Similar to the previous definition, the U.S. defines it as "any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein" (Clinton, 2000). The level of protection for an MPA is not clearly defined in this statement and can vary from minimal restrictions from fishing and water pollution to no access of fishing and disturbance of any kind. Therefore, a marine protected area can mean different things to different people, depending on the level of protection and the purpose it serves. In the U.S., there are six levels of protection: uniform multiple use, zoned multiple use, zoned with no-take area, no take, no impact, and no access.

### 2.2.1 Types of MPA

Uniform multiple use, zoned multiple use, and zoned with no-take area MPA are typically applied to marine sanctuaries and other various types of MPA. These provide the least level of protection with controlled fishing allowed and human activities. Multiple use areas are generally used in larger areas of MPA and most common in the U.S. Zoning is used to grant access to specified areas to different user groups (National MPA Center, 2004).

Marine reserves provide a higher level of protection where removal and significant damage of resources are prohibited. Marine reserves may be parts of a marine sanctuary. They consist of no-take, no impact, and no access areas. No-take areas prohibit fishing and allow some human activities. No impact areas prohibit any activities that may harm their resources, such as fishing and pollution. No access areas restrict any kind of disturbance on MPA and are used only for research, monitoring, and restoration.

These different levels of protection are applied to many types of MPA: national marine sanctuaries, fishery management zones, national parks, national monuments, national wildlife refuges, marine reserves, and many others. Not only do MPA protect biological resources but they also protect cultural resources, such as the historical artifacts found in marine areas from World War II.

Since a marine protected area is such a broad idea, we will define which MPA we are concerned with. We are particularly looking at MPA that aim to enhance coral reef ecosystems and solve the overfishing problems in Puerto Rico. Since most of the MPA in Puerto Rico are marine reserves and concerned about the lack of enforcement of regulations, we will study the applications of a marine reserve.

### 2.2.2 Process for establishing an MPA

Depending upon where an MPA is located, it can be established through federal or state government. U.S. waters stretch up to 200 nautical miles from their shoreline and are divided into state and federal territory. The Puerto Rican government has jurisdiction over the first 9 nautical miles from shore. The state can establish an MPA through legislation, designation of an appropriate natural resource agency, or ballot initiative. However, the federal government must have permission from the president or Congress (Wing, 2001).

The Department of Interior and the Department of Commerce oversee the federal MPA with the help of other federal departments. Overseen by the Department of Interior, the National Park Service manages the 12 national seashores and 34 national marine parks. The National Park Service can restrict activities that interfere with their conservation efforts, such as, commercial fishing. The Department of Commerce supervises National Oceanic Atmospheric Administration (NOAA), which is responsible for the thirteen national marine sanctuaries. Their management plans are reviewed every five years and may include adding marine reserves or changing policies.

If an MPA requires the permission of both the state and federal government, the state generally manages over the state waters and the federal government matches the state's protection measures for consistency throughout the MPA. Also, advisory groups are established to relieve some of the burden required by the state and federal government. These advisory groups consist of members from each level of government and local community.

Another group that helps the federal government protect their waters is the Fishery Management Council. It consists of commercial and recreational fishers, scientists, and state and federal members that are familiar with their region's management and resources. There are eight councils, including one in the Caribbean, that make recommendations to the secretary of commerce and the National Marine Fisheries Service (NMFS). The council is notified of new restrictions and can create permanent or temporary fishing closures. However, non-fishing activities are restricted by other federal agencies.

Though there are many benefits of an MPA, it is hard to convince resource users and community members, as the short term inconveniences can be costly and most have a hard time seeing past them. Beyond the ecological and academic aspects of MPA establishment and operation, there are economic, social, and political implications described forthwith.

### 2.2.3 Management Plan

Once a marine protected area is established, it needs a program for management. The construction of a management plan helps resource managers solidify the goals, methods, and characteristics of the reserve and of conservation efforts. In addition to presenting regulations and the measures of protection, a management plan is a living document that characterizes the resource and spells out the management schemes. Although there is no widely accepted procedure for constructing a management plan, the DNER has its own preferred guidelines, which focus on the values and uses of the resources and the organization of managerial responsibilities. The management plan should describe management

programs such as enforcement, education, research, and administration. A plan would also include the financing plan, without which there can be no effective management.

There are three kinds of management, macro, regional and sectoral. Looking at Puerto Rico as a whole is a macro type management. A regional approach is used when Puerto Rico is broken up into economic or administrative regions for management. A sectoral approach looks at only one sector of the economy such as economic or infrastructure. The effectiveness of the sectoral approach is limited because the interactions between the sectors are not taken into account.

### 2.2.4 Socio-economic Implications of Marine Protected Areas

Marine protected areas are not easy to instantiate. There are many tensions within the community that can get in the way; one of the biggest tensions is the economic and cultural need for fishing. Many island communities are based around subsistence fishing. Subsistence fishing is the ability of a fisher to harvest only enough fish to feed himself and his family, and not enough to make a profit. This leads to the obvious problem that if an MPA is established on the fishing grounds of these subsistence fishers, they will not have the money to support their families and will not have enough food to live off of. The large percentage of artisanal and subsistence fishers in Caribbean island reef communities (Burke *et al*., 2004) increases tension between the fishers who continue to use their resources at an increasing rate and the organizations who wish to conserve the coral reefs.

Due to a web of interactions, damage to the coral systems is geographically related to large and growing coastal populations. Accordingly, attempts at preserving those threatened coral ecosystems and overfished areas must take into account the spectrum of relationships that coastal communities have with their ocean resource. In the worthy quest to study and preserve one of earth's greatest biological resources, institutions must have some perception for

the toll this pursuit has on human life. A long-term payoff is assumed in our attempts to save the environment, but the short-term consequences are often felt by the others. Herein lies the implementation gap. In a 'top-down' management approach, the needs of user groups may be overlooked. Those in the position to place restrictions on marine resources must make themselves fully aware of the importance of resource to the diverse user groups, not only to the economy, but to the preservation of culture and a valued way of life.

Resources are limited, and to those that depend on what they can take from the sea, it makes little sense to give up useful area to sanctuaries. The benefits are not immediately apparent and are predicted through ecological modeling and observation. It is of course extremely difficult to apply the scientific method to marine ecology, and assumptions have to be made along the way. In fact, according to Garry Russ, in a review of coral reef MPA, there is no truly scientific experimental evidence of the spill-over effect, only models that rely on assumptions such as offspring dispersal, recruitment and other factors impossible to quantify in the field (Russ, 2002). The spill-over effect is export of fish from the increasing populations in protected areas. Russ also points out that a reserve is only justified if there is a net export of fish from the reserve such that the loss of the area required to set up the reserve is compensated (Russ, 2002). In order to gain public support, this compensation must be clearly demonstrated. A lack of knowledge of the operation and benefits of a reserve can lead to poaching by fishers because of the assumed decrease in income and the desire to fish in an MPA where there are more fish (due to lack of fishing in the area) so as to complement this loss (Hollup, 2000). This is yet another reason for the importance of educating fishers in the area.

It is important to realize that overfishing is not the only threat to the coral reefs and it may not even be the most detrimental. Fishers realize that coast-related pollution, sedimentation and other water quality changes can have a far deeper impact on nearby reefs. MPA that focus mainly on fishing regulations

may easily receive criticism by the users who may very well understand that their actions damage the coral, but also that there is a larger picture to look at.

When those that live by the sea are affected by decisions made without consideration of their input, those regulations lack the advantage of valuable knowledge. Also, as Hollup (2000) points out, input and support by user groups validates the existence of government regulations, enhancing the legitimacy of the reserve and compliance with its requirements. With lowered implementation costs, community-based resource management should function superior to government or institutionally implemented conservation programs. Most artisanal fishing cultures have established their own means of regulating resource use, but population booms may complicate these traditional means. An attempt should be made to realize and incorporate any existing hierarchies or authorities of the coastal management (Hollup, 2000).

Although fishers are not the only human population dependent upon the coral system and affected by its protection, it is most central to their lives. For many, it is their only source of income and food. Fishing is commonly a family tradition and the only job skill they learn. Despite the economic stimulation that is supplied by tourism (a commonly-cited benefit of MPA), a lack of education or other skills limits the job opportunities for fishers (Hollup, 2000). When the economic benefits of MPA are evaluated, it must be at a resolution that describes the costs and benefits for every stakeholder, especially the primary users.

Revenue from tourism is a critical part of Puerto Rico's economy. There are those who depend on income from visitors to the coral reef; diving, skiing, and especially recreational fishing. Although some of the tourist activity is not affected by regulations and healthier corals should mean more tourists, the possible loss of revenue concerns local residents and diminishes support (Guénette *et al*., 2000). All must understand that the long-term gain of restoring the coral systems must be greater than the profits of degrading the resource.

Ultimately, it will be the users that determine the success or failure of conservation attempts. Management agencies must make every attempt to

understand the cultural importance of the resource. The successful Fagatele Bay MPA in the American Samoa incorporated an understanding of village life and regulations. Efforts were made to promote the continuation of traditional use of the resources (Guénette *et al.*, 2000). Co-management and user participation are two important aspects of resource conservation. An analysis of potential MPA sites in Puerto Rico will require a definition of the intended management scheme and an assessment of the social complications that lead to problems with implementation and enforcement.

### 2.2.5 Socio-political Implications of Marine Protected Areas

The importance of user-group education, participation, and input into MPA goes beyond effective planning and implementation. The fishers of Puerto Rico are known to be politically active their political influence has been enough to halt the establishment of an MPA in the past (Valdés-Pizzini, 1990). Any assessment of MPA success or failure in Puerto Rico must take into account, along with all the social and economic aspects above, the political ramifications that these aspects might cause.

As mentioned previously, user-group support will depend largely on user-group participation in planning and considerations made on their behalf. Additionally, support for an MPA depends on the community's understanding of the costs, benefits, and magnitude of preservation. Support from each party depends on how much they must sacrifice in the present and how each separate party will benefit in the future. According to Hoagland and et al. (1995) and the National Research Council Staff (2001), the costs of an MPA include:

- Research
- Monitoring
- Enforcement
- Purchase of private-owned land and facilities
- Decline in revenue generated from commercial fishing and tourism
- Restrictions from fishing and recreational activities for locals and tourists

- Loss of waste disposal sites in the waters
- Decrease of employment
- Less development opportunities

In addition, Hoaggland and et al. (1995) and the National Research Council Staff (2001) points out that to convince the coastal communities to accept the establishment of an MPA, they must understand the following benefits for the future:

- Increase of fish in number and size
- Improved quality of tourist activities
- Increase employment rate due to increased tourism
- Increase in property value
- Increase of sites for cultural and scientific research opportunities
- A healthier and more aesthetic environment
- Better water quality
- Public outreach and education

In order to gain profits in the future, money needs to be invested for protection, such as research of its reefs, monitoring for water quality and diseases, compliance with environmental laws and regulations, and facilities to conduct research. Although these costs may be unfavorable to many businesses, the outcome will be an increase of resources from these coral reef ecosystems, eventually leading to a more profitable and beautiful future than one without a marine protected area.

Another factor that will predict community support is the time commitment that is necessary for the ecosystem to rebalance itself. If a coral reef ecosystem is replenished within a 5-10 year span, the stakeholders (fishers, business owners, government, tourists, and locals) will be more supportive for a marine protected area in their community than if it takes many decades.

Through an understanding of the basic social, economic, and political implications of MPA we begin to see the complicated considerations that may determine the success or failure of an MPA. With an understanding of the

logistics and implications of MPA we can take a closer look at the specific problem that is the focus of this paper, the coral reef crisis.

### *2.3 The Coral Reef Crisis*

An understanding of the damage caused to the reefs requires knowledge of their biology. The coral reef is the result of a symbiotic relationship between a coral polyp and single-celled photosynthetic algae that evolved within a finely tuned ecosystem. The coral polyp is a simple sea animal with stinging tentacles and a stomach which digests plankton and provides nutrients to its symbiont. Single-celled photosynthetic algae live within the cells of the polyp and provide the sugar products of photosynthesis. The calcium carbonate skeletons of the polyps build up over time to create a reef (CoRIS, 2004b). A realization of the ecological interactions of the reef system is necessary when attempting to prevent its destruction.

The diverse and highly productive reef system consists of a network of organisms which contribute to the balanced and efficient cyclic use of a limited amount of nutrients (Roberts, 1995). There are many critical roles within the processes of the reef system. Environmental changes and anthropogenic stresses are passed on through the webs of interactions.

According to Wilkinson (2004), "Coral reefs are invaluable for their riches in biodiversity and essential resources for the sustainable livelihoods of many coastal communities." They protect the shoreline from erosion, shelter many endangered and commercially-valuable species, and produce chemicals for natural products. Their beauty also brings aesthetic pleasure to tourists and locals through recreational activities. However, the exploitation of coral resources and abuse of its environment are rapidly leading to their destruction. We describe these abuses and threats in the paragraphs to follow.

Coral reef degradation has increased tremendously over the past few decades. Natural threats combining with anthropogenic disturbances are taking their toll. Globally, it is estimated that 10% of the reefs are completely destroyed,

30% are in critical condition, and experts predict that 60% may be lost entirely by 2050 (CoRIS, 2004a).

Coral reefs have always been subjected to natural disturbances such as major storms, hurricanes, diseases, predators, and climate changes. They have developed ways of recovering from such temporary disturbances. The environmental conditions of these intricate habitats must remain constant over time; any changes increase the risk of damage. Hurricanes and storms cause large waves and choppy waters which break or flatten the coral. Corals are sensitive to changes in temperature. Subtle fluctuations in the climate producing an increase or decrease in the water temperature may destroy the coral or render it susceptible to disease (CoRIS, 2004a). Predation is also a major cause of natural coral depletion. Although these natural threats are common, healthy coral is quite resilient and can withstand or recover promptly from such threats. The main problem is the overlap of natural threats with anthropogenic pressures.

There are a continuously increasing number of human interactions with coral reefs due to the increasing populations of developing coastal communities. Coral reefs are used heavily for fishing and recreation. The diverse ecosystem of the reefs proves to be an excellent source for fishing, but exploitation takes its toll. Fishing, along with other forms of recreation such as scuba diving and boating, are all harmful to the coral. Fishing lines and nets get caught up in the corals' elaborate folds and branches, damaging or killing parts of the reef. Overfishing certain species of fish from their coral reef habitat causes a decrease in target fish size because they are fished before they have time to grow to full-size. A decrease in the individual sizes of the target species and a forced shift to lower-valued species are evidence of an overfished ecosystem (McManus *et al.*, 2000). These symptoms indicate a disturbance in the ecological relationships of the reef. The decrease in biodiversity and loss of functional components of the ecosystem break down the resiliency the reef has to natural pressures (Burke *et al.*, 2004). Scuba divers often cause damage by touching or breaking off pieces of the coral. Injuries from boat anchors are also common (Burke *et al.*, 2004).

The reefs are directly affected by human-produced, land-based sources of pollution. Water pollution from agriculture and land development causes the nutrient levels to change dramatically (Hughes *et al.*, 2003). Nutrient-rich runoff and the dumping of human and industrial waste into the coastal environment causes eutrophication, a bloom of algae and other organisms which quickly deplete the water's oxygen and compete with the coral. Further, the development of coastal areas (the removal of mangrove trees, the destruction grass beds, and agricultural efforts) lead to the erosion of the land into the waters. The increase in turbidity has detrimental effects on the coral, which require clear water in order to carry on photosynthesis (Burke *et al.*, 2004).

Coral bleaching occurs when the coral polyps expel the symbiotic algae, which can be caused by many different changes in the environment, including toxins, salinity changes and most commonly, an increase in sea surface temperature. Coral bleaching was never observed in the Caribbean before 1983, but is now a formidable threat (Burke *et al.*, 2004). The buildup of greenhouse gases has been accompanied by an increase in the earth's temperature. Coral bleaching may soon become an annual threat in the Caribbean (Hoegh-Guldberg, 1999, as cited by Burke *et al*., 2004). The presence and effect of this stress will continue to become more significant.

Due to increasing populations in the land of the U.S. Caribbean, there has been a catastrophic decrease of coral habitats. Of the 3040 km² of reef in the US Caribbean, 16% is destroyed and 56% are in critical condition. There has been a major decline in coral cover from an average of 50% cover 25 years ago to an approximate 10% on the reefs now. The major species of coral in this area (elkhorn, staghorn, and fused-staghorn coral) are currently under investigation to become protected under the federal Endangered Species Act (Wilkinson, 2004).

### 2.3.1 Overfishing

This section focuses on overfishing, the collection of fish from the ocean at a faster rate than the stocks can replenish themselves. It is one of the major

problems that coral reefs and fishing areas face in this complex crisis. This over-collection of our ocean resources causes the depletion of many species of fish and even endangerment of some. Steps have been taken to control this depletion but few have been successful.

#### 2.3.1.1 Fisheries Management

Laws and regulations are established to eradicate the misconception that the ocean is a limitless resource. Due to its massive size and seemingly endless boundaries, humans have long considered its resources unable to be affected by human actions. This idea was expressed by Hugo Grotius in the 1600's when he said that "the seas could not be harmed by human deeds and therefore needed no protection" (National Research Council Staff [CB], 2001). In the last century, it has been shown that this is not the case. Human actions have indeed affected the ecosystem and it has been found that resources within the ocean are not limitless as was once believed. With human population growth, overfishing has become a large problem. Through restrictions and regulations, the government has tried to control the damage being done to our ocean resources. However, these regulations have been largely ineffective.

Through technological advances, humans have not only become more efficient in catching fish, but have also been able to catch enormous quantities at once. Now, overfishing has become a very large problem for many species. In fact, out of all the different stock of species that are fished, about 25-30% of these species are overfished and 44% are being depleted (National Research Council Staff [CB], 2001, as cited in Garcia and Newton, 1997; FAO, 1999; NRC, 1999a). Attempts have been made to control the fishing industry and protect dwindling stocks. In different areas of the world, many different restrictions have been used to restrict the damage done to the stocks. These regulations include gear restrictions, restrictions on the minimum size or weight of fish caught, and establishment of fishing seasons for certain species (Russ, 2002). These restrictions, however, are not as effective as intended.

There are a number of problems with current methods for regulating the amount of fish harvested from the ocean. The main problem is that "management [of fisheries] depends on a conceptual model of a fishery that makes three simplifying assumptions: (1) the fishing fleet targets and exploits a single species stock, (2) the stock of interest is segregated temporally or spatially from other stocks, and (3) the individuals are perfectly mixed so that the effects of fishing are well spread over the whole stock" (National Research Council Staff [CB], 2001). These assumptions severely hinder the effectiveness of current regulations.

Due to the assumption that fishing fleets exploit only one single species of stock, there is no account taken of relationships between different species such as predator-prey relationships. For example, if we remove too many fish that are at the lower end of the food chain, then other fish higher up on the food chain will suffer from lack of food. Also, by assuming all fish of one species are segregated from all others, one is not taking into consideration the effects of "bycatch", the accidental harvesting of fish not specifically targeted by the fishers. Fishing gear such as nets cannot discriminate between species of fish, so often non-target species are caught as well.

Lastly, because of the assumption that the population of the stock is perfectly mixed, concentration of fishing in one area can deplete all the resources in that area. For certain species of fish, specifically species such as tuna and plaice that are highly mobile, this is a reasonable assumption because due to their large migration and swimming area. If the stock is overfished in one area, then the rest of the stock can easily fill the area back in. However, this assumption has been inappropriately applied to low-mobility fish that do not travel far from their habitat (National Research Council Staff [CB], 2001). Low-mobility species, such as rockfish and sedentary invertebrates, will replenish overfished areas eventually, but very slowly. This creates the problem that if an area is overfished, it will take a long time to recover and the total population will remain much smaller in the following years. If other areas are overfished in the following years as well, then the population of that species will be significantly threatened.

### 2.3.1.2 Effects of Fishing on Coral Reefs

As a major component of the reef system, the composition and state of fish life has a deep influence on the health of the coral reef. Overfishing is a detrimental stress that is felt by not only the target species, but by the entire ecosystem. Many fishing methods are non-specific that act upon a range of fish species similar in morphology and behavior (Russ *et al.*, 1991, as cited in Roberts, 1995). Subsistence fishers take advantage of the predictable bounty of the reefs, sometimes extracting entire local populations from breeding grounds and removing the most reproductively capable members of the species (Russ 2002, Burke *et al*., 2004).

The loss of the larger predator species has a predictable and profound impact on the rest of the ecosystem. Decreased selection in the prey populations may cause some unchecked prey species to displace others, leading to a decrease in species diversity and the loss of species not directly affected by fishing (Roberts, 1995). Herbivorous fish species are affected directly through unintentional harvesting due to fishing methods, and indirectly through the loss of predators and other functional members of the ecosystem.

These species are directly important to the coral as predators of non-calcareous filamentous and fleshy algae, which compete with the coral for space on the sea floor (McManus *et al.*, 2000). McManus and colleagues suggest a synergistic relationship between the loss of herbivore species and the eutrophication of coastal waters from human waste (McManus *et al*., 2000). Coral waters are usually quite deficient in nutrients, which is good for the coral and its associate algae, but not for free living algae. The addition of excessive nutrients from contaminated run-off results in algal blooms, in which the free-living slimy algae overgrows the coral and inhibits the attachment and growth of new coral polyps (Burke *et al.*, 2004). It is clearly necessary to consider the whole ecological picture when investigating the health and conservation of the reef.

### 2.3.2 Ecosystems Approach to Management

MPA are designed to protect critical habitats from threats within the reserve, but give little to no protection to areas outside. A new approach that has been considered recently is the ecosystems approach. In this approach, rather than focusing solely on the coral reef habitats and the species that live within, attention is given to all related habitats, marine and terrestrial. The Convention on Biological Diversity defines the ecosystem approach as: "a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way" (Convention on Biological Diversity).

Also discussed by the Convention was the necessity of adaptive management when working with ecosystem management, as there is still incomplete knowledge of how it functions. The lack of knowledge makes it hard to implement this approach because all of the relationships between habitats are not fully understood. However, it is known that land-based habitats often have important effects on the coral reefs. For example, the mangrove forests (e.g., Figure 1) are integral to coral reef habitats. Many species of fish spend the early part of their life living in the root system of the mangrove forests (e.g., Figure 2). An ecosystems approach attempts to protect against not only damage to critical land-based habitats, but also damage to the marine habitats themselves that originate from outside the reserves.

**Figure 1: Mangrove Trees in La Parguera (Garcia-Sais *et al.*, 2004)**

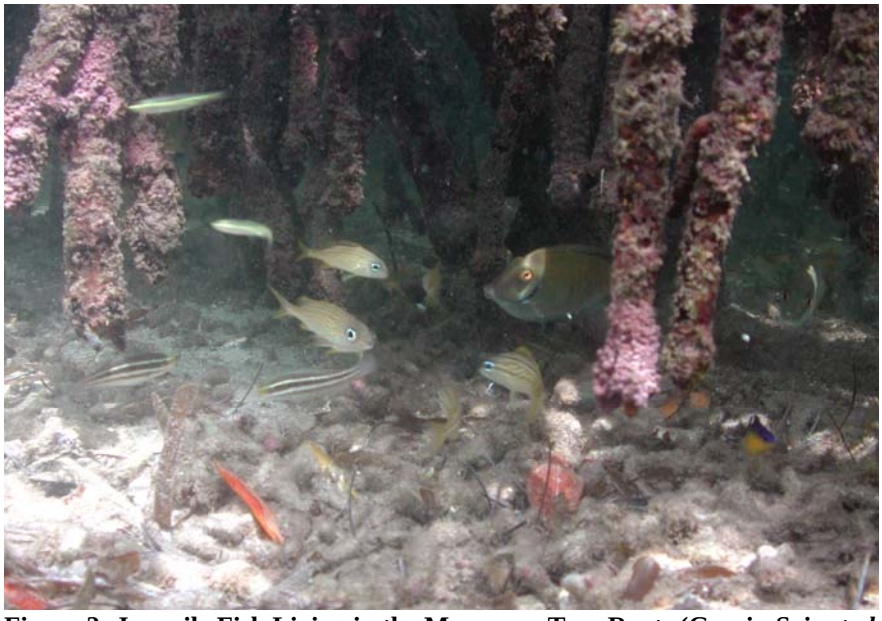

**Figure 2: Juvenile Fish Living in the Mangrove Tree Roots (Garcia-Sais *et al.*, 2004)**

#### 2.3.2.1 Sedimentation and Pollution

The roots of trees and vegetation prevent loose dirt from washing away during rain. Deforestation and construction loosen the soil, allowing the rainwater to carry it away. The sediment is washed into rivers and streams, and subsequently carried into the ocean (e.g., Figure 3). The sediment deposited in the ocean blocks sunlight to marine habitats such as the coral reefs which need sunlight to survive.

This problem is a major threat to marine resources because unlike direct threats inside the boundaries of the reserve, sedimentation often originates from miles inland. This makes it extremely difficult to control and regulate. Even if a reserve is extended inland to protect land-based habitats and sedimentation from the coastline, sedimentation is still difficult to control because it stems from the center of the island and extends all the way to the coast.

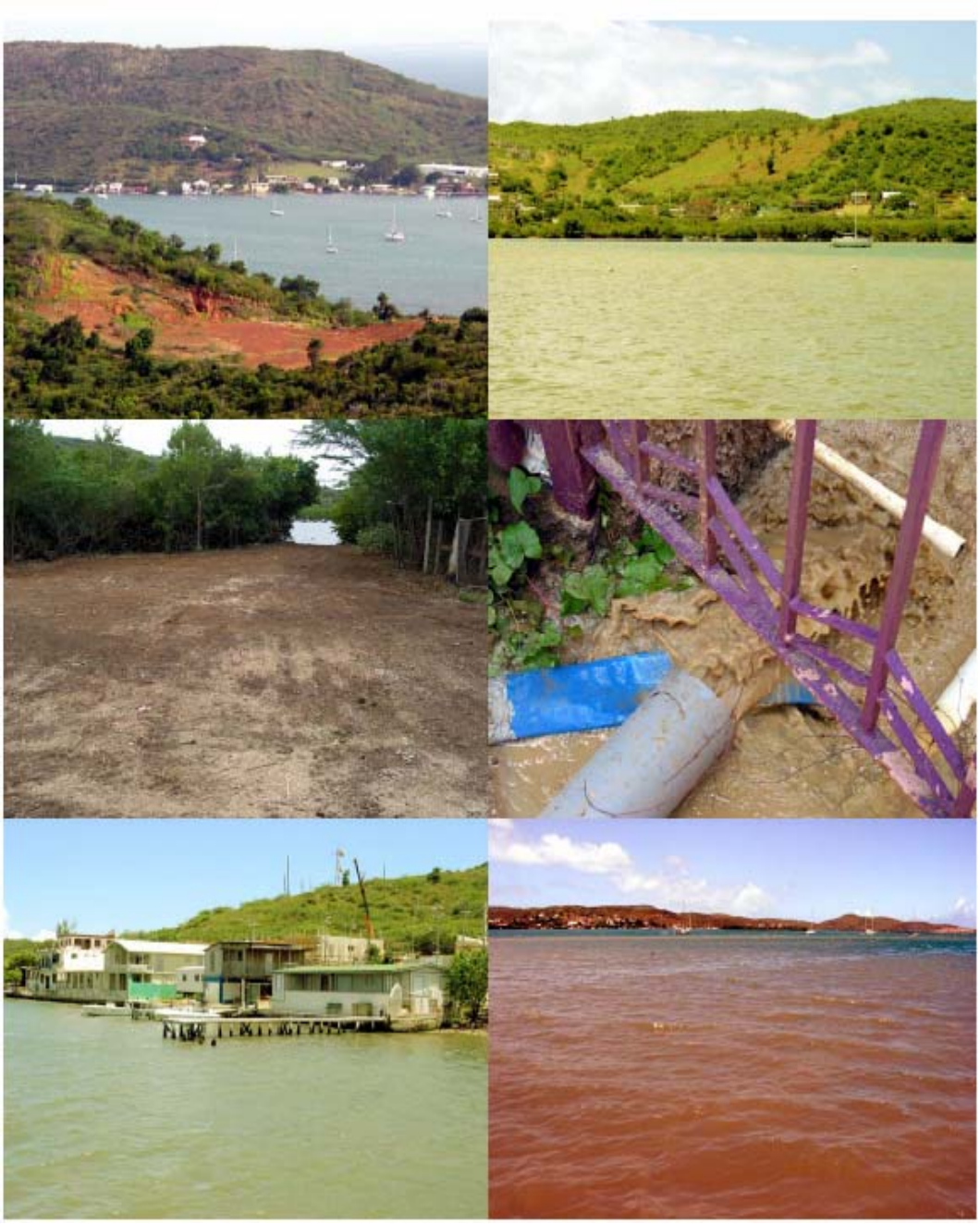

**Figure 3: Effects from Sedimentation Around Culebra (Hernández-Delgado, 2004)**

Pollution is a similar problem in that it does not originate from a single source. Like sedimentation, pollutants are washed into the ocean through runoff from rivers and streams during storms, and it can originate from great distances.

Watershed pollution causes an increase in the pH of the water, decreasing the water quality. Coral reefs and the marine life that live within are sensitive to small changes in pH and hence, excessive runoff and land-based pollutants will cause major degradation of coastal marine life.

#### 2.3.2.2 Traditional Ecological Knowledge

Traditional ecological knowledge (TEK) is the empirical knowledge obtained outside the realm of what is commonly considered science. It is the understanding of an environment and its component species that is obtained through daily interaction, observation, and use of an area. TEK is refined as it is passed down through generations of domestic users. This knowledge can be a valuable supplement or basis for scientific ecological studies.

### 2.3.3 Point Source Damage

Point-source damage can seriously injure the reefs and halt restoration within MPA. Destructive fishing methods such as traps, nets, fishing lines and the use of bleach to stun fish all have deadly effects on the coral. If the coral is destroyed, this habitat will disappear along with the fish that reside there. Many MPA have regulations against fishing, however due to lack of enforcement often fishers continue to harm the reefs in this manner. Inexperienced and unknowledgeable boaters often damage the reef just as much when they run aground on the reefs or pulverize the coral with their motorboat propellers. When anchoring boaters often kill the coral when their anchor drags or they anchor unknowingly on top of a reef. Even recreational scuba divers and snorkelers can do serious damage to the reefs by touching or breaking off pieces of coral while enjoying the reef. This may not do as much damage as boaters, but it is a significant problem and users need to be educated about the harm caused by touching or breaking off the coral.

### 2.3.4 Coral Reef Task Force

In recent years, efforts have been made by the U.S. government to preserve the resources in the ocean, specifically resources in coral reefs. With the decreasing number of fisheries, awareness and actions to conserve and restore the coral reef ecosystems have grown dramatically in the last decade. One of the first major steps taken was the unveiling of the Executive Order 13089 on Coral Reef Protection (Clinton, 1998).

Executive Order 13089 on Coral Reef Protection requires that all federal agencies whose jurisdiction affect the coral reef ecosystems must assure that their actions restore, protect, prevent, and do not pressure these ecosystems. Coral reef ecosystems are defined to be "species, habitats, and other natural resources associated with coral reefs" (Clinton, 1998). Within the order, the U.S. Coral Reef Task Force is introduced. Their duties include developing a program to map and monitor U.S. coral reefs, conducting research on the major causes of degradation, and developing measures that conserve coral reefs. These include solutions of "land-based sources of water pollution, sedimentation, detrimental alteration of salinity or temperature, over-fishing, over-use, collection of coral reef species, store degradation of coral reefs, and direct destruction caused by activities such as recreational and commercial vessel traffic and treasure salvage" (U.S. Coral Reef Task Force, 2000a). Another initiative for the Task Force is to cooperate with other organizations, scientific agencies and government bodies on the international level to provide support and resources to conserve and protect the world's coral reef ecosystems.

The U.S. Coral Reef Task Force acts essentially as a guide for the management of coral reef ecosystems. They have written, in collaboration with other conservation organizations, strategies of maintaining marine protected areas and research information of various ecosystems across the U.S.

The Task Force stresses the need for a management system that addresses all problems within a specified ecosystem to ensure the health and survival of the coral reef. A management plan must include steps that enforce laws and

regulations, map coral reefs within their area, monitor the conditions and changes of the ecosystem and water, and restore the damages that have already been caused.

One of the first steps of coral reef management includes extensive mapping that must be made to locate the status and location of affected ecosystems. This will help identify the geographical characteristics and biological species of the area. The U.S Task Force is currently in the process of mapping all U.S. coral reefs in high resolution maps taken from satellites, aircraft, and in situ surveys, and in large scale, low resolution maps. Other technologies are also being developed to enhance the mapping of coral reefs. Maps of coral reefs located in shallow areas have been completed in Puerto Rico, U.S. Virgin Islands, parts of Florida. All other areas of the U.S. are currently in the process of mapping (NOAA, 2002).

In order to ensure the safety of the coral reef ecosystem, enforcement of the laws and regulations must take place with the help of federal, state, and local organizations. Enforcement may include trained officers patrolling each site for violations and workshops that raise public awareness of the threatened coral reefs, the regulations, and penalties. Along with these methods, careful and detailed protocols and consequences must be developed and implemented in the case of any violation (U.S. Coral Reef Task Force, 2000b).

Aside from the damages caused by direct human activities, other major threats to coral reef ecosystems, such as, diseases, water-impurity, climate changes, and alien species must also be monitored. Scientific testing can determine the quality of the water and presence of disease. Monitoring the amount of fish and healthy coral in the protected area are also ways to determine the condition of the ecosystem. Coral reefs take centuries to repair and grow, which is why active management must transplant adult coral reefs to damaged areas or develop other methods that will restore the ecosystem more rapidly.

Some of these guidelines provided by the U.S. Coral Reef Task Force have already begun to be implemented in certain areas across the U.S., such as the

Caribbean and Hawaii. However, more effective action in these areas and further development of all other ecosystems are still needed. These guidelines embody most management plans used for the conservation of coral reefs that are currently taking place in the U.S. Hopefully these new guidelines will help to alleviate much of the damage being done to the coral reefs.

### 2.3.5 Global Conservation Efforts

Not only is the U.S. facing problems with their coral reef ecosystems, but there is an overall decline of coral reefs in the world. Growing areas of dead coral colonies covered in algae need aid in order to recover. The number of protected areas is continuously increasing, but there is a global struggle to enforce and implement the regulatory frameworks and management plans of reefs, which are in critical condition.

Just ten years ago, there was almost no government recognition whatsoever of the importance of the coral reefs in the world. Now, governments are becoming more aware of the reef value. Many countries are in the process of designing management plans or have already put regulations into place. These plans and regulations are still in the early stages, but in-general the results are showing that there needs to be better implementation, stronger enforcement, and more communication between government and non-government bodies.

Southeastern Asia is the location of some of the world's most declined coral reefs. The Asian governments have declared many areas as protected sites and have set up MPA in numerous zones. Even though the legislation and protected areas do exist, there is inadequate enforcement and implementation. People disregard the regulations and use the coral reef resources in areas which are declared marine protected areas with no consequences. For some areas, there is a total lack of communication to the local people and they are completely unaware of the damage they are causing. For the coastal populations, coral reefs make up people's livelihoods since fishing and tourism are essential to their economies. There is very little monitoring and studying of the coral reef areas,

which is a result of minimal technical and financial capacity. The supervision of the protected coral reef areas is insufficient but with a little more attention and cooperation, the coral reefs will begin to recover. Recently, there have been improvements in raising awareness, such as reef issues being displayed on billboards, talked about on the radio, and integrated into school curriculum (Wilkinson, 2004).

Australia is a prime example of a country with a functional and effective coral reef management system. They have raised awareness of the value and importance of the coral reefs through government initiatives. The Australian government coordinates with non-government organizations and through teamwork they have built a very successful strategy to regulate the local coral reef areas. Although Australia faces much less human pressures on their reefs than many other island communities do, their coral reefs are in good condition as a result of hard work and dedication to the issue. They have well-financed coral reef programs and state of the art technology to monitor the reef area. Since their system works so well, Australia is quick to assist other countries in developing their own working management policies.

Within the last six years, the Philippines have established many functioning MPA in order to protect the coral reefs located off of its largely populated coast. Lapu Lapu City in the Philippines is a great example of an urban setting being able to control and manage MPA using community-based management and protection. The community works together to educate and monitor their local reefs and have actually improved their economy through the MPA. The community combines its efforts with those of the city and government, and together they are able to manage the regulated areas well (Ross *et al.*, 2004).

Monitoring the use of the marine area brings in a lot of money from tourism. According to the study of the urban MPA of Lapu Lapu City (Philippines), the "total revenue generated for the community and local government is roughly U.S. $200,000 per year" (Ross *et al.*, 2004). Instead of

being able to use the area however and whenever a person chooses, they have to pay fees to scuba dive, fish, boat, and swim in that area. Tourism brings money not only to the water itself, but also to all of the restaurants and shops along the coast. The community situates most of its vendors in areas nearby the MPA, which brings in money and also provides an extra means of protection; the vendors can indirectly watch over the area as they are selling their goods. The fees to use the water and a percentage of profits from vendors go directly to the community and the municipal government, and in turn, go to the cost of management and enforcement of the MPA. The community ends up bringing in more money than they are using to manage the MPA. Although this area is designated a no-take zone for fishing, thus putting many fishers out of jobs, the well-managed marine area attracts more tourism; this increase in tourists creates more employment opportunities. Although it is difficult and tiresome to manage an MPA, if it is accomplished effectively the local economy benefits.

The coral reefs of the world are presently in overall poor condition. Anthropogenic disturbances are the main causes of the tremendous deterioration. "Unless the current rates of over-exploitation and destructive harvesting are controlled, the coral reefs will continue to deteriorate and many will degenerate completely" (Wilkinson, 2004). Although the condition of the coral reefs is unfortunate, there is hope for the future of these indispensable ecosystems. Many countries are having great success with government issued policies to protect and conserve the coral reefs in their area. The countries that are struggling with legislation and protection are showing signs of effort and desire to improve the quality of their local reefs, which are steps in the right direction. Around the globe, state and federal governments are working with environmental committees and scientists to take appropriate action for the conservation of coral reefs. Hopefully the lessons learned from these successful MPA will help Puerto Rico's problem of coral reef degradation.

## *2.4 Puerto Rico*

Puerto Rico consists of one main island and five smaller islands. The total land area of Puerto Rico is estimated to be 8,959 $km^2$, which is less than three times the size of Rhode Island. It lies to the east of the Dominican Republic and between the Atlantic Ocean and Caribbean Sea. The coastline covers 501 km.

### 2.4.1 Conditions of the Coral Reefs

Coral reefs around the island are degrading and even the most abundant and healthiest areas of living coral have also been impacted by environmental and human pressures. Some species that have been devastatingly affected are the staghorn and elkhorn coral (e.g., Figures 4 & 5). In over two decades, hurricanes and white-band disease have degraded these species. Other diseases that have affected the coral reefs in Puerto Rico include black-band disease, yellow-blotch disease, and white plague II.

**Figure 4: (top) Elkhorn Coral, *Acropora Palmata*, (Hernández-Delgado, 2004)**
**Figure 5: (bottom) Staghorn Coral, *Acropora Cervicornis* (Hernández-Delgado, 2004)**

Overfishing, water pollution, coastal development and runoff, and fuel from ships and boats are all of high concerns to the coral reef environment in Puerto Rico. In 2002, NOAA suggested that that 97.7% of the coastline is

suitable for sustaining marine life. However, the water is still threatened by contamination from industrial sources, sewage, urban runoff, and marinas.

### 2.4.2 Current Protection Measures of Coral Reefs in Puerto Rico

Major research and management is currently being implemented by the government and many conservation programs. Since 1999, the Puerto Rican government set up two no-take zones in two of their marine protected areas: the Luis Peña Natural Reserve and the Desecheo Marine Reserve. They are areas designated to be limited to tourism, recreation, and education, and fishing and anchoring are prohibited. These are major steps taken to ensure the survival of those ecosystems. An area of 5009.6 $km^2$ has been mapped of the coral reef ecosystems in Puerto Rico, including the islands of Vieques, Culebra, Desecheo, and Mona (Kendall *et al*., 2001).

Currently there are 25 MPA in Puerto Rico, including nine marine reserves. The Puerto Rico Planning Board, the Puerto Rico Legislative, and the Department of Natural and Environmental Resources (DNER) with the Caribbean Fisheries Management Council are responsible for designating these marine reserves. They are managed by the Natural Reserves and Commonwealth Forests Divisions of the DNER's Bureau of Reserves, Refuges, Coastal Resources, and the Puerto Rico Conservation Trust. Under this management, the Environmental Quality Board (EQB) monitors the quality of water off the coasts and observes direct and indirect human activities that may lead to pollution. Research has been conducted since the 1960's and efforts have recently increased. In projects from the 1960's, scientists identified many species in the coral reef ecosystems in Puerto Rico, and then they cooperated with the government to set up guidelines and regulations for designating Natural Reserves. From the late 1970s to the 1990s, research focused on the impacts of environmental and human pressures. For the last 10 years, the focus of the research has been on prevention of damage to and general protection of the coral reefs. Monitoring programs were set up at

many of the sites and assessments on their conditions, in relation to all marine life in the ecosystems, are constantly updated.

The government of Puerto Rico has authority over the waters 16.7 km off the shore. The development of laws and legislations are the responsibility of the Planning Board and the Governor. Other government agencies that are involved in conservation planning and the enforcement of related laws and regulations include DNER, EQB, the National Marine Fisheries Services (NMFS), and the Regulations and Permits Administration (RPA). All agencies involved collaborate to ensure the protection and the conservation of the natural resources under their jurisdiction. Additionally, the five-year Coral Reef Action Plan (1999-2004) was set up by the Coral Reef Working Group inside the DNER, and other organizations that push to conserve coral reefs in the U.S., such as the Sea Grant program of the National Oceanic and Atmospheric Administration (NOAA).

### 2.4.3 Sponsor Information

The National Oceanic and Atmospheric Administration is a federal agency with the vision of creating a "better world through environmental and ecological knowledge and stewardship" (NOAA, 2004), funding research that will help make the best social and economic decisions for this country. One goal of NOAA, to "protect, restore, and manage the use of coastal and ocean resources through an ecosystem approach to management" (NOAA, 2004a), has led to the creation of the Center for Sponsored Coastal Ocean Research - Coastal Ocean Program (CSCOR/COP). This federal-academic partnership conducts research critical to the management of coastal ecosystems and to coastal policy decision making nationwide. The CSCOR/COP administers Coral Reef Ecosystem Studies (CRES) in Florida, Hawaii, Micronesia and the Caribbean (CSCOR, 2002a).

The CRES-Caribbean is led by the College of Arts and Science at the University of Puerto Rico. This program sponsored our IQP project, which in essence comprises the core of the CRES approach (CRES, 2002a):

- Identify and evaluate factors critical to the decline of coral reefs in the proposed study areas;
- Evaluate effective management approaches;
- Develop tools to assist resource managers;
- Evaluate socio-economic concerns vital to management plans; and
- Integrate environmental studies, socioeconomic impacts, and modeling into a comprehensive ecological study.

This project will utilize these approaches. The development of MPA in Puerto Rico will be evaluated from the standpoint of fisheries managers and stakeholders, providing a better understanding of socio-economic concerns (Mr. Valdés, personal communication). There is a lack of communication between the scientific community and the fishing community, which is a problem for knowledge-based conservation of coral reefs.

The CRES and NOAA provided the information obtained by related environmental programs. A closely related CSCOR program that will offer significant biological information is the Puerto Rico Coral Reef Monitoring program.

Fortunately, there are many organizations involved in efforts to conserve the coral reefs. Our project was concerned with policy-making organizations of Puerto Rico and the Virgin Islands, as well as fishery management organizations and NOAA (Dr. Valdés, personal communication). The CSCOR program also has many partner organizations, a combination of academic and government institutions across the nation.

Our sponsor is administered by a federal agency with the purpose of providing scientific information for policy makers. The research we conducted may have a direct effect on our subject. We were fortunate to be able to dedicate our efforts to such an important cause.

## *2.5 Organizations*

There are a number of organizations that participate in the creation and management of MPA. In order to better understand their role in this process, we must understand who they are. Each organization can contribute in different ways to the creation and management of MPA. In order to extract lessons learned by these organizations we must understand their history and role.

### 2.5.1 Conservation Trust

The Conservation Trust of Puerto Rico was established in 1970 in an attempt to safeguard not only the natural resources but also the island's natural heritage through historical sites and landmarks (Conservation Trust of Puerto Rico). Not only is the Conservation Trust focused on acquiring and conserving landmarks and natural resources, but it also helps to educate the community on the importance of these sites. Their methods are an important example that has been useful for our project. Through a study of their sites and programs we gained an understanding of how we can educate and satisfy the needs of the community in our study of marine protected areas. We looked at one of their sites, Hacienda La Esperanza. At La Esperanza, the public is able to understand the history of the site through the restoration of the various buildings and fields. This enables the public to feel what life was like in the past. Through education, the Conservation Trust hopes to spur the community into understanding the benefits of conservation, and also to create and enhance their respect for nature. The Trust works with schools to integrate environmental awareness into the curriculum and educate the young. The intent to educate the young will not only help to prepare future generations, but will also help information to trickle back to the parents and influence them as well. This will teach future generations and their parents this desired respect of nature. By enabling the public to participate in programs like bird counts and tree plantings, the Trust helps people to accept the reserves and the benefits provided to the community. The people who work for the Trust consider themselves perfectionists and being perfectionists is a great

help in their mission to create an understanding and respect for nature. The Trust devotes itself to their projects to be well thought out, well planned, and well executed.

### 2.5.2 CFMC

The Caribbean Fisheries Management Council is one of the eight regional Fisheries Management Councils established under the Magnuson-Stevens Act of 1976. This advisory board helps the federal government protect its waters. The Council is composed of 10 members, 7 that can vote and 3 that cannot, consisting of commercial and recreational fishers, scientists, and local and federal members of the government that are familiar with the ocean resource use and conservation in the Caribbean. The three non-voting members are from the US Coast Guard, The Fish and Wildlife Service and Department of State. The Council creates fishery management plans (FMP) which are submitted to the Secretary of Commerce for approval and implementation. However, activities and impacts other than fishing, such as pollution, are regulated by other federal agencies.

The Magnuson Stevens Act grants the CFMC the ability to develop and implement a fishery management plan that applies within the Exclusive Economic Zone of federal waters as well as state waters up to the shore. The Council can make decisions that will be enforced by the U.S. Coast Guard and make mandatory "recommendations" to local governments. The Council was a key organization for us to talk to in our project. They are directly involved in two of the five sites we are looking at for our project, Bajo de Sico and Tourmaline. Bajo de Sico and Tourmaline both are only partly outside of the nine nautical mile limit of Commonwealth control. Therefore, the Federal and Commonwealth governments share control of these natural reserves, so the Council worked in conjunction with the DNER to create the FMP for these sites. Their experience with the creation of FMP for these reserves was invaluable for our project in learning about the process of creation and management of MPA and the important factors to consider during this process.

### 2.5.3 Surfrider

Surfrider was first established in Malibu, California by a group of surfers who wanted to protect the ocean and the access to its waves. It is a private non-government, non-profit organization focused on protecting marine resources and the surrounding environment. They work to encourage sustainable economic growth and attempt to retard land development on coasts that need protection. Surfrider has been operating for 20 years and has grown to over 40,000 members.

Surfrider is a grassroots organization that works with the local community to solve problems and promote environmental protection. They are involved in most of the preliminary steps of setting up a marine reserve by spreading knowledge of the area, helping to set the boundaries of the area, and keeping the area clean. The decisions that Surfrider makes are meant to reflect the ideas and suggestions of the local community. Information, stories and opinion from experienced members of this group furthered our understanding of the bottom-up approach to reserve development. Further, this group helped us find further informative contacts.

This organization and the local people of Rincón have been deeply involved with the establishment of Tres Palmas marine reserve. This area has been threatened by land development that harms the coral reefs and marine area. Surfrider worked with local fishers to establish the boundaries of the marine reserve. Their most powerful and focused argument is to protect the elkhorn coral, a recognizable natural asset and officially threatened life form that has been so plentiful and healthy in that area. This marine reserve was officially instituted fourteen months ago and Surfrider is still working on refining and increasing the zoning of the marine reserve.

which is under consideration by the Environmental Protection Agency (EPA) to become an endangered species.

### 2.5.4 CORALations

CORALations is a non-profit organization started in 1995 by Mary Ann Lucking in San Juan, Puerto Rico. They attempt to identify projects that can be conducted by non-government organizations to perpetuate the preservation of coral reef ecosystems. They attempt to bring together the government, scientists, and the community to work on coral reef conservation projects together. They recognize the benefits of a grassroots approach to conservation and realize the extra time this approach often takes. CORALations engages in aggressive coral preservation activities such as coral reef reconstruction, continuous monitoring, and educational outreach programs. Through their persistence and constant concern for coral reef health they educate the local communities about the benefits to preserving the marine resources (CORALations).

To this end they came to Culebra in 1995 when they learned that the local fishers had proposed a No-Take Zone to the DNER and had been fighting to get it approved. CORALations desired to help bridge the gap between the community and the government to enable establishment of the Luis Peña Channel Reserve there. They have done a great deal of educational work to broadcast the value of marine reserves to the community and the government. In 1998, the DNER desired more public education and CORALations responded by creating habitat touch tanks that were open to the public, which were later donated to Vieques. These tanks were forms of outreach that allowed the entire community to participate and learn, including those apprehensive about underwater environments (Lucking). The touch tank exhibition is only one example of the educational and conservation activities that demonstrate the complete dedication that CORALations has towards conserving coral reef ecosystems.

### 2.5.5 DNER

The Department of Natural and Environmental Resources (DNER), also known as Departamento de Recursos Naturales y Ambientales (DRNA), was established in Puerto Rico in 1972 under Statutory Law No. 23. Their mission is

"to protect, to conserve and to administer the natural and environmental resources of the Country of balanced form to guarantee to the next generations its benefit and to stimulate one better quality of life." They attempt to fulfill this mission by promoting sustainable use of the natural resources, creating plans and methods for managing the resources, and transforming the attitude of the Puerto Rican people towards that of conservation. The DNER has jurisdiction over natural resources and systems as well as public properties. (Departmento de Recursos Naturales y Ambientales)

For this project we were most involved with the Coastal Zone Division, a subset of the DNER that is involved specifically with coastal resources. They are in charge of all MPA within the oceanic, nine nautical mile limit of the Commonwealth control. Their primary functions include the creation of new reserves and the funding, enforcement, community education, and management plans for established reserves.

## 3. METHODOLOGY

The ultimate goal of this project was to help UPR Mayaguez and Coral Reef Ecosystem Studies assess the success or failure of MPA in the Caribbean by evaluating the lessons learned from stakeholders through conservation efforts. Our team identified the social, economic, political, and technical implications of MPA in the Caribbean. We gathered information from interviews, focus groups, and literature. This allowed for a rich summary and evaluation of the complicated hurdles and opportunities for successful MPA development and management.

The project took place between the dates of March 14$^{th}$ and May 4$^{th}$, 2005. At the end, we delivered both a presentation and report on our findings to our sponsor, UPR Mayaguez. We looked at five different MPA sites in Puerto Rico: Canal Luís Peña (Culebra), Tres Palmas (Rincón), La Parguera, Tourmaline, and Bajo de Sico (Figure 6). All of the sites differ in their methods of management, schedules, and governance. We visited each site and conducted interviews with individuals familiar with the history, management, and characteristics of each

reserve. We looked at the characteristics and implications of each marine managed area (MMA, a designation including MPA and reserves with any marine element) and characterized common resource and environmental management in general. With the collection of data, we consolidated all our information into a narrative report and comparative summary of lessons learned.


**Figure 6: Map of Puerto Rico displaying the location of the five points of interest: La Paguera (1), Tres Palmas (2), Bajo de Sico (3), Tourmaline (4), and Luis Peña (5).**

## *3.1 Literature Review*

Throughout the project, we researched literature concerning the sites that we are studying, as well as documents explaining circumstances and implications of related conservation efforts. Materials included academic papers, transcripts of management planning proceedings, descriptions of legislatures and organizations, and educational materials. At each of our interviews, we asked for references to literature on each site and the social implications of the MPA on the surrounding area. This gave us a good insight of each site's social, history, and ecological context.

We chose this method because it gave us an understanding of broad concepts and numerical information that may be hard for interviewees to remember or explain. In addition, it gave us information that we may not have time to gather during the interview. The literature both added to and validated the information gathered during the interviews and focus groups and is reflected throughout the report.

## *3.2 Interviews*

We conducted formal interviews with key stakeholders that are experienced in the management and implementation of each site, as well as a number of involved scientists. The objective of our interviews was to define the process of reserve development and general considerations of the investigated sites. This gave us valuable insight into the logistics and policies of the managed areas. This information allowed us to comprehend the relative effectiveness of different management schemes and the specific social concerns involved.

In order to fully understand the problems facing the establishment of marine managed areas, such as MPA, nature reserves, and fishery reserves, we characterized the web of interactions involved. In order to comprehensively summarize the pitfalls and considerations involved in managing marine resources, we gained insight into the perceptions and roles of all those involved in or affected by the use and conservation of the resource. We identified and engaged representatives of the actor groups (fishery managers, fishers, recreational business owners, researchers, policymakers, federal and local government entities, and non-government organizations) specific to the investigated sites. In the interest of time, we sought the most knowledgeable and information-rich resources: individuals with extensive and diverse experience with marine resource management and marine managed areas. Ideally, we would have interviewed multiple members of each of the actor groups involved. However, our interviews were focused on a diverse set of individuals who collectively gave us a wide-angle view of the different hurdles and varying interpretations of the hurdles in

the path of MPA development and management. Contacts for initial interview subjects were obtained through our liaison, Dr. Manuel Valdés-Pizzini, and further subjects were obtained using the "snowball" method that identified a web of particularly knowledgeable professionals. In total, we conducted 14 formal interviews. Provided below in Table 1 and Table 2 is a list of people we contacted throughout the duration of our project.

| Name | Title/Position | Organization | Investigated Sites Experienced With |
|---|---|---|---|
| Miguel Rolón | Executive Director of CFMC | Caribbean Fishery Management Council | Bajo de Sico and Tourmaline |
| Edwin Hernández | Marine Biologist | University of Puerto Rico, Rio Piedras | Luis Peña and Tres Palmas |
| Maritza Barreto | Associate Professor of Geography | University of Puerto Rico, Mayaguez | None |
| Eugenio Piñiero | Chair of CFMC, Spokesperson for the Secretary of Commercial | Caribbean Fishery Management Council, Union of Commercial | Tres Palmas, La Parguera, Bajo de Sico, and Tourmaline |
| Ernesto Díaz | Administration of Natural Resources of the DNER | Department of Natural and Environmental Resources | All |
| Rich Appeldoorn | Marine Biologist | University of Puerto Rico, Mayaguez | Luis Peña, Tres Palmas, Bajo de Sico, and Tourmaline |
| Carlos Gaston | Realtor, Biologist | | Tres Palmas |
| Ruperto Chaparro | Director of Sea Grant | Sea Grant | Luis Peña, Tres Palmas, and La Parguera |
| Lourdes Feliciano | Secretary of Fisher Association | Fisher Association | Luis Peña |
| Luz Riviera | Dive Shop Owner | | Luis Peña |
| Mary Ann Lucking | Director of Coralations | CORALations | Luis Peña |
| Taso Soto | President of the Fisher Association | Fisher Association | Luis Peña |
| Ramon Feliciano | Ex-mayor of Culebra (1950-1980) | Municipality of Culebra | Luis Peña |
| Fernando Silva | Director of Natural Areas Protection and Programs | Conservation Trust | La Parguera |
| Damaris Delgado | Director of Bureau of Coastal Reserves | DNER | Luis Peña, Tres Palmas, and La |

**Table 1: Formal Interviews Conducted**

| Name | Title/Position | Organization | Investigated Sites Experienced With |
|---|---|---|---|
| Manuel Valdés-Pizzini | Associate Dean for Research College of Arts and Science | University of Puerto Rico Mayaguez | All |
| Debbie Boneta | Scientist | Conservation Trust | None |
| Michelle Scharer | Student, Expert of Marine Protected Areas and Fisheries | University of Puerto Rico Mayaguez | La Parguera |
| Alfonso Aguilar | Expert of Marine Protected Areas and Fisheries | University of Puerto Rico Mayaguez | La Parguera |
| Leon Richter | Regional Director of Surfrider | Surfrider Foundation | Tres Palmas |
| Graciela Moliner | Fishery Management Plan and Habitat Specialist | Caribbean Fishery Management Council | Bajo de Sico and Tourmaline |
| Robert Matos | Director of Coastal Zone Management | Department of Natural and Environmental Resources | Palmas, and La Parguera |
| Juan Agar | Fisheries Economist | National Marine Fisheries Service | All |
| Eileen Alicea | | NOAA | All |
| Ken Lindeman | Senior Scientist | Environmental Defense | Tres Palmas |

**Table 2: Interviews Conducted**

We believe this interview plan to be a valid method for accomplishing our objectives because we needed to gather a large amount of data that represents the thoughts of a diverse group of people within a set of distinctive scenarios. Also, compared to surveys, this more personal interaction with open-ended questions expedited the collection of the desired data.

We attempted to find the balance between the ecological success of an MPA and its social success with the users. In addition to defining specific perceptions, beliefs, and understandings, we gathered a great deal of information from the interviews with resource managers, researchers, and users. In defining the specific management scheme for each site, we defined the current social and economic considerations made on behalf of those affected by restrictions and where these considerations may be lacking. Specifically, we learned about the degree to which users of the coral reef participate in management planning and enforcement of the regulations of the MPA in question. We defined the role of each organization in the conservation of the reefs and their relationships with

other parties involved in reserve management and establishment. We found out if and how the organizations take advantage of the traditional ecological knowledge of resource users. We also discussed efforts of communication and education of resource users on environmental awareness and the benefits and costs of MPA.

The interviews were formal, but personal. It is important to us that we respect their anonymity where requested, and that interviewees understood that we represent an academic endeavor attempting to recommend mutual solutions to a mutual problem. Focus was directed towards individuals' needs, concerns, insights, and specific situational context. We have provided some of the critical questions below and a complete interview plan in Appendix A.

- In your opinion, what is the best way to manage marine resources?
- Could you please describe your role in the planning, management, or enforcement of MPA?
- What other groups are involved and how?
- How are users involved in conservation efforts, and what means of user education are employed?
- How does research incorporate "traditional ecological knowledge?"
- Please explain how the ecosystems approach is employed with *this MPA*.
- What factors were considered in planning this MPA?
- What is the status of the management plan for this MPA?
    - Where do funds for management come from?
    - How well is it followed?
- What were the challenges to MPA development, at this site?
- What are the challenges to developing and implementing a management plan?
- How do you feel about co-management, and what kind of co-management exists with development and management of *this MPA*?
- What are the challenges to obtaining public support and promoting public participation in MPA?
- How have the biological goals of *this MPA* been fulfilled?
- How are regulations enforced *here*?
- What are the challenges to enforcement?
- What gaps in knowledge must be resolved?
- Is an MPA the most appropriate way to (*purpose of site*)?
- Is *this* MPA successful?
- If you had a Magic wand (varita magica), the ability to change anything, what would it be?
- Will the number of successful MPA increase?
- What is the future of *this MPA* and MPA in general?

## *3.3 Focus Groups*

Our research included the observation of a focus group conducted by Dr. Manuel Valdés-Pizzini at the office of the Caribbean Fisheries Management Council in Old San Juan. A description of the proceedings including a list of participants is contained in Appendix B. Due to time constraints of the project period we were unable to conduct a focus group as originally intended. However we were fortunate enough to be invited to attend this informative event that was close to our topic of research. Titled "Fish Species in Crisis," the four questions that were asked brought forth the groups ideas on the current crisis, what has to be done, the hurdles, and their view of the future.

## *3.4 Considerations for Data Analysis*

The analysis and consolidation of the data obtained in the formal and informal interviews, focus groups, and literature review is largely subject to interpretation and realization of themes and prevalent gaps. The analysis involves a summary of perceptions and considerations in the context of each site in regards to political, economic, technical, and social factors. Further analysis involves the identification and characterization of the gaps present in reserve development and implementation. We systematically described the factors to consider in planning and implementing natural and fishery reserves. With examples of successful tactics and an understanding of group relationships, we developed an outline of considerations to make in the attempt to foster stewardship and implement the social change necessary for successful resource management.

## 4. RESULTS

Through our interviews and literature research we obtained a great deal of information regarding the five sites and MPA in general. In the following section we will inform the reader of the challenges to MPA success at the five sites and in general. We will also discuss the lessons learned by stakeholders and what the general consensus is on the future of MPA. Table 3 summarizes some of the differences in key variables in MPA development and management.

| | Tres Palmas | Luis Pena | Bajo de Sico Tourmaline | La Parguera |
|---|---|---|---|---|
| Catalyst | NGO, community members | The fishers | CFMC, then fishers | DNER |
| Patrolling | None | Some, the fishers | Yes, Coast Guard | None |
| Management Plan | In the Process | In the Process | Fishery Management Plan | Special Planning Area for Coast |
| Public Participation | Tree Planting, Beach Cleanup, Petitions, City Meetings | Early Development, Patrolling and Education, Fishing Associations | Area selection by fishers | Minimal, feedback in development |
| Education | Word-of-mouth, City Meetings, Signage | Brochures, Youth Programs, Signage | Brochures when registering, NMFS publications, Word-of-mouth | None |
| Biological Impact | Unknown | Positive | Positive | Unknown |
| Public Support | High | Waning | Support by default | High, Save a Minority |

**Table 3: Components of MPA success: Description of key variables between the sites, color coded for relative level of presence.**

| |
|---|
| HIGH |
| MEDIUM |
| LOW |

## *4.1 Luis Peña Channel Marine Reserve*

The Luis Peña Channel Marine Reserve is located off the coast of Culebra, an island 27 kilometers east of Fajardo, Puerto Rico. The area is comprised of 475 hectares of marine waters between the island of Culebra and the smaller island of Luis Peña that is located to the west of Culebra (Figure 6). The site was established with the purpose of protecting and preventing damage to coral reefs and preserving the diversity of critical habitats for endangered and threatened marine species, such as fish and sea turtles. (DNER)


**Figure 7: Borders of Luis Peña Channel Marine Reserve (Hernández-Delgado, 2003)**

### 4.1.1 Basic History, Uses

Tourism is the main industry in Culebra, having been largely substituted for the original industries of livestock, agriculture, and fishing. There is one

factory that produces medical supplies, but most of the jobs in Culebra are centered in the tourist and service sectors. Unemployment on the island is low, 3.9% in 2003. The people of the municipality of Culebra have the highest median family income in the eastern region of Puerto Rico (Estudios Téchnicos Inc., 2004). Many residents hold more than one job and some of those listed as unemployed are still working.

Even though fishing and agriculture have been replaced largely by tourism and the service sector, they are still staple industries to the residents of Culebra. With the exception of a select few, fishing is no longer a full-time job for people. However, many still use fishing to feed their families and supplement their income from other jobs.

### 4.1.2 Legal History

Starting as early as 1980, fishers of Culebra have been asking the government to close a marine area "for the propagation of target reef species" (Hernández-Delgado *et al.*, 2000). It was not until June 1, 1999 that they finally got their wish, when the Department of Natural and Environmental Resources (DNER) established the Luis Peña Channel Natural Reserve. Furthermore, on September 30, 1999, the DNER banned all fishing activities under Administrative Order No. 99-15,

**Organizations involved in the Luis Peña Channel Marine Reserve**

*CORALations*
Public education is their primary purpose. This NGO has also been trying to bridge the communication gap between the DNER and the Fishing Association.

*NOAA*
Provides funding to ACDeC to develop the management plan and guides them in the process

*DNER*
Serves as an administrative parent of ACDeC

*Sea Grant*
Provides advice to all parties employing their range of experience dealing with reserves

*Fisher Association*
Assists in education by endorsing educational materials put out by other organizations with their logo to give them local standing. This association also has political power and community standing. They feel largely ignored by the government.

*Authority for the Conservation and Development of Culebra (ACDeC)*
Its status as a commonwealth or municipality is still in debate. They are under the umbrella of the DNER, and they receive funds from NOAA for the development and management of the reserve.

making the Reserve a *de facto* Marine Fishery Reserve (Hernández-Delgado *et al.*, 2002).

The Luis Peña Channel was selected for the reserve due to its highly diverse and valuable ecosystems. Hernández-Delgado *et al.* (2002) characterized the marine life within the reserve, identifying a total of 69 species of coral. The reefs are incredibly diverse, with 221 species of fish identified, as well as a large abundance of sea grass habitats that were designated a critical habitat by the National Marine Fisheries Service on October 2, 1998.

According to representatives from the local Fisher Association, not only is the area highly diverse with several marine habitat types, an added benefit for the placement of the reserve in the Luis Peña Channel was the lack of fishing that took place there. The Luis Peña Channel used to be a very popular fishing spot, leading to a significant amount of overfishing. In addition, the US Navy used Culebra for bombing exercises for almost 75 years. The bombing ended in 1975 and left craters in the reef up to 60 feet in diameter (Figure 7). Both of these factors made the profitability of fishing in the degraded reef very low and hence, fishers used other spots to fish.

**Figure 8: Much of the unexploded ordinance left over from the Navy bombing of Culebra cannot be removed because of coral that is growing on top and around them. (Hernández-Delgado, 2004)**

### 4.1.3 Management Plan

It is unfortunate that it took so long to establish a marine reserve at Culebra, especially since the fishers realized the threats to the reef thirty years ago and there was substantial community support. Though there is still no management plan for the reserve, there is one currently in the process of

development. NOAA has given a grant to the Authority for the Conservation and Development of Culebra (ACDeC) for the development of the management plan; however, it came at the wrong time. The election for mayor of Culebra took place during the same period as work on the management plan commenced. The election resulted in a transition of political parties, therefore government operations, along with the development of the management plan for Luis Peña, came to a standstill.

Compounding this problem, there have been major setbacks in the process of creating the management plan due to opposing perceptions on community input. Through our interviews we gathered that the community feels that on multiple occasions the DNER has changed the proposed management plan without consulting them. The DNER finds it hard to communicate with the local people because of the distrust issue and failed past attempts. Unfortunately, due to this delay, ACDeC is in peril of losing the limited-time grant by failing to produce a management plan by the deadline.

### 4.1.4 Enforcement

When the reserve was established the area began to recovery ecologically; however, about three years after the establishment, community support began to wane due to perceived violations of trust and lack of enforcement by the government. Without a management plan, there is no budget, no equipment, and no set method for enforcing the area.

We have been informed that there have been six major violations of trust by the DNER that have affected the support of the reserve in the community. These violations are discussed later, but to give an example, one of these violations occurred when a DNER environmental enforcement officer was caught fishing within the reserve. He had supposedly been fishing within the reserve so much that one could tell through monitoring information where he had been fishing. Instead of disciplining the officer for his actions, the DNER moved him to a higher paying job in another department (Lucking). The DNER Secretary

subsequently released this information, which reinforced the idea in the community that the reserve was not going to work. This attitude encouraged a lack of compliance and fishers started harvesting fish once again, in the newly revitalized area.

There is currently no effective patrolling in the reserve due to the absence of an official management plan setting forth an enforcement protocol. The patrol boat has fallen into disrepair and due to lack of funds there is no money to repair it. The only patrolling that is done in the area is by the manager of Cordillera, a marine reserve 27 kilometers away in Fajardo. He can only patrol twice a week on a set schedule and as a result, poachers usually have no trouble in avoiding him. Moreover, even if there was a new enforcement officer, there is no patrol boat to use. The fishers generally patrol and report violations to the proper authorities, but the judicial process is slow and ineffective against poachers. The combination of these issues contributes to an extreme lack of enforcement. If this problem is not addressed, off-island fishers and poachers are likely to become bolder and the reserve less effective at preventing resource harvesting.

One last thing that has impeded enforcement in the reserve is boundaries that are not clearly defined. Upon creation of the reserve, a line of demarcation buoys was set. However, the DNER set the buoys up in the wrong place, such that instead of going straight across between two peninsulas, it bowed out. After the buoys were fixed, a storm washed many of them away and the DNER suspended their replacements. Also, the reserve is not marked on any navigational map, which causes further ambiguity in the boundaries of the reserve. It makes it difficult for people to remain outside the boundaries of the reserve if they do not know where the boundaries are located. This gives poachers an excuse when they are caught because they can deny knowledge that they were within the reserve.

### 4.1.5 Biological Impact

According to Edwin Hernández, over the course of the first three years (1999-2002), the reserve has been a success. Biomass increased initially between 300% to 800%. However, as mentioned earlier, community support has diminished and people have started to ignore regulations. At this point, even with the lack of compliance, enough people respect the reserve that fish populations are still increasing. In fact, grouper weighing 50-70 lbs. have been spotted where none have been seen in a very long time. There is concern that as the compliance continues to decrease, without the adoption of a comprehensive and accessible management plan, the reserve will become ineffective and the fish populations and their habitat will once again suffer.

Without an ecosystem approach to land use, biological systems have become increasingly fragmented. Deforestation and watershed pollution are the most problematic forces causing damage within the reserve. Both cause the degradation of water quality, as deforestation creates sedimentation blocking sunlight to the coral. The main problem is that deforestation, sedimentation, and pollution have widespread effects. Since these problems do not come from a point source, they are hard to control. In order to prevent against sedimentation and watershed pollution, an ecosystem approach must be investigated to extend management plans inland; the land and water are connected and need to be managed as one unit in order to protect valuable marine ecosystems.

### 4.1.6 Public Participation

There was a great deal of community support for the reserve, especially since the local fishers were the ones who originally pushed for it. Approximately thirty years ago marine reserves were an uncommon tool for resource management. The fishers realized the risk to the area around Culebra and felt that a marine reserve was a good potential solution.

Though all of the organizations were equally involved in the beginning, further into the process many felt their input was being disregarded. Many

residents of Culebra feel that they are being instructed instead of listened to by NOAA and the DNER. It is important to allow users to identify problems and potential solutions on their own in order for them to believe they are being respected. The DNER recently produced a management plan proposal with little community input, raising the likelihood that the community will oppose the plan and a new proposal will need to be created.

Another problem can be found in the marine reserve documents that are compiled by the government. Using large words and technical terms does not encourage the community to read these documents. If the community does not comprehend the materials or is not informed of them, they will be in the dark as to the status of the marine reserve. The community has generally shown support for the reserve and in order to do so, the community needs to know what they support and what actions the government is taking.

### 4.1.7 Co-management

Co-management is a delicate subject that provokes differing sentiments depending on the stakeholder. The Fisher Association and CORALations felt that their views were not being sufficiently taken into account by ACDeC and the DNER. The users think that instead of having a role and a say in their own backyard resources, they are being told what to do and not asked for input. The DNER finds it hard to communicate with the local community and the NGOs due to an ongoing distance and distrust in their relationships, but believes they are doing what is right for the health of the marine resources in their decisions.

Some decision makers consider co-management as allowing users to perform volunteer patrolling within the reserve, to educate other users, and to help with the maintenance to the infrastructure. This is not sufficient empowerment for the local community; they want shared responsibility in making decisions about regulations and enforcement of the marine reserve. They feel that the process is as much community-based as it is government-based, or at least it should be. Our key informants indicate that the community senses a lack of

control of the reserve that they are trying to create and this has led to frustration. Not only that, it has created a rift between CORALations and DNER. CORALations originally set out to bridge the gap between the community and DNER. In doing so, according to Mary Ann Lucking, she has become unhappier with the DNER than the community. They feel that the government has failed to meet its claimed responsibilities. CORALations has expressed this view to the community. This rift has hindered the establishment of the management plan.

There is a common perception that the DNER is highly politicized and politicians are motivated by their desire for votes. If there is a large majority that opposes the development of the reserve, a politician may not advance the process, and vice versa. The community and NGOs involved in the process have indicated that they feel the government wants to control the development of the reserve and leave them out of the decision-making. It is unfortunate that the local NGOs feel that the government has not effectively addressed continued community involvement. Not involving the community in decision-making further hinders the progress of the reserve.

### 4.1.8 Education

It is important to educate the community of the value of coral reefs and the benefits of marine reserves. The negative connotations that the word conservation brings has impeded support for it. Many local people we were told, hear 'conservation' and associate it with 'no'. That is, conservation indicates limitation to the user. It is the perspective of CORALations that instead of not allowing people to do something, focus must be turned towards the pride of the community. Preservation through pride is something CORALations has been working very hard for in Culebra. If the community is encouraged to be proud of their heritage, they will be more likely want to preserve that heritage.

The DNER currently has no set educational program; CORALations takes on the education responsibilities. The management plan outline provided by the DNER requires all proposals to have an outreach program, but little has been

accomplished in that area. CORALations educates the community through brochures, school curriculum, and after-school learning activities such as snorkeling. Once they provided an elaborate touch-tank exhibit for the Culebran community to enjoy and learn from. Their efforts are persistent but more funding is needed for this project to expand. The DNER has difficulties establishing budgets for educational projects due to limited funds granted to them by the federal and commonwealth governments.

### 4.1.9 Challenges

There are a number of challenges involved in the development and management of the Luis Peña Channel Marine Reserve. These problems have delayed the progress of the reserve significantly. Many of these challenges are discussed in previous sections, but emphasis needs to be put on education and enforcement.

The marine area of Culebra is threatened by overfishing, apparently mostly by off-island fishers. A significant number of the fishers are not from Culebra but are from other islands nearby. There is a great deal of support for the reserve from the fishing community in Culebra, but the foreign fishers may not share that same respect and pride of the area. There should be education programs and outreach to the community not only in Culebra but also in the surrounding islands to lessen the impact of overfishing in the reserve area.

Enforcement is non-existent in the reserve, and outreach to the local and nearby communities can increase. However, education and enforcement will prove useless if the reserve continues to be damaged by outside sources. Deforestation and construction (Figure 8) cause sedimentation, which lowers the water quality and harms the marine resources. These factors are hard to control because they stem from the center of Puerto Rico and have too many variables to address; for example, land development permits are issued in watershed areas and little is done to control erosion and sedimentation while construction is occurring.

**Figure 9: Deforestation around Luis Peña Channel Marine Reserve (Hernández-Delgado, 2004)**

### 4.1.10 What needs to be done

There are a number of actions that should be taken in order to overcome the problems discussed in the previous section. Educational and outreach activities need to proliferate so that the community can be aware of the status of the management plan and current events within the reserve. This requires that all documents are readily accessible and written in a language that can be easily understood by the general public. These straightforward documents may increase communication between the parties involved and promote good relations and teamwork.

The boundaries of the reserve need to be clearly marked and a regular enforcement officer should be trained and hired, in order to effectively enforce the regulations of the reserve. Proper equipment, such as a new patrol boat, is essential. These needs require funding that can either be raised within the community or granted as a set budget from the government.

### 4.1.11 The Future of Luis Peña Reserve

Most people when asked about the future of the reserve are unsure. The fishers indicated that as long as people can start to work together the reserve will be a permanent success. The fishers hope to one day establish many reserves all around the island, protecting other vital marine habitats. Representatives from the DNER are optimistic and think that in the long-run users will make better decisions and will hopefully have a bigger budget to work with. Mary Ann Lucking of CORALations had a less positive view. She indicated that the reserve will be successful only if watershed pollution, sedimentation and deforestation are regulated properly and controlled. Edwin Hernández agrees with Lucking on this subject and believes that an ecosystems based approach needs to be taken in order for this to happen.

Overall, the future of the reserve is less optimistic than when it was initially established; support for the reserve is decreasing. There is still optimism and hope, but the many problems encountered along the way are causing people to be less confident. If the main problems are not resolved in the near future the reserve may fail.

## *4.2 Tres Palmas Marine Reserve, Rincón*

The reserve is located in Rincón, Puerto Rico, on the western coast of the island with an area of 86 hectares. The Tres Palmas reefs are home to the rare *Acropora palmata* (elkhorn coral) which is under consideration by the Environmental Protection Agency (EPA) to become an endangered species. They are shallow reefs that are close to shore and therefore are highly threatened (Figure 9). The main stress on the coral in the Tres Palmas Marine Reserve is water pollution from land-based sedimentation and run-off. Tres Palmas is a reserve dedicated to preserving the elkhorn coral. The coral in Tres Palmas was healthy when the reserve was created and Tres Palmas is still a relatively new protected area, so it is too early to determine the biological impact that the reserve has had on the elkhorn coral colonies.

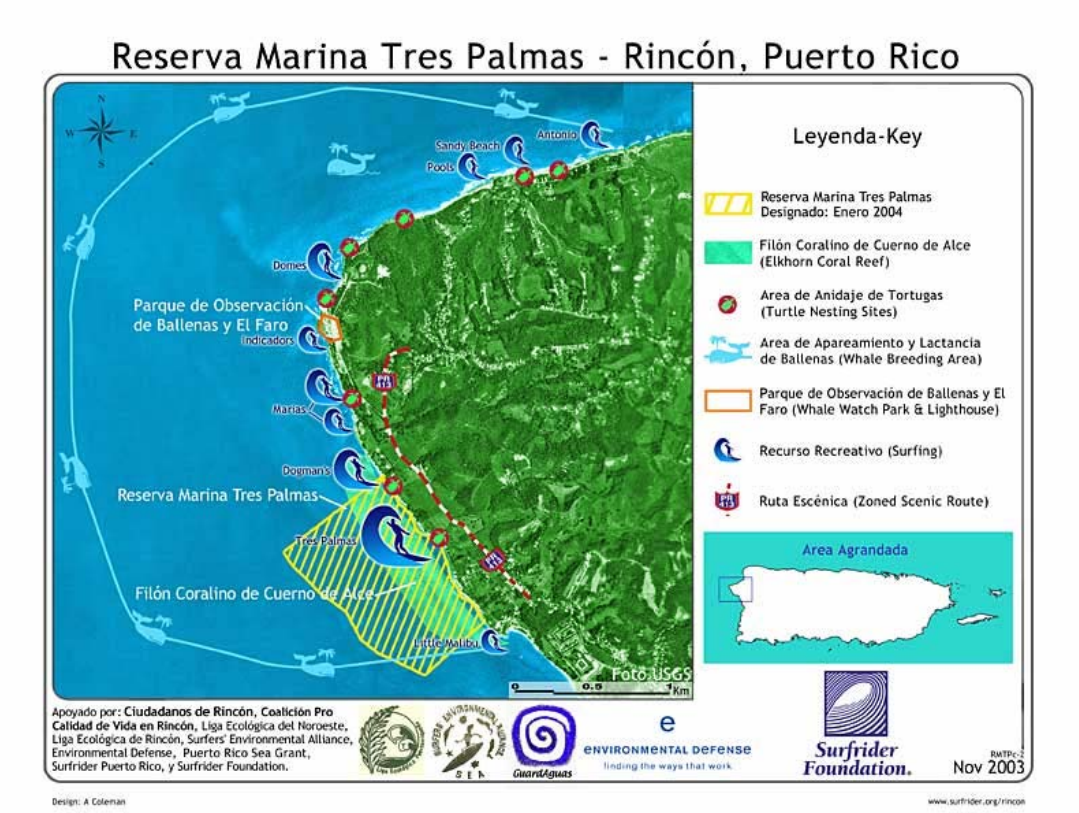


**Figure 10: Boundaries of Tres Palmas (Surfrider Foundation)**

### 4.2.1 Basic History (Uses)

Rincón has the biggest waves in all of Puerto Rico and attracts surfers from around the world. Rincón is also a tourist destination because of the great surfing and beautiful coral reefs. Approximately 40% of Rincón's economy is generated from tourism (Surfrider Foundation, 2005a). In six out of the twelve months in the year, the area is closed to the people because of the enormous waves and dangerous water conditions. The bad weather, huge waves, and shallow waters keep fishers out of the Tres Palmas area.

When surfers came to Rincón, a high priority was to protect the area that they used for surfing and recreation. However, recreational reasons were not enough to convince the government to designate the area protected under law. Therefore, they used the elkhorn coral (Figure 10) colonies as their driving force to protect the area and the main purpose of the marine reserve is to conserve and protect the coral reefs. Not only does the elkhorn coral attract tourism because of its beauty, the reefs also protect the shoreline from erosion and provide a diverse habitat for fish (Surfrider Foundation, 2005a). The Tres Palmas Marine Reserve is also under protection to further the goal of sustainable development. Many hope being protected under law will slow the process of land development nearby, since construction negatively affects the ocean and its resources due to sedimentation and pollution.

**Figure 11: Pictures of Elkhorn Coral, *Acropora Palmata*, from Tres Palmas (Surfrider Foundation, 2005)**

### 4.2.2 Legal History, Development

Tres Palmas Marine Reserve was established in January of 2004 after three years of persistent efforts by the Surfrider Foundation. It was "the first marine reserve on the Puerto Rico mainland" (Surfrider Foundation, 2005). There had been other natural reserves established, but Tres Palmas was the first reserve dedicated solely to protecting the marine resources. Members of Surfrider and environmental activists collected over 7,000 local and 35,000 international signatures in support of protecting the marine resources in Rincón. Originally, Surfrider worked with the community and a local realtor to set the boundaries of the reserve. When it was first proposed, the fishers opposed this idea because the reserve area was too big and included prime fishing areas. The fishers sought out Sea Grant's help to decrease the size of the reserve. Surfrider then worked with the fishers and Sea Grant to reduce the area so that the boundaries did not affect their fishing grounds. Once all parties were in agreement, the area was designated a marine reserve.

**Organizations involved in the Tres Palmas Marine Reserve**

*Environmental Defense (Ken Lindeman)*
Initiated establishment of marine reserve

*Surfrider Foundation*
Administers the Tres Palmas Marine Reserve

*Union of Commercial Fishermen*
Helped establish boundaries of the reserve

*DNER*
Designated the marine reserve

Although the demand for the reserve came from the community, the views of some important stakeholders were neglected in planning. There is an opposing view of the initial steps taken in the development of the Tres Palmas Marine Reserve. Surfrider's primary consultants were Environmental Defense and a local realtor, and the local community and fishers were not consulted in mapping the original boundaries of the reserve. The first set of boundaries mapped by Surfrider and the realtor were too large and affected the fishers' access to the ocean, so the fishers opposed it and sought the help of Sea Grant to work with Surfrider and reduce the size. After the fishers' concerns were

met, they approved the proposed mapping, and Tres Palmas was designated a marine reserve.

### 4.2.3 Management Plan

The fishers and the local community are working with Surfrider Foundation and Dr. Manuel Valdés-Pizzini on developing the management plan for Tres Palmas. There is no management plan currently implemented, but one is presently being constructed with the status of the funding unknown.

### 4.2.4 Enforcement

Since there is no written management plan for Tres Palmas, there is no means of enforcement. There is no funding or budget set to enforce the area. Environmental regulations have been known to be bypassed by money and government influence due to personal relationships. Tres Palmas Marine Reserve is right now simply a paper reserve, an area designated a reserve but is not serving a purpose because few actions are being taken to restrict and enforce the area. Time and money are not being put into Tres Palmas but are being put into the creation of new reserves. Tres Palmas is a reserve on paper, but there is no enforcement or protection of the marine resources at this time.

### 4.2.5 Biological Impact

Currently, there is no significant data on the biological impacts of the marine reserve because it is too early to observe any ecological response. Assessment and monitoring plans are not present until a management plan is approved and implemented.

### 4.2.6 Co-management

The use of co-management is present in the Tres Palmas Marine Reserve between Surfrider Foundation, the fishers, and the local community. They needed to work together to set the boundaries of the reserve and they are still working

together to protect the area and develop the official management plan. The fishers of Rincón are developing a proposal for a multiple-use MPA that will expand the present Tres Palmas Marine Reserve. Their intentions are to be the enforcers of the reserve.

### 4.2.7 Public Participation

There is high public support for Tres Palmas because the community was involved in the process from the start. Surfrider is a grassroots organization with an emphasis on working with the local community to solve problems. In Rincón, there are monthly beach clean ups organized by Surfrider representatives and volunteers who clean the Tres Palmas beach. These events provide Surfrider with the opportunity to talk with the local community and promote awareness of the marine reserve. The community is active and holds regularly scheduled meetings whenever new developments occur. Knowledge spreads through Rincón mostly by word of mouth and door to door education.

Tres Palmas Marine Reserve has a positive impact on the nearby populations and resource users because it keeps the resources healthier and helps maintain a unified community. Fishers support the no-take zone of Tres Palmas. They are willing to keep the area closed, partly because they do not fish in that area.

### 4.2.8 Education

The first activity that promoted awareness was the initial gathering of signatures in support of the reserve. This outreach informed the local community of the importance of the area and educated people on the resources that were in their backyards. Surfrider Foundation representatives educate the local people by word-of-mouth. They conduct regular beach clean ups and teach the people on the beach about their purpose. Those people tell their friends and family, and the word gets spread. There are frequent town meetings where volunteers and Surfrider representatives educate and inform the local community on new events.

It is also a time when the local community can express concerns or issues they have with the reserve. There is much public support for the Tres Palmas Marine Reserve, therefore the public learn and then educate others.

### 4.2.9 Challenges

One of the biggest challenges regarding Tres Palmas was initially getting the area designated as a marine reserve. It was a long, three-year process of trying to get all stakeholders in agreement. Fishers and land owners were two groups in opposition to the reserve because they felt that it would put limits on the use of private property. Now that all parties support Tres Palmas Marine Reserve, it is important to maintain the public support and participation for the prosperity of the reserve.

The protection of the watershed area and special zoning were not addressed in the development of the reserve, but are essential for keeping sedimentation to a minimum. Sedimentation stemming from the center of Puerto Rico is not being controlled and is a great threat to the coral reefs. Permits for land development are issued frequently for areas that are environmentally sensitive and unfit for developing.

### 4.2.10 What needs to be done

The management plan is being developed, so that actions can be taken to overcome the challenges. The watershed area is an issue that has been neglected thus far in the process of developing Tres Palmas Marine Reserve. It is essential for the future of the marine resources that the watershed area be zoned to control and minimize sedimentation. Another possible solution to run-off and pollution is to establish sedimentation ponds throughout Puerto Rico, including inland and along the coast.

The managers of the reserve must maintain the consent of the community in all decisions regarding the reserve and educational programs need to be established to teach people the benefits of the marine reserve. There also needs to

be better means of enforcement. If the regulations are not enforced, the reserve serves little purpose.

### 4.2.11 Future of Tres Palmas

Before one can tell if Tres Palmas Marine Reserve is succeeding in its goal to preserve the marine resources, the management plan of the area needs to be established and enforced. Many are hopeful that the reserve will increase in size and that the coral and fish stocks will be restored to their maximum potential.

The fishers of Rincón are devising a plan for a series of smaller MPA to make up one large MPA and they are willing to help with the enforcement of the area. Without more funding, these goals will be difficult to accomplish. Therefore, a budget needs to be set for the protection of Tres Palmas Marine Reserve.

## *4.3 Seasonal Closures of Tourmaline Bank and Bajo de Sico Bank*

Tourmaline and Bajo de Sico are located west of the island, approximately 11 and 18 miles from the coast of Mayaguez, respectively, at the edge of the insular shelf, and are therefore entirely aquatic. The deep ocean floor includes hard and soft corals, sponges, algal plains, sandy and hard floors and seagrass beds. These areas of 2330 hectares each have been identified as seasonal spawning areas for the red hind fish (*Epinephelus guttatus*). The purpose of these closures is to aid in the recovery of the red hind by protecting the spawning area and to reduce conflicts among fishers.

### 4.3.1 Basic History, Uses

The fisheries on the west coast of Puerto Rico have traditionally been known to be the most productive area, but landings have continued to decrease over the last thirty years. The areas of water above the insular shelf, known as Tourmaline and Bajo de Sico, are locations where aggregations of red hind form during the spawning season (December-February). During these aggregations, fish are aggressive, plentiful, and hence, extremely vulnerable. This fact is well known to fishers. Groupers such as red hind have been harvested from spawning aggregations for many years. However, increased effort and fishing pressures at these predictable aggregations have led to unsustainable loss of fish populations. After the Nassau grouper was virtually decimated in these areas and entered the protection of the no-take policy of the CFMC's 1990 Amendment 1 to the Fishery Management Plan (FMP), efforts increased in collection of red hind.

**Organizations involved in Bajo de Sico and Tourmaline**

*CFMC*
Development of Management Plan

*National Marine Fisheries Service (NMFS)*
Administrative hand of CFMC, enforcement

*DNER*
Local Cooperation with CFMC, enforcement

*U.S. Coast Guard*
Patrolling and enforcement

*Fishing Community*
Planning in later stages, enforcement

Subsequently, decreases were observed in red hind landings and fish size and even changes in sex ratios (likely a result of lower reproductive output, as harvesting interferes with spawning behavior) (CFMC, 1996).

### 4.3.2 Legal History, Development

In an effort to reverse the declining trends in the resource and help ease tensions between resource users, the CFMC worked with the DNER to identify a potential closure area that would protect the spawning grounds of red hind. The CFMC prefers to protect spawning areas rather than implementing more widespread policies, such as size limits and quotas, for several reasons. For instance, juveniles are vulnerable to the same fishing methods as adults. Furthermore, it is impossible to discriminate red hind from other species with most gears, especially in the dense spawning areas. Since the fish are removed from great depths, the pressure change kills or weakens the fish. Therefore, throwing fish back is not a viable option. It was concluded that the best way to recover the populations was to first protect the spawning aggregations.

The Magnuson Stevens Act (the same NMFS action that created the CFMC) granted the CFMC the ability to develop and implement a fishery management plan that applies within the Exclusive Economic Zone of federal waters as well as state waters up to the shore. The Council can make decisions that will be enforced by the U.S. Coast Guard and make mandatory "recommendations" to local governments. In 1985, the Reef Fishery Management Plan was implemented. This included regulations on destructive fishing methods, as well as establishing minimum size limits for two species, Nassau grouper and yellowtail snapper.

In response to the decrease in red hind populations, part of the Amendment 2 (1993) to the FMP included the seasonal closure of a three by five mile area at Tourmaline during the spawning season (December 1-February 28). During this period, no fishing would be allowed. At public hearings, it was later brought to the attention of the Council that the closed area was poorly chosen.

Although part of the area comprised spawning habitats, much of the area was not appropriate for spawning. The area contained fishing areas for other valuable species as well as sandy areas used by the fishers to store traps during bad weather. Therefore, the closed area was an undue burden on the users. The fishing community aided in the identification of two other nearby spawning areas known as Bajo de Sico and Abrir La Sierra. In the 1996 regulatory amendment to the FMP, the Council heeded the concerns of the users and the knowledge of this more effective alternative. Seasonal closures at Bajo de Sico and Abrir La Sierra were established and the area of Tourmaline was reduced. The DNER issued an administrative order that closed the corresponding areas in commonwealth waters to all fishing gears during the season. Due to there proximity, the three closures are considered a network of managed areas. However, in March 2002 the Commonwealth fishery regulations changed. Instead of banning all gears at the two sites during the spawning season, there is an island-wide ban on catching Red Hind during the spawning season within commonwealth waters. Although there will still be mortality due to bycatch, this regulation should protect the spawning aggregations.

### 4.3.3 Management Plan

The management plan for these areas is part of the 1996 amendment to the FMP and includes the seasonal closure of the sites. No fishing is allowed in these areas during this time (Dec. 1- Feb. 28). However, permits can be obtained to fish for highly migratory species (HMS), which can be selected for with certain hook types. The extent of the management plan goes as far as the closure of these areas, as well as traditional fishery regulations such as island-wide gear restrictions, size limits and species restrictions. The plan also consists of related recommendations to the local government that includes compliance with closures in the parts of the area that exist in state waters, monitoring recreational and commercial fishing activities, and the assessment of coastal effects to the reefs and related ecosystems.

### 4.3.4 Enforcement

The sites are regularly patrolled by the Coast Guard, which has the boats and manpower to cover large areas. A member of the fishing community has pointed out that the focus of the Coast Guard patrolling is on illegal immigration and drug trafficking and not reserve regulations. In addition, the officers are not educated enough to identify restricted species. Education for the officers is critical but also complicated because the officers are rotated out every several months. However, at the very least, these areas have a regular authoritative presence. Further, the fishers take it upon themselves to uphold the rules of the reserve by reminding others of the regulations and reporting violations.

### 4.3.5 Biological Impact

The red hind species of grouper is increasing in minimum length and the spawning populations and local fish stocks are increasing. In this regard, the closures are a success. However, changes made throughout the whole ecosystem should be considered when taking into account the effects of the increasing grouper populations. The director of the CFMC, Miguel Rolón, pointed out the possibility of a "Big Mama" syndrome, where a reserve that favors one species causes that species to displace others and actually reduce the biodiversity and health of the ecosystem.

### 4.3.6 Co-management

The organization of the Caribbean Fisheries Management Council provides some degree of co-management with the users and community. However, planning for the reserve included users only in the later stage. The members of the council include individuals from different backgrounds with working knowledge of marine resource management. The current chair of the Council, Eugenio Piñiero, is a lifetime fisher from the Rincón area. The meetings of the Council are open to the public and conducted after public notice. The management plan specific to these two areas is part of a much greater

management plan, one that includes Puerto Rico and the U.S. Virgin Islands. For this reason and because there seems to be no push from either side to modify the current closures, there is no running management process that the users of affected areas could participate in besides patrolling, which is, as previously mentioned, well within the ability of the Coast Guard.

### 4.3.7 Public Participation and Support

These areas are well known spawning habitats and the users understand the impact of obliterating a spawning population. These areas are currently supported by the fishers because the areas were identified by them as more sensible closures than the larger area that was previously located at Tourmaline. The fishing community also knows that if they cause these closures to fail, there are more inconvenient alternatives that might replace them. The CFMC and DNER still have alternative plans ready to be set into action, including the restoration of the larger area.

### 4.3.8 Education

Educational materials are available whenever the fishers receive and renew their fishing licenses from the DNER, submit landings documentation, or complain. The NMFS published color brochures that include a map and summary of the restrictions. Since all fishers are supposed to be licensed, all should be informed. Mr. Piñiero stated that most of the clarification of the regulations is done by word-of-mouth. The literature that dictates the regulations of the reserve are part of an unwieldy document with large appendices. Information in this form is not easily accessible to the public.

### 4.3.9 Challenges

There are currently challenges to the successful implementation of this type of management scheme (a seasonal closure protecting a single species). The health of the fish stocks is not only dependent upon protecting spawning

populations from harvesting, but also upon protecting the environments that are needed for these life stages and other critical life stages to exist. The success of this plan is dependent upon the realization of land-based effects, sedimentation, chemical and thermal pollution, the proper measures to reduce these stresses, and their effect on these areas. The management plan includes a recommendation for an assessment of coastal effects, but the extent to which these are being performed and acted upon is yet to be determined. With continuing land development, these effects are a significant challenge to maintaining the health of these and all marine areas.

Fishing gear and anchors are the greatest direct physical threat to the coral reefs. The reefs are protected from fishing gears only during the spawning season. Damage can happen at other times that could adversely effect the fish populations and the health of the ecosystem. Further, the Magnusen-Stevens Act does not allow the CFMC to prohibit anchoring in the areas. As a result, there is the constant threat of habitat damage to due to anchoring. One way to prohibit anchoring is to declare an endangered resident coral species. There are two species, elkhorn and deerhorn, that are currently threatened, but investigation into whether their status should be upgraded to endangered is difficult because the distribution of these species varies greatly.

### 4.3.10 Future of MPA

According to the director of CFMC, there are no plans to make changes to these areas in the near future. They are serving their purpose by protecting spawning grounds and there is compliance. Rolón pointed out that the situation is looking good with the current restrictions in place and that the CFMC would not want to create tensions by imposing new restrictions.

## *4.4 La Parguera*

La Parguera Nature Reserve is located along the southwest coast of Puerto Rico (Figure 11) between the towns of Guánica and Cabo Rojo. This nature reserve of 5114 hectares includes many important ecological ecosystems, such as bioluminescent bays, salt marshes, mangroves, coral reefs, keys, and islands (Garcia-Sais *et al*., 2000). The purpose of this site is to maintain its natural resources of high ecological value and provide habitat for a number of endangered species (brown pelican, mariquita, sea turtle, tinglar, and peje blanco) (DNER).

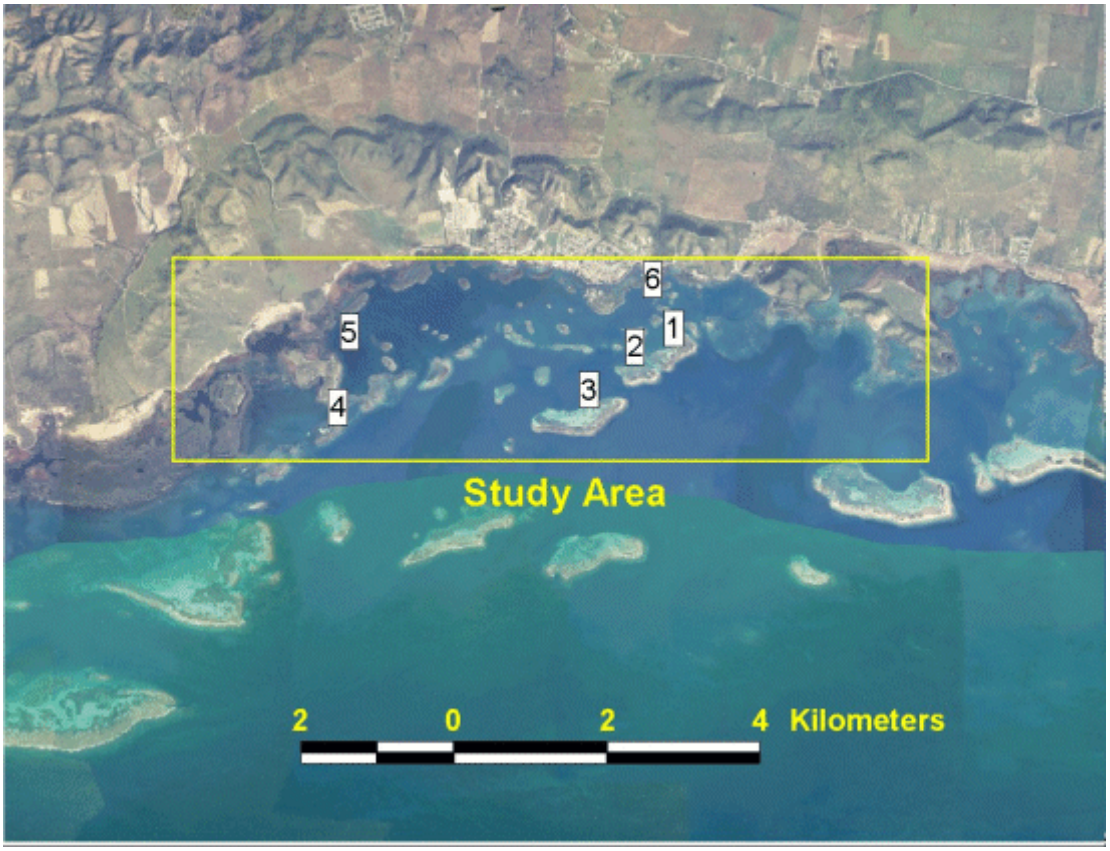


**Figure 12: Map of La Parguera Nature Reserve. The numbers represent: (1) Cayo Caracoles (2) Cayo La Gata (3) Cayo Enrique (4) Cayo Collado (5) Entrance to Canal Corto (6) Nautical Club (**Otero)

### 4.4.1 Basic History, Uses

La Parguera was originally a fishing village. In the 1930's, casetas (illegal homes built on stilts over the waters) were constructed and owned by fishers. Some of these homes do not have adequate sewage systems and are polluting the water. In the 1950's, there was a boom in the development of hotels and guest houses for tourism. Currently, the casetas are owned by lawyers, judges, doctors, and other high-income individuals. The economy of La Parguera is mostly dependent on tourism and the area is mostly fished by fishers outside of the community (Fiske, 1992; CNRI, 1999).

**Organizations involved in La Parguera**

*DNER*
Attempted to establish marine sanctuary and designated nature reserve in 1979

*Papayo Fisher Association*
Protected against establishment of marine sanctuary

*Sea Grant*
Protected against establishment of marine sanctuary

*Conservation Trust*
Acquired land in La Parguera and is conceptualizing future plans for the site

### 4.4.2 Legal History, Development

Managing the marine area of La Parguera has been the focus of much controversy. La Parguera Natural Reserve was designated in 1979 by the Planning Board of Puerto Rico and DNER. Initiated by NOAA and followed through by DNER, a marine sanctuary was proposed to the community of La Parguera in 1983. However, a strong opposition was organized by the Papayo Fisher Association.

The DNER sent a representative to La Parguera to reach out to the community for support by explaining the goals of a marine sanctuary and working with community leaders. However, when a hearing was held, many local interest groups and fishers who also sought the help from the Independence Party of Puerto Rico and other political representatives expressed their complaints. Unfortunately, the DNER was not able to establish the marine sanctuary because the newly elected governor at that time rejected their requests.

There have been continuous attempts to establish a no-take reserve since then. One of them was initiated by Reni García, a scientist from UPR Mayaguez in 1993. He received much support from the fishers in La Parguera and the Sea Grant program took initial steps toward outreach and education. Their proposed area would include the Turrumote cay which consists of developing reef areas. However, they soon learned that this area was fished by fishers who lived outside of the community and who had not been consulted regarding the plan. There was general support from most of the communities. However, it took the effort of one fisher to halt the planning for the reserve. He was a community leader that convinced the community that the reserve was not beneficial. Once again, the proposal for an MPA failed (Geoghegan *et al*., 1999).

Currently, the Conservation Trust owns some of the private land in La Parguera. Some are hoping that the Trust will play a big role in conservation at this site. Sea Grant is also trying to find solutions to protect the valuable ecosystems, such as charging rent on the casetas so that the money would be spent toward conserving the area.

### 4.4.3 Management Plan

There is currently no management implemented specifically for the nature reserve. However, there is a management plan published by the DNER in 1995 for the Special Planning Area of La Parguera. This area includes part of the inland and coastal area of Parguera. The Special Planning Area of La Parguera is meant to be a territorial extension and complement to the protection of the Natural Reserve. This management plan includes geographical descriptions, biological values, and identification of biological impacts of natural resources found in La Parguera. It also includes proposals for future projects, such as expanding the nature reserve and building a public aquarium (DRNA/PMZC, 1995).

### 4.4.4 Enforcement

Buoys have been recently arranged in the marine areas of La Parguera. These buoys are used to prohibit certain actions, such as speeding, within the nature reserve. However, there is no active enforcement present. Many of the patrollers are failed cadets who express little motivation or feel compelled to act in the same manner. They also do not have boats to travel in and as a result, cannot apprehend violators.

### 4.4.5 Biological Impact

Since there is no active management or enforcement, it is not possible to measure if the biological impacts of conservation efforts. If the community does not comply with the regulations, the measurements of the biological changes will not reflect the intended purposes of the nature reserve. One study has been conducted in 2004 by Reni García who characterized the different marine species and habitats in the nature reserve but no information has been collected on the biological impacts in this area.

### 4.4.6 Co-management

When the DNER first developed the plan for a marine sanctuary, there was little or no community involvement in the decision-making process. For this reason, some of the community felt threatened by their intentions and opposed the idea.

In the second attempt, the developers consulted the community and the fishers within the community who generally supported the reserve. However, they failed to consider those who would be affected by the reserve that lived outside of the community.

### 4.4.7 Public Participation and Support

The attempts of 1983 had not involved the community's input. However, in the following attempt, the fishers of La Parguera suggested that the area near

Turromote would be a valuable reserve and it did not include any of the areas that they used for fishing. There was support and participation by the fishers of the Parguera community for a marine reserve and not by the fishers who would be most affected by the reserve.

There is frustration felt by some of the stakeholders because of the attempts to establish a marine reserve have failed. Some of the fishing community feels that pollution by the casetas is more detrimental to the ecosystems than their own actions. They believe that until the threats from the casetas are resolved, they should not be accused for harming the natural resources. However, at least one member of the fishing community believes that it was a failure and has given up hope for conservation in this area because the site is too developed and the community will not support it.

### 4.4.8 Education

The management plan for the Special Planning Area for La Parguera proposes a plan to develop a public aquarium and an artist's exhibition. This project will include the collection and research of organisms. It will also provide opportunities to collect data and educate others about marine life and their environment. The aquarium exhibition targets Puerto Rican families and tourists (DRNA/PMZC, 1995). A time frame has not been set for this project.

### 4.4.9 Challenges

The term ‘marine sanctuary’ was misinterpreted by the community because of the sacred connotations “sanctuary” implies in the Spanish culture. This led the people to believe that no extractive or fishing activities would be allowed at all. There was another communication barrier since some of the meetings were held in English. Thus, it was difficult for the native Spanish speakers to participate. They were also afraid that their recreational fishing and tourism revenues that had driven their economy would be affected. In addition,

vacation homeowners were worried that their casetas would become public property (Fiske, 1992).

In both attempts, the planners failed to include the affected parties in the development process. This left the parties threatened by their actions and thus, resulted in failures. The first fallen attempt demonstrates the need for political support and without it, efforts for conservation can be impeded.

La Parguera is still facing many challenges that hinder the protection of its ecosystems. Currently, there is no management plan specifically for the nature reserve and any existing restrictions are not enforced. Many of the patrol officers do not have their own boats and express a lack of motivation in their work.

### 4.4.10 What needs to be done

La Parguera has been a struggle and this area requires different approaches in order to protect its valuable ecosystems. Ernesto Diaz suggested that since the management plan for La Parguera encompasses a large area, the area should be zoned for different uses instead of creating extra management plans for smaller divided areas in the large area.

### 4.4.11 Future of La Parguera

Of the perceptions gathered, our interviewees generally were disappointed and believe that La Parguera would be a great struggle to effectively protect the habitats and marine life. However, there is some hope that the Conservation Trust and Sea Grant will be important players in conservation at this site.

The Conservation Trust is developing a conceptual plan to restore a historical salt operation for education and interpretation. The project would include a visitor's center where the public could learn about the site's history, salt-producing operator, bioluminescent bays, and other valuable ecosystems in the area.

### *4.5 Future of MPA in General*

Many of the people we interviewed were optimistic about the future of MPA. There is growing interest in both conservation and the use of MPA as a tool for this purpose. Monitoring and research methods are improving. Marine resources within the reserves are generally improving in quantity and diversity and most people see the continuation of this trend. Many also indicated that a shift to an ecosystem approach is in the near future. Richard Appeldoorn (UPRM) added that he believes that both top-down and bottom-up approaches to MPA development will see the benefits and encourage this shift. Moreover, he mentioned that marine reserves are imperative to an ecosystems approach because they prohibit all human interaction: it is the only way to measure success. There are hopes that the numbers and sizes of MPA will increase. Edwin Hernández talked about legislation from 2000 that states at least 3% of the shelf must be preserved as no-take zones. Instead of increasing the number of reserves he hopes they will increase the number of no-take zones within currently established MPA.

Not all people are optimistic though. Mary Ann Lucking agrees with others that the number of MPA will probably increase but added that it won't matter if problems with water quality and pollution are not fixed. MPA do not currently protect against these factors and without adequate protection, the marine life within the reserve will be exterminated from these outside sources. Carlos Gaston indicated that the government and others are becoming discouraged by the current lack of success of MPA. Hopefully, a few presently established reserves will become clearly successful; this will validate for everyone the benefits that MPA can provide.

# 5. ANALYSIS

A number of challenges that have hindered MPA development and management were discussed during our interviews with resource managers, academics, NGOs and resource users. In this section we reflect on things we heard as potential issues and solutions. Drawing from an analysis of these hurdles and the suggestions of our interviewees, we present the lessons to be learned for the future improvements of MPA. We have looked at a relatively small set of situations and people, so the applicability of these lessons may be limited in some respects. However, these problems that occurred can be learned from and the lessons can be applied elsewhere. The recommendations and ideals presented below are the accumulation of ideas that were collected through the interviews. They represent the interpretation and consolidation of those ideas gathered through literature research and personal communications. Every attempt was made to preserve the intended messages of our interviewees, while at the same time condensing and ordering the derived lessons and adding our own perspective, where appropriate. We have sorted the challenges into nine categories: funding, enforcement, education, politics, overfishing, feedback and monitoring, public participation, management plan, and coastal effects. Each category starts with a list of the hurdles, suggested responses, and other lessons learned. In some cases, the suggested response is the realization of an identified hurdle. In others, suggestions are made for how the different parties can overcome the problem, as discussed in the brief narratives.

## *5.1 Funding*

**Hurdles:**

- Lack of funding
- Unpredictability of long-term funding
- Misappropriation of existing funds for other purposes

**Responses:**

- Funding sources and managers should plan for the long-term nature of MPA development and maintenance.
- Funding for monitoring and research efforts should be balanced with real-time enforcement.

Lack of critical funding is a prominent challenge to many MPA. The effective management of resources requires funds, not only in the establishment of MPA, but also for continued enforcement, education, and monitoring. Without a budget for an MPA, there are no means of purchasing boats and equipment, nor of hiring properly trained personnel for enforcement. It is also difficult to conduct monitoring activities to verify if the reserve is fulfilling its biological goals. Lack of funding has also impeded the development of management plans; without financial resources, there is no way to pay researchers and government workers who guide this process.

Unfortunately, few MPA have any budget at all and those that do often receive funding in pulses. Inconsistent and undependable funding is problematic. The processes that lead to comprehensive resource management and the cycles of nature are long-term. Therefore, proper monitoring and conservation require continuous funding and support. Unpredictable or short-term funding sources may cause long-term programs that are running one year to be dropped the next. Funding sources should understand the long-term nature of these projects, and resource managers should budget for it. Further, the funding sources should take into account the sensitive political nature of resource management in Puerto Rico: that it takes time and can be interrupted by political events and power shifts. For example, the change of mayor in Culebra recently held back development of the management plan .

The community and NGOs encounter significant burdens in the costly pursuit of legal actions against companies and land developers that threaten their "backyard resources" through pollution, sedimentation, and deforestation. The uneven wealth between those imposing on the environment and those fighting to save it is a great challenge to these efforts. The battlefield is more like a hill, and big industry is the king. Further, the developers can pay to have permits through virtually instantly while researchers wait months for a grant to investigate damages to the environment.

The misappropriation of existing funds is one hurdle pointed out by the director of Coralations. Mary Ann Lucking informed us that in 1995, CORALations attempted to place mooring buoys around the island of Culebra to stop damage to the reefs from anchors. Upon contacting the DNER, they were told that there was already a program to set up the buoys, yet for the past ten years the DNER had not placed one mooring buoy in the reserve. Managing agencies and academic conservation efforts have received criticism for spending greater time and funds on research, monitoring, and managerial issues rather than on real-time preventative measures. This statement should be evaluated for its validity and importance to management goals.

## *5.2 Enforcement*

**Hurdles:**

- Trust and credibility of enforcers must be maintained/recovered.
- New laws are being created without enforcing existing laws.
- Delayed/non-existent prosecution
- A lack of properly trained personnel
- Negative connotations associated with government-dealt restrictions
- Lack of funding

**Responses:**

- Enforcement should be consistent and uniform, and prosecution swift.
- Recruitment and education of rangers should be maintained at a high level.
- Presentation and language of regulations should empower rather than restrict.
- Managers should define and address the reasons behind violations
- Coordination between enforcement agencies is crucial.

Even with strong community support and education, there is a need for enforcement through a physical authoritative presence. MPA will be rendered ineffective without enforcement of regulations because there will always be people who are not aware of the regulations and those who do not respect them. It is important for managers to assess the reasons why restrictions are not being followed, so that enforcement or education can be developed in the proper direction.

Marine reserves are more difficult to enforce than terrestrial areas because of the nature of the area. Extra funding is required to obtain and maintain equipment such as boats and helicopters. The demarcation of boundaries requires maintenance (buoy replacement). A great challenge to enforcement efforts is a lack of funding for these necessary aspects.

When enforcement programs stall due to issues of funds, when there is a lack of physical presence and maintenance of the regulations, respect is lost for the regulations and the regulating agency itself. The regulating and enforcing agency (and especially its representatives) should have a positive local standing. Trust and credibility should be maintained, and if lost, diligently pursued until recovered. Respect for authority figures should be encouraged and the enforcers

should gain that respect by leading by example and abiding by their own restrictions. In Luis Peña Channel Marine Reserve, a ranger was caught fishing within the reserve. Enforcement of the regulations should be consistent and uniform. There is a tendency for those with great wealth or standing to be held above restrictions. Partiality and favoritism defeat the purpose and power of the regulations. The familiarity of enforcers with the users can lead to a lack of firm enforcement, especially in small communities. One way to maintain impartiality is to have rangers who are from another community and are able to maintain personal distance.

The prosecution of infractions should be uniform and it should be swift. In Culebra, it takes several years for a penalty to be dealt with after a documented infraction. This long process allows violators to have no repercussions for their actions and allows others to follow their path. This is yet another way that people lose respect for environmental laws and regulations.

There is a perception that environmental laws continue to be created while existing laws fail to be enforced. First, the community needs to support and comply with existing regulations before they can accept new ones. This is also true for MPA. When MPA are initially set-up, they exist only on paper without regulation or benefits. Until existing MPA prove their successful operation and the benefits can be seen, new MPA might suffer from a lack of credibility.

A problem that exists in certain sites is the lack of motivated and trained rangers. In Parguera and other areas, most of the patrol officers are failed police cadets who are not properly trained and informed of their duties. There have been instances in which rangers failed to identify different regulated species. It has been suggested that minimum requirements for rangers should be instituted, and that comprehensive education should be pursued.

Enforcement should be a coordinated effort, including the managers and enforcers as well as other agencies and users. NGOs and resource users may take a part in upholding the rules if given the chance. In some areas like Culebra, where there is no constant authoritative presence, some fishers inform others of

the rules in order to prevent an unfair disadvantage. Coordination between government and local agencies is also critical to enforcement success. For example, in Tourmaline and Bajo de Sico, which exist between commonwealth and national territory, there exists coordination between the Coast Guard, the National Marine Fisheries Service, and the DNER.

People do not like being told what to do or not do. Regulations should be conveyed in a manner that empowers the community and the individual, not in a manner that restricts them. Empowerment includes individuals realizing that respecting the restrictions will give them the power to restore the marine resources. To further complicate this sociological fact, many people of Puerto Rico, especially Culebra and Vieques, maintain negative feelings towards wildlife reserves and environmental restrictions. In the past, wildlife reserves were established to keep people out of areas contaminated with unexploded ordinances that were distributed by the U.S. Navy during decades of target practice on the islands. These types of negative connotations associated with government-dealt restrictions should be taken into account when attempting to enforce such regulations. Therefore, the presentation and language of regulations should address this sensitivity.

## *5.3 Education*

**Hurdles:**

- Must reach all members of the community and the rangers.
- A wide variability of backgrounds within target groups.
- Many methods only reach those who are interested in the effort already.
- Instilling the altruistic nature of conservation.

**Responses:**

- Use personal contact and word-of-mouth dissemination.
- Reach the community through the children.
- Use community leaders, role models, and celebrities to educate.
- Address the different needs and backgrounds of groups within the community.
- Bring common goals to light so that work can be towards a common good.
- Trust should be facilitated through openness.
- Descriptions of management specifics should be easily accessible and in lay terms.

Awareness is one of the crucial components of a successful MPA. Besides the specifics of restrictions, communities should first understand the value of the resource and its protection. They should then be made aware of the fragility of the resource and the injury associated with the loss of the resource. Educational efforts should also demonstrate the benefits of resource management and marine reserves. When the purposes of regulations are made clear, people are more likely to accept them.

Education is needed for all members of a community and the rangers who will be enforcing the regulations. Not only should the rangers be clear on the rules, they should also be able to clearly convey the importance of the regulations and act to educate users and community members through personal contact. Direct contact is a tedious way to reach people, but it is effective. Word-of-mouth can be a powerful tool; the "snowball method" (five people tell five people who tell five people, and so on) rallied much public support for the Tres Palmas Reserve.

There are a number of other methods used to educate the community. One commonly used method is the publication of newsletters and mailings. As the

major route of communication, this approach is largely ineffective. The people who read such publications typically are those that are already interested and concerned with the MPA. Educational community meetings also suffer from this effect, reaching only those who support the MPA already.

One way to reach a community is through the children, and common practice is to focus environmental education in schools, augmenting their curriculum to include marine ecosystems, natural reserves, and conservation efforts. When children are educated about the MPA, not only are they more likely to support it, but they also may spread their knowledge to their parents and throughout the entire community.

There are a number of significant aspects to take into consideration when attempting to educate the community about the reserve. The use of community leaders, role models, and even celebrities is a tactic that can make the opinions and social changes associated with resource management more acceptable.

In order to educate effectively, a trusting relationship with the community should be established by the managing agency through openness and honesty with stakeholders. This includes communicating and considering their interests as decision-makers and implementing some of their ideas. Trust is also important if management efforts are to take advantage of the knowledge of the users, which may greatly benefit the planning process. Users can share their knowledge of the conditions before the depletion of the resource, the baseline. Once a baseline is established, it should be made known so that the people can decide what they are willing to do to get it back.

It is often hard to educate the community as a whole because there is a wide variability of target groups; differences in education levels, dependence upon the resource and goals. Each group has its own interests and concerns and each party should be addressed independently. Educational efforts should exist with the realization of these differing backgrounds.

One of the hardest principles to instill in any community is an altruistic outlook, which is critical because resource management involves some degree of

sacrifice or restraint. If education can bring the common goals of all the groups to light, then people are more likely to act for the common good. Tres Palmas is such an example, where community members wanted to save their coast from development and surfers wanted to preserve the surfing area. If the people can realize their pride in the health, beauty, and heritage of their resources, then conservation becomes personal. Environmental protection should not be about restrictions, it should be about maintaining a culture and love for the Earth. This needs to be the focus of education and efforts for social change. The public should be active participants in conservation efforts so they can realize that they are the stewards of their environment, and that they can make a difference.

Educators and managers should be media savvy. They should know when it is time to publish the successes of the reserve and when to suppress setbacks and failures. The development of an MPA may be lengthy and may have setbacks that should not instill doubts and further impede efforts. Educators should also know how to make the specifics of the MPA easily accessible to the people. Lengthy technical pieces with dense vocabulary are the common form of management documents. These formal documents should be summarized and made available for all to understand. This was done for the FMP for Bajo de Sico and Tourmaline. In Culebra however, a proposed management plan was criticized for its density and size. If the particulars of regulations are not easily understood, then there may be unintentional depletion and damage within the reserve.

## *5.4 Politics*

**Hurdles:**

- MPA are too often used as a political tools for unrelated purposes.
- Miscommunication, dislike, and conflicts of interest between stakeholders and the government.
- Perception that politicians are solely motivated by votes.

**Responses:**

- Pressure should be applied by the people to instill political value on conservation.
- Communication with all involved parties, resolution of conflicts.

Politics can be either detrimental or beneficial to the process of MPA development and management, depending on whose view and which cases you are looking at. There is a perception that, in addition to the dollar, politicians equate their activity in a politically charged cause with votes. If support for a project costs votes, politicians are not likely to support it. The corollary should also be true. This means that the people that have a great deal of power to make things happen may also be the ones pressured to remain neutral or to act against it. Without the support of politicians or with politicians working against them, MPA development becomes a long process or may fail altogether.

Politics also have the ability to aid in conservation. When the people show their concern for the resources and pressure the politicians, conservation efforts may be expedited. In the case of Culebra, it was a personal contact of someone who had a connection to legislative power that finally pushed the designation through. There needs to be a political will to protect marine resources. It is up to the people to make the politicians aware of the importance of conservation.

Politics are intrinsically tied to power and when an MPA becomes a political tool of power, the effects can end up being detrimental to marine resource conservation efforts. This will undoubtedly anger some parties and cause negative feelings to be associated with the reserve. Further, an MPA that

only exists on paper, and that is set up as a "cool thing to do," as Miguel Rolón, a fishery manager puts it, will cast doubt on other and future conservation efforts by the government.

Miscommunication, ill will, and difference of interest between stakeholders can cause the process to come to a standstill. If opposing parties refuse to sit down together to discuss the issue, there is no way to resolve differences of interest. Communication is essential so that the community can voice their grievances and the politicians can demonstrate their initiatives. Focus should be paid to developing connections between the groups and facilitating information exchange.

A problem confronting Puerto Rico is an incompatibility between the Federal and Commonwealth governments. There is an apparent lack of effective communication between these two powers. This results in confusion of jurisdiction and sets another barrier that conservation efforts need to overcome. The alignment of goals and methods will be critical to cooperative management.

## *5.5 Coastal Effects*

**Hurdle:**

- Land-based damage to reefs is extensive, but lies outside the jurisdiction of most MPA

**Responses:**

- Stronger ecological considerations in land-use practices
- Establishment of no-impact areas

The coastal effects of sedimentation, pollution, and nutrient runoff can be of significant detriment to the marine ecosystems (Figure 12). However, it is commonly outside the realm of the MPA to control coastal effects. These contaminants might originate far inland or be carried from other marine areas by the currents. For resource managers, this makes the monitoring of water quality and assessment of impacts critical tasks. However, in order to stop these effects, real-time preventative measures need to be adopted on the land. Ecological considerations need to be made in the land-use permitting process, respecting the importance and fragility of watershed areas. The problems of sedimentation are not local to a reserve area, it is an island-wide issue that is affecting many marine ecosystems. Land developers are blind to the fact that their construction affects the rivers, filling them with sedimentation and pollution. Land development should adopt preventative measures such as sedimentation ponds.

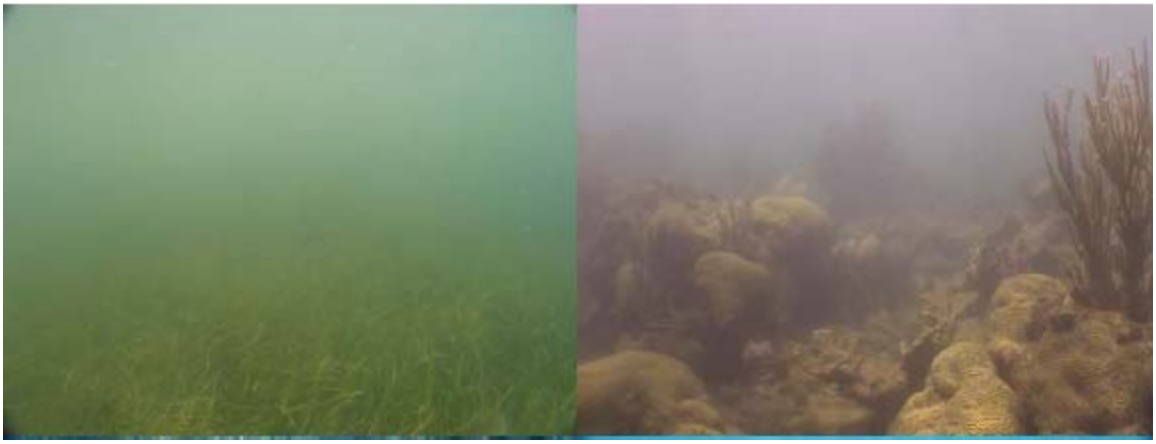

**Figure 13: Effects of Sedimentation in Luis Peña Channel Marine Reserve (Hernández-Delgado, 2004)**

In addition, land development on the coast often involves the clearing of mangrove forests. Mangrove forests are an integral part of the coral reef ecosystem. Much marine life use the mangrove roots as a habitat at some point in the life cycle. If this habitat is destroyed many of these species will likely die out. Also, if sewage is treated properly the resulting product is essentially just water which can be dumped almost anywhere without adverse effects. Unfortunately, some of the sewage treatment plants in Puerto Rico do not properly treat the waste before dumping it, releasing harmful nutrients and chemicals into the ocean.

Coastal problems are very serious, because unlike the other problems described in this section, they damage the reefs from *outside* the current MPA borders and therefore cannot be controlled through MPA management.

If MPA can be extended to the land and can dictate the use of the land adjacent to the marine area, then nearby coastal effects can be controlled. This approach is complicated by private land rights. Further, inland effects such as erosion into rivers can be just as detrimental as those effects generated near the coast. If an area can be designated as a no-impact zone, as with the protection of an endangered species or a federally designated critical habitat, then the restriction of remote damage can be pursued. Such will be the case in Tres Palmas if the elkhorn coral is elevated from "threatened" to "endangered."

## *5.6 Overfishing*

**Hurdles:**

- Benefits to surrounding areas are overexploited
- Fishing within the reserve may still occur due to lack of enforcement.

**Responses:**

- Areas near a reserve should be monitored for ecosystem health and patrolled as well.
- Vulnerability and long-term value of the reserve should be made clear to fishers.

Overfishing remains a real concern for ecosystem health and continues to challenge reserve success. Fish stocks often replenish very slowly, and without enforced catch limits or fishery closures within MPA, fishers can easily deplete this marine resource very quickly. With overfishing and the depletion of fish stocks, there comes a loss of biodiversity as species and their relationships within the ecosystem are lost. An especially damaging type of overfishing is that which takes place along the reserve boundaries. The spillover of fish from the reserve may end up worthless due to an increased concentration of fish just outside a reserve. In effect, the presence of the reserve could lead to degradation of the area around the MPA, defeating the purpose. Biological monitoring and enforcement should also address the areas adjacent to the reserve area, and there have been suggestions for the establishment of buffer zones.

Fish aggregation sites have similar problems. With large quantities of fish in one area, it is easy to take a great quantity and quickly deplete marine resources. Fishers have an inherent need to live in the moment due to their need to make money and feed their families. This makes it hard to encourage them to look at the long-term benefits of MPA. The vulnerability of these areas should be made clear to the users and management measures should provide protection. Because the news of bountiful fishing waters may travel faster and farther than news of new marine reserves, foreign fishing efforts are a significant threat to reserves. This is a cause for adequate patrolling as well as education, including the demarcation of reserves on nautical charts.

Overfishing is often considered the most significant challenge to MPA success, especially by the governmental resource managers. Fishers believe that their actions are not as detrimental to marine resources as sedimentation and watershed pollution. Both threats affect the health of the marine resources.

## *5.7 Feedback and Monitoring*

**Hurdles:**

- Employment of user knowledge and feedback is limited by trust.
- Success is relative to the scale of time, so monitoring must be continuous.

**Responses:**

- Users must trust the managers, and managers must respect the importance of the knowledge of users.
- Monitoring needs to be expanded to the economic and social impacts of the MPA.

There is a need to know how human activity and management planning are affecting the health of the ecosystem and the lives of the people in the area, so as to adapt management schemes and measures to the situation. A viable source of feedback on resource management and biological monitoring is the user group. Users often have deep knowledge of the life histories, habitats, and interactions between various species. The potential benefits of using traditional ecological knowledge in planning and management are great because it can facilitate planning and assessment by supplementing scientific research, and in some cases provide more accurate and complete information than scientific research, due to the amount of experience that fishers have with the resource. As described in the case study, the fishers of Tourmaline advised the CFMC that the closed area contained much non-critical habitat, while two smaller, valuable habitats were nearby. The act of participating in monitoring activities allows the users to better see the connection between the information they are gathering and their own actions and hopefully resource restrictions. The challenge to taking advantage of user knowledge is trust. When resource managers do not trust in the experience and validity of user knowledge, they discard potential sources of monitoring as well as a chance to get the users involved with conservation efforts. When users do not trust the motives and plans of resource managers, they are less willing to share their knowledge. Resource managers should make an effort to gather traditional ecological knowledge and at least, compare it to empirical data.

Before this can happen though, trust has to be established through open communication and education.

Monitoring the effects of a reserve should be continuous and long-term, as the success of a reserve is relative to the scale of time that it is observed. The natural cycles of the ecosystem and of species can be extremely long-term. Comprehensive monitoring includes more than the quantity and size of fish. It looks at total ecosystem health and its effects on the fish.

There is a need to define the social and economic indicators of the effects of an MPA. The ability to understand the economic and social impacts of an MPA will aid in optimizing management and will make the community aware of the benefits of the reserve, such as increases in tourism revenue.

## *5.8 Public Participation and Co-management*

**Hurdles:**

- When the government maintains all responsibilities of management, there may be community resentment.
- If community needs are not met, the development of the MPA may need to backtrack.

**Responses:**

- When willing and able, the community should be delegated responsibilities for developing and managing the MPA.
- Involvement of NGO's and community leaders promotes public participation.
- There is value in community input, for identifying problems and solutions, as well as promoting compliance.

Public participation is a necessary component to MPA success**,** and the needs of the community should be assessed during the initial steps of development. If neglected, the process has the possibility of having to backtrack when the community opposes the proposal and it does not get approved during public hearings; such was the case in Culebra. Cooperation and compromise between all stakeholders are valuable attributes to the MPA process in order for it to move forward smoothly. Cooperation can begin with open communication between the managers and the users. Often, different groups do not want to compromise and make sacrifices which halt the process. This may be one reason that community groups often feel excluded from the development process.

The community may feel resentment towards outsiders for coming in and developing and managing their environment. The community feels most familiar with their own region and when the government implements regulations without consulting them, they get angry. Resource managers should allow a community to contribute in management. They can promote compliance and also aid in the identification of problems and potential solutions during the planning process. Progress is being made in this direction as NGOs gain an increasing role in resource management. Resource managers are realizing the value of NGOs as route for public participation.

The DNER has a large amount of responsibility as resource managers; planning, monitoring, and enforcing. Co-management with the community presents a chance to relieve the government of some of these aspects of management, allowing the government to focus on those tasks that the public cannot perform. Co-management, according to the DNER, should be limited to volunteer patrolling, education of other users, and help with maintenance of the reserve infrastructure and equipment. If members of the community participate in the education of community members, they are also educating themselves in the process. More public participation may lead to achieving political support and possibly more funding.

More than one group wanting to lead the process can cause confusion and a battle for control. This has occurred between the DNER and local communities. The community loses trust in the government when environmental regulations are bypassed by money and influence. Some community members believe that the DNER is unable to listen, learn, or change. Many times the local community wants to lead the process of MPA development and management. The government has concerns that if managing powers are granted to the community, they will overstep their boundaries and take on responsibilities of regulating that are legally the governments'. Government representatives think that each party's involvement and level of participation need to be set prior to the initial movements towards establishing a marine reserve. This, they believe, will eliminate confusion, empower all parties involved, and define roles from the start.

This increases outreach and it empowers the community to take part in the conservation of the resource, which allows them to develop a connection with the area. This reduces costs for the government because they do not need to pay for personnel and equipment to accomplish said tasks. The empowerment of the local people to set and enforce regulations is not a part of DNER's view of co-management; they believe it is the legal right and responsibility of the DNER and of no one else. If the communities can understand the importance of the government maintaining those rights and that it is in their best interest, then a

level of co-management can be sustained that will benefit all. There is a balance that exists between community empowerment and government responsibility. Having only one side of the balance will not work, both community participation and government responsibilities should be utilized in order for co-management to work properly.

## *5.9 Management Plan*

**Hurdles:**
(Encompass all those previously mentioned)

**Lessons**:
- Assess the applicability of ecosystem management.
- Demonstrate benefits of management on a smaller area before expanding.
- The management plan must have clear objectives.
- All types of resource use and needs of users need to be identified.
- Maintain traditional use and culture associated with the resource.

MPA are one set of tools in the toolbox of ocean resource management. These multiple reserve and regulation types all may be appropriate in different situations. In order to manage fish stocks, the use of an MPA is combined with traditional management techniques, such as gear restrictions or species-specific restrictions, in order to protect the fish outside the confines of the reserve. Setting and enforcing these restrictions are not easy tasks.

It has been pointed out, however, that managing our ocean resources as a whole is far simpler, conceptually, than managing the parts. The ecosystems approach is a viable method, whereas the relationships between ocean habitats, human interactions, and land-based effects are taken into consideration and aligned with the cause of conservation. Resource managers are realizing the need to move away from the single-species approach of management to the ecosystem approach. The challenge is to identify the critical habitats and their linkages with the human world, for example the fish species being caught depend on the area of Puerto Rico you are examining.

Sometimes in order to create a large reserve with public support, a smaller area needs to be designated first. When the operations and values are successfully demonstrated on a smaller scale, the effort can be subsequently expanded with the support of the community.

As discussed earlier, enforcement, monitoring, and education all require continuous funding. The management plan should include plans for long-term

financing for the management of the reserve, where funds will be obtained and how they will be distributed.

Clear objectives need to be established. Without clear objectives there is no way to know if the reserve is a success or not. It is important to decide what type of management is required.

Comprehensive management requires the identification of all the uses of the resource and of the needs of all the users. To do this everyone should be involved from the beginning and their interests taken into account. The divisions within the target populations should be identified and representative contacts should be made. Biologists, ecologists, and other researchers involved in management should also understand the needs of the users. This is intrinsic to the purpose of resource management, which is ultimately people management. Further, resource managers can interact with NGOs and the community in order to find and select the best management options.

Maintaining traditional use and cultural identities is important and is a significant way for resource managers to show respect for those that they are managing. Management should plan for the maintenance of these things by allowing for some traditional use of the resource and providing opportunities for displaced users. If resource management favors the displacement of lower class people by upper class and the loss of its traditional cultures, then the management will lose the support of those displaced communities. Management should have a focus on conflict resolution between groups and work with the common goals of all the groups.

## 6. CONCLUSIONS AND RECOMMENDATIONS

There are a number of important components to MPA development and management that need to be considered. Every prospective MPA area has different characteristics and when choosing a location, the following five factors should be evaluated: (1) construction and sedimentation, (2) pollution, (3)

biological value, (4) community dependence and (5) public support. We have found these components to be the most critical to MPA success.

It is important to look for areas which are not affected by pollution and sedimentation. Otherwise these two factors would undermine any protection the MPA would give to the area from activities within the reserve. The biological value of the area needs to be assessed to validate that the value of the habitats and marine resources outweighs the cost of management, enforcement, and education. It is also important to look at community dependence on the area because significant dependence on the area may result in less community support for the MPA, and displace many resource users which might put pressure on other areas. Lastly, public support can reduce costs for enforcement of the area.

Besides these five factors it is important to evaluate MPA as an effective tool for marine resource management. Most of the people we interviewed indicated that MPA were the most appropriate tool for preservation of marine resources. However, there could be improvements to the current system. Inclusion of land-based effects into the management plan or even extension of the reserve inland is becoming imperative in some places where sedimentation and pollution are a problem. This is especially true within Puerto Rico because the amount of construction is soaring. MPA should also be extended on the water as well to include larger zoned areas around the no-take area. This will not only protect a larger area, but also create a buffer zone around the reserve. One other way to make MPA a more effective tool is to create a series of small no-take zones in key aggregation sites to more efficiently protect certain species.

MPA can be an effective teaching tool. By establishing an MPA, an educational device is created to teach people that the marine resources in that area are valuable and they should do their part to help preserve it. Ideally, marine resources would not need management. According to Ernesto Díaz of the DNER, "the most successful outcome is a system that requires the least amount of management while remaining sustainable". A self-administered type of management would be optimal, one in which the user has learned to respect the

rights of his neighbor and the rules of nature. It is only when decreasing resources are identified that management is required and institutional arrangements such as MPA must be made. If MPA proves the best solution, the challenges and lessons learned discussed in this report need to be understood and considered to promote successful resource management. An important point to draw from this report is that an MPA is only a tool; the people, not the resources, need to be managed in order to conserve the marine ecosystems. If each person takes pride in the remarkable resources that are in their "backyard" and does their own part to keep them healthy, there would be no need for MPA in Puerto Rico.

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Appendix A. Interview Plan

**In-Depth Qualitative Interview (Our annotated version)**

What Valdés has stated interest in:
*Hurdles to development of an MPA*
*Process of development of each*
*Participants and their roles*
*Success?*
Management plan and adherence
*Current state of process*
Enforcement?
*Biological Impact?*
*Use of Co-management*
*Public participation*
*Appropriateness of MPA to protect corals, fisheries, biodiversity*
*The future*

In addition to this, we're interested in:
Assessment and realization of social implications
Contextual History

Classification and Importance (➢>❍>●) of questions, exclude if covered

*Main Questions*
- o 1. Describe how the marine resources were controlled before MPA.
- ➢ 2. In your opinion, what is the best way to manage marine resources?
- ➢ 3. What is the purpose of *this MPA*?
- ➢ 4. Could you please describe your role in the planning, management, or enforcement of MPA?
- ➢ 5. What other groups are involved and how?

*Of Policy Makers and Managers*
- ➢ 6. How are users involved in conservation efforts, and what means of user education are employed?
- o 7. What is your interaction with fisher associations, and what role do they play in conservation at this site?
- • 8. How are the concerns of the community assessed and applied *here*, and in resource management in general?
- o 9. How does planning/management incorporate "traditional ecological knowledge?"

*Of Researchers*
- ➢ 10. How do you take into account the social effects of an MPA?
- ➢ 11. How does research incorporate "traditional ecological knowledge?"

*Of All*

- 12. Please explain how the ecosystems approach is employed with *this MPA*.
- 13. What factors were considered in planning this MPA?
- 14. What factors were neglected or simplified?
- 15. What were the challenges to MPA development, at this site?
- 16. What were the processes that allowed for these challenges to be overcome?
- 17. What is the current state of *this MPA?*
- 18. What is the status of the management plan for this MPA?
  - Where do funds for management come from?
  - How well is it followed?
- 19. What are the challenges to developing and implementing a management plan?
- 20. How do you feel about co-management, and what kind of co-management exists with development and management of *this MPA*?
- 21. How are regulations enforced *here* and what are the challenges to enforcement?
- 22. How have the biological goals of *this MPA* been fulfilled?
- 23. What are the effects of *this MPA* on nearby populations and resource users?
- 24. What are the challenges to obtaining public support and promoting public participation in MPA?
- 25. What kind of tensions and politics exist between the parties involved with the use and conservation that may affect the development of MPA?

*Of all Non-government*

- 26. Please describe for us your perception of the governments (Politicians, and then resource managers) motivation to conserve the reefs?
- 27. How well do they understand the problems related to ocean resource management?

*Of all*

- 28. What gaps in knowledge must be resolved?
- 29. Is an MPA the most appropriate way to (*purpose of site*)?
- 30. When we are considering the outcome of resource management efforts, what do you describe as "success?"
- 31. How do you quantify the environmental success of an MPA?
- 32. Is *this* MPA successful?
- 33. What is the future of *this MPA* and MPA in general?
- 34. Will the number of successful MPA increase?
- 35. Is there anything else that you think we should know?
- 36. If you had a Magic wand (varita magica), the ability to change anything, what would it be?
- 37. Was there anything we should keep confidential?
- 38. Are there any other people that you feel would be particularly knowledgeable about the challenges at these sites?

- 39. Do you have or can you suggest any documents related to *this MPA* or other materials that you believe would help us?

## Appendix B. List of Interviewees

| Name | Title/Position | Organization | Investigated Sites Experienced With |
|---|---|---|---|
| Miguel Rolón | Executive Director of CFMC | Caribbean Fishery Management Council | Bajo de Sico and Tourmaline |
| Edwin Hernández | Marine Biologist | University of Puerto Rico, Rio Piedras | Luis Peña and Tres Palmas |
| Maritza Barreto | Associate Professor of Geography | University of Puerto Rico, Mayaguez | None |
| Eugeñio Piniero | Chair of CFMC; Spokesperson for the Union of Commercial | Caribbean Fishery Management Council, Union of Commercial | Tres Palmas, La Parguera, Bajo de Sico, and Tourmaline |
| Ernesto Díaz | Secretary of the Administration of Natural Resources of the DNER | Department of Natural and Environmental Resources | All |
| Rich Appeldoorn | Marine Biologist | University of Puerto Rico, Mayaguez | Luis Peña, Tres Palmas, Bajo de Sico, and Tourmaline |
| Carlos Gaston | Realtor, Biologist | | Tres Palmas |
| Ruperto Chaparro | Director of Sea Grant | Sea Grant | Luis Peña, Tres Palmas, and La Parguera |
| Lourdes Feliciano | Secretary of Fisher Association | Fisher Association | Luis Peña |
| Luz Riviera | Dive Shop Owner | | Luis Peña |
| Mary Ann Lucking | Director of Coralations | CORALations | Luis Peña |
| Taso Soto | President of the Fisher Association | Fisher Association | Luis Peña |
| Ramon Feliciano | Ex-mayor of Culebra (19??-19??) | Municipality of Culebra | Luis Peña |
| Fernando Silva | Director of Natural Areas Protection and Programs | Conservation Trust | La Parguera |
| Damaris Delgado | Director of Bureau of Coastal Reserves | DNER | Luis Peña, Tres Palmas, and La Parguera |

## *Section 1: Focus Group*

*Location:* CFMC

*Date:* April 1, 2005

*Moderator:* Manuel Valdés-Pizzini

*Participants:*

Ramón Martinez – Head of Water Resources

Maria Lopez – PhD student working with Edwin Hernández in Culebra

Eugenio Piñiero – Commercial Fisherman, Chairman of CRMC

Miguel Rolón – Director of CFMC, Fisheries Manager

Mirna – Fisher licenses

Craig Lilystrom – DNER

**Focus Group**: Fish Species in Crisis

Fish are a resource in crisis. Many species are at critical stages from being captured before they are ready to reproduce and at a smaller size.

Species in danger:

Merocherno batata (almost extinct)

Carrucho

Chillo ojo Amarillo

SAMA (mutton snapper, seasonal closure on catch from April to May)

Caballito de mar

Gator

**Why in crisis?**

- Fish have certain aggregating areas and fisherman know these areas and take advantage.
- The fishermen are taking greater quantities and the size of the fish that are being caught is decreasing.
- Lack of time for fish stocks to replenish.
- There is a lack of funding, regulating, and enforcing by the government.
- More research is needed on each species.

- Lack of participation, education and willingness to learn and change.
- The fish habitats are being destroyed by land development, boat anchors, pollution, etc.
- Politics are hindering protection efforts.
- People are in opposition to the laws and regulations being set.
- Fisherman not worried about the issue, they want to work and make money.

**What needs to be done?**

- More consistent and continuous monitoring, need census for each geographical area.
- Need to educate and direct the fishermen.
- Promote awareness and outreach to the public.
- Help different groups see eye-to-eye on the problem, especially the government and the fisherman.
- Shared responsibility – burden not on one group of people.
- Negotiation and compromise between participants (co-management)
- Need education at every level – people of all ages.
- Fisherman need to get more involved in the management and protection.
- Take into account all of the factors affecting the fish – not just the fishermen.
- Everyone needs to be involved and on the same page to solve the problem.
- Need to follow through with actions and ideas for conservation.
- Limited entry, gear restrictions or no-take zones need to be established.

**Hurdles**

- Fishermen are of a wide range of ages and education levels so it is difficult to promote awareness of the problem to fishermen as a group.
- Fishermen need good news about the conservation and protection before they are able to accept and support it.
- Meetings are held to promote awareness but the same few people attend every meeting.

- Public participation is low.
- Puerto Rico lacks a system-based management office for resources like the Coral Reef Task Force.
- Actor groups do not interact and work with one another.
- Land development damages the essential fish habitat.
- Funding by the government is minimal or non-existent.

**Will the problem be solved?**

[7 people asked if pessimistic or optimistic about the issue]

*Pessimists*: 1

Gentrification

Fishers start fishing at young ages, they take a long time to learn about the problem, and by the time they are knowledgeable there are new young fishers starting off with no idea. (Never-ending cycle)

*Optimists*: 6

New monitoring and regulations seem hopeful and people seem to be more accepting and realize the need for conservation.

**Magic Wand**

[If you had a magic wand, what would you change about the issue?]

1. Willingness to learn, listen and change (Politicians)
2. Education and outreach, getting the information out about MPA impact
3. Funding, money for enforcement
4. Limited entry for fishermen.
5. Compatibility between the Federal and Commonwealth governments
6. Legislature
7. Assessment plans to control erosion (lessen the impact on the coral reefs)
8. Acceptance of the reality and status of the resources and the problem
9. Inform fishers of the science

**Things to keep in mind:**

- Economic and Social impact
- Line between recommendation and results.

- Commercial fishermen have different needs than recreational fishermen.
- We have always faced the problem of the populations of certain species of fish declining.
- Puerto Rico's economy relies on fishing; it's been a long-time part of the culture. If economy declines, need for fishing increases.

## *Section 2: Interview Summary – Miguel Rolón*

**Date:** April 4, 2005
**Location:** CFMC
**Conducted by:** Elliot Miller

**Name:** Miguel Rolón
**Agency:** Caribbean Fishery Management Council (CFMC)
**Representative of:** Fishery Manager
**Sites familiar with:** All
**Sites experienced with:** Bajo de Sico, Tourmaline
**Years experienced working on marine reserves:** 30 years
**Other background:**

**Hurdles in Process**

- **Development**
  It is hard to establish a marine reserve on the coast where the land value is high (many hotels, businesses, and land development), unless it will be for their exclusive use. It is easier to establish an MPA the farther it is away from the coast because less people will know about the MPA. However, the community still doesn't like to be in the dark and uninformed. Money is a big problem for MPA development.
  In order to overcome these challenges, there needs to be education that demonstrates the value of a marine reserve. There are benefits of preserving the coral reefs and using them for their aesthetic beauty. For example, it was demonstrated to the community of St. Croix that having a marine park would be beneficial to the tourism industry. However, the fishers had other ideas and did not support it.
- **Management**
  There needs to be money for patrol. No matter how much education and outreach is carried out, there will always be the people who don't care. Therefore, there needs to be enforcement and tools for it.

**Participation and roles**

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**Group Interactions**

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**MPA**

- **Successful Resource Management**

Successful resource management occurs when the community supports the regulations and understands why they are emplaced. There also needs to be a continuous combination of enforcement, outreach, and education.

- **Management Plan**

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- **Co-Management**

Without co-management, there will not be an effective MPA or else the cost of managing it for enforcement will be high. There are different ideas of co-management. His idea of co-management includes real decision makers (fishers, residents, housewives) as real decision makers. Allow them to participate and demonstrate that their ideas are considered the implementation of resource management. Make sure credit is given to them. It is important to establish a relationship of credibility through openness and honesty with all stakeholders.

- **Enforcement**

National Marine Fisheries Service, the coast guard, and the local government work together in enforcement.

- **Biological Impact**

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- **Public Participation and Support**

Example: The CFMC organized a series of workshops concerning the Marine Conservation District of St. Thomas before it was implemented. They brought the community, fishers, people from other islands, scientists, photographers, and politicians to debate the pros and cons of a marine reserve. They expressed their ideas and opinions. The MPA is smaller than the proposed area but the best thing is that it is supported by all the stakeholders (fishers, community, politicians, decision makers). It has been easy to enforce but there could be better enforcement. Because they found trap in the water and contacted the authorities.

Sending newsletter is not an appropriate form of user education. They invite a representative of the community to their meeting so that the community will know how to get involved in the process of development. Tell them to go to the public hearing and meetings.

As long as the original goals of the MPA are still valid and are being fulfilled, it will create support. Support can also come from role models, famous people.

**Social Implications**

Politicians should have the willingness to protect the natural resources and have marine reserves be managed effectively. NOAA doesn't have an official policy. A marine reserve is not good for fisheries unless there is a set of management measures that parallel with the reserves.

**Is MPA Appropriate Tool?**

There needs to be clear objectives.

Composed of open and closed areas
Series of marine reserves is better than one marine reserve.
Politicians only think of the votes for themselves. They will implement things that will help him. There are a lot of marine reserves called paper parks. Corruption. Brother of a minister caught fishing in a marine sanctuary. No one cared.

**Future of MPA**

Tres Palmas is in the process of establishing itself in the community as a reserve.

Bajo de Sico and Tourmaline will remain the same because they have specific objectives of protecting spawning grounds. These areas are supported by the fishers.

Culebra has a lot of community support and will have a good future. Since 1985, it took the government a long time to set up the MPA. The fishermen are fishing around the reserve but they have problems of enforcement because of the fishers not from the area.

Paguera is a struggle for the Planning Board because it is a big MPA that needs different approaches.

**Recommendations:**

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**Other:**

Bajo de Sico and Tourmaline were implemented by CFMC and send it to the Secretary of Commerce.

## *Section 3: Interview Summary – Edwin Hernández*

**Date:** April 6, 2005
**Location:** UPR Rio Piedras
**Conducted by:** Jillian Yao

**Name:** Edwin Hernández
**Agency**: UPR, Rio Piedras
**Representative of:** Researcher, Reserve Manager
**Sites familiar with:** All of them, through diving.
**Sites experience with:** Most of his work has been with Culebra. He worked with the

> Tres Palmas group, who was using the lessons of Culebra MPA development. He was dropped from the team when he was removed from the Culebra project for "having a different style of doing things."

**Years experience working with marine reserves**: With marine reserves since 1992. He

> worked with Culebra since 1996. He is the author of the technical documents for Culebra submitted to DNER for use in development of the

management plan. As a scientist, he observes the changes in life within and without the reserve to gauge the effect of threats and conservation efforts. Now works with Fisher Associations to supply biological advising.

**Other Background:** Professor of Marine Biology at UPR Rio Piedras

**Process**

The fishers were concerned about the health of the coral ecosystem after decades of military bombing. They have been asking the DNER for a reserve since 1980. It took nearly two decades for the government to listen. At one point they worked with Sea Grant with Chaparro, but still failed. Finally they got a proposal through with a scientist though the municipality (through a political connection).

There was a challenge of establishing "where and how much." In the beginning meetings where held with the people of Culebra and the secretary of DNER. This included a lot of user interaction in the beginning. Things changed later with the management process, with a resistance to share wider managing powers.

There is currently a rift between the municipality and ACDeC over who should lead the project. This may lead to a collapse of the project. The stakeholders are seeking alternative means of managing the resource.

**Hurdles in Process**

- **Development**

The multiple routes of establishment ("it's a mess")

1. DNER makes environmentally concerned suggestion to Planning Board, supported by scientific documents, PB makes decision
2. Declared by law (ex. Desecheo, Tres Palmas)
3. Administrative order of the Secretary of DNER - under law 278 (Luis Peña and Mona were administrative orders)

This multilevel framework makes things more complicated.

- **Management**

Monitoring efforts in PR have been extremely limited. Culebra has the longest running fish community monitoring program (since 1997). Everywhere else lacks replicate data over long enough amounts of time. So far they have no comparable data.

The government does not understand the threats and problems. Some parts of the government are implementing conservation-minded research and management, but the government of PR is being quite flexible with environmental regulations in order to benefit developers (the "fast tracking process"). Requirements ten years ago were stronger than today, guaranteeing public hearing and environmental impact assessments. Now the community involvement is frequently skipped.

**Participants and Roles**

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**Group Interactions**

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**MPA**

There was no community-based management before the MPA (open access).

- **Management Plan**

Puerto Rico has one approved management plan (Hobos Bay Natural Estuarine Reserve, DNER and NOAA), done with a top-down approach, involving community only at the end.

In Culebra, it started with sitting the people down and involving them in what management schemes would be established. Funds were received through the Authority for the Conservation and Development of Culebra (ACDeC), under the umbrella of DNER. The status of the organization (as commonwealth or municipal organization) has been in debate since the Autonomous Municipalities Act.

Culebra is most likely losing their funding. Since 2003, after 2 years, there is still no product (management plan). The problem is the lack of trust and violations of trust by the government towards the community. For example, one Vigilante, a member of the environmental police was caught fishing within the reserve. The patrolling vessel was rumored to have been seen fishing. In another violation of trust, they stopped listening to some partners of the project. They fired Edwin. They are changing the management scheme without consulting the community. Fishers and the community are almost dropping from the project. The mayor, chair of board of directors of local authority for the conservation and development of Culebra, "mixed politics with other stuff", is making changes and "pissing off everybody."

Bring in the people, scientists, government, and community and brainstorm the ways to establish a management plan.

- **Co-management**

There is an increasing realization of the importance of co-management. The more entities that are involved in the process that have a role in some part of the conservation, the better. Appeldoorn and Lindeman published a paper outlining the correlation between co-management and success and compliance (planning and participation).

The people want to participate and will help enforce the regulations. Co-management will promote compliance. For some reason, the people's management plan in Culebra is not getting through.

Culebra – A board of fishermen, ACDeC, DNER, and a working group including

scientists, NGO's, Environmental Defense (Ken) and other organizations and groups as sources of information. There is an organized group of fishers, recreational service providers, and citizens. However, the government high jacked the process. Some people within the agency, including the former secretary (who was this?) never trusted the process of engaging the community. There are some examples where it worked perfectly, such as Bosque de Pueblo, successfully started and implemented

by the community. The people beat developers twice and had the government acquire the lands and create a state forest.

- **Enforcement**

In Culebra, the patrol boat has fallen into disrepair. The manager from Cordilleta, Fajardo has to monitor the area and was the one who caught the fishing officer.
The fishers perform most of the patrolling in Culebra. They observe what is happening and make visitors aware of the regulations. The fishers have stopped the university vessels in the closed area.

- **Biological Impact**

For the first two years, the populations boomed (refer to report on disk). The surrounding areas slowly increased. Since they now lack a functioning boat and a daily presence (patrolling twice a week from Cordilleta), and the combination of the lost of trust, many people stopped complying. Compliance has dropped due to loss of trust and poor management. Regardless of problems, fish populations have increased by hundreds of percents, but are still not as high as they used to be.

- **Public Participation**

The people want to participate. However, if there is a problem with the government, there is a loss of compliance. The people need to know about it. There needs to be a formal education set up. In the public schools, there has been progress directing the curriculums. Work produced by graduate students at UPR and others have been used for curriculum development in terms of marine science for kids. Sea grant helps with the education, providing materials. DNER has no program to promote understanding the importance of coral reefs. Government is now forcing all proposals to include an outreach effort, but they need to follow up themselves.

**Social Implications**

Gaps in knowledge exist of socio-economic impacts. Manolo was the first one to get these studies going. It is not a priority for the agencies. It will remain up to the individual scientists to look into this.

**MPA Appropriate Tool?**

**-----**

**Future of MPA**

Legislation from 2000 that states at least 3% of the shelf is preserved as a no-take reserve. The local government is working with the Coral Reef Task Force in order enhance management. Instead of increasing the number of reserves, they will increase the number of no take zones within those reserves.

The future of coral reef and fish needs to focus on the ecosystem approach. Single-species approach misses many things. Spawning grounds and all life-stage areas must be protected (nursery grounds, water column, mangrove, rocky bottoms, sea grass, back reef, deep reef). If you manage from an ecosystems approach, you are managing a functional group of species. [ecological roles, connectivity, biodiversity]. A broader systems approach is

necessary. Since Luis Peña is a no fishing reserve, it is approaching the ecological view. At the experimental level it is working.

**Recommendations**

Fishers' knowledge must be included, especially when identifying important spawning aggregation areas. You must engage their trust in order to use their knowledge, which is greater then anyone else's.

Scientists need to get into the decision-making levels of the government.

**Other**

Successful Resource Management:

> Success depends on whom you ask. DNER may tell you that they have been successful. The area with the greatest enforcement is Cadilleta near Fajardo, which is also threatened the greatest by recreational activities. There are still gaps, which prevent full success. Zoning for uses of resources are not established within reserves. We do not know the background status and the impact off activities on these areas. If you can not measure this, you have no idea if you are successful.
>
> Culebra has not been successful. The lack of management, patrolling and demarcation has led to a loss of fishers from the area because of increased in poachers. With no demarcation buoys, education, or even a presence in the area or on nautical charts, people do not know where the reserve ends and begins, so it is easy for poachers to move in.
>
> To measure success you have to look at social and economic indicators. Valdés and Edwin are working on a project at Cordilleta figuring out the best way to identify areas for no- take reserves, assembling social and empirical science. As for indications of success, he could not answer, "because that is the issue"

Coral reef rehabilitation stage- artificial reef growing. Elkhorn and Staghorn have been established as "threatened." Too many information gaps exist to declare them as "endangered," yet numbers have decreased greatly in areas. In this project they are using TEK to identify the areas with the reefs used to be. Eventually they will begin to reconstruct the areas.

There has been an increase in scuba diving within the Culebra reserve. People realize that there are more fish, that the reefs look better. No body is monitoring increased in visitors or revenues, but they should be.

On the importance of fishing ,most are part-time. The area has a strong pull for recreational fishers. The majority of artisanal fishing is reef-related.

The government is beginning to realize the money in conservation. People want to see natural healthy areas. "The less, the better."

**Documents Received**: Culebra Technical Documents and Management Plan draft. The status of the reserve and the status of resources in Culebra are on disk he gave us. It includes ten alternatives, and the suggested management plan (which the DNER rejected, a working document much smaller than the DNER behemoth, with its appendices).

**Contact Received**:
Theresa Televast, NWF
Lourdes Feliciano, Secretary of Fishing Association
Ramon Feliciano, Fisher and former mayor
Taso Soto, President of FA and former mayor
Mary Ann Lucking, Coralations

## *Section 4: Interview Summary – Maritza Barreto*

**Date:** April 6, 2005
**Location:** UPR Rio Piedras
**Conducted By:** Mary Desrosiers

**Name:** Maritza Barreto
**Agency:** UPR Rio Piedras, Associate Professor of Geography
**Representative of (actor groups):** Researcher/Scientist
**Sites familiar with:** Familiar with sites, but not marine reserves
**Sites experience with:** None
**Years experience working on marine reserves:** 18 years coastal studies, not MR
**Other background:** Coastal studies of sedimentation and erosion around the island

**The Process**

A good plan for research, biology, and anthropology is necessary.

**Hurdles in Process**

- **Development**

There is usually a great deal of resentment about outsiders for development and management. Community members think that outsiders want to tell the community how to live and they do not like this.
The Puerto Rican government is interested in fast track development, which is only concerned with short-term benefits.

- **Management**

There is a misconception by the community of what a marine reserve is.
Consultants for the government are not very knowledgeable, they often give advice to sound important but that is wrong.

**Participants and Roles**

Only three offices really question development instead of signing legislation immediately:

- US Fish and Wildlife Service – appears to have a lot of power
- Planning Board
- DNER

**Group Interactions**

Autonomous Municipalities creates fighting but also gives more power to say no.
Government interest in conservation depends on who is in charge.

**MPA**

- **Management Plan**
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- **Co-Management**
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- **Enforcement**
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- **Biological Impact**
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- **Public Participation**

  In collecting Traditional Ecological Knowledge, you are also training the community to understand and notice connections between their actions and the effects on nature.

**Social Implications**

The main implication of marine reserves is the feeling of displacement.

**MPA Appropriate Tool?**

Do not take marine resource management as simply a scientific study, educate the community and acknowledge their concerns.

**Future of MPA**

If no new initiatives are introduced, MPA will not be successful.

**Recommendations**

Permanent site studies must be established instead of short studies before moving on in order to understand long-term effects.

**Other**

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## *Section 5: Interview Summary – Eugenio Piñiero*

**Date:** April 7, 2005
**Location:** CFMC
**Conducted by:** Martin Driggs

**Name:** Eugenio Piñiero
**Agency:** Caribbean Fishery Management Council, Union of Commercial Fishers
**Representative of (actor groups):** Fisher, CFMC Chair, Spokesperson of Union of
Commercial Fishers, Administrator of the fishing village in Rincón
**Sites familiar with:** All, especially Tres Palmas
**Sites experience with:** Tres Palmas, Bajo de Sico, and Tourmaline
**Years experience working on marine reserves:** Commercial fisher for 25 years, Chair
of CFMC for 5 years

**Other background:** He has been fishing and surfing since he was 5 years old.

**The Process**

The original attempt at Tres Palmas was an unnecessary waste of effort because the fishers were not consulted in its creation. Surfrider Foundation contacted the wrong people with their first primary consultant being a realtor. The original mapping by the realtor and Surfrider affected the fishers' access to the ocean, but not the properties of the realtor. The fishers opposed this initial mapping, and sought out Sea Grant's help to reduce the size and boundaries of the proposed reserve. After the size reduction and the fishers' concerns were met, the area was designated a marine reserve. Six months of the year the reserve is closed to the public because of the enormous waves and the dangerous conditions in the water. The bad weather, huge waves, and shallow waters cause the fishers to stay out of the area anyway and not use it for fishing. The main purpose is to protect the elkhorn coral. This species of coral is in danger and makes the marine reserve possible.

The DNER initiated the original area closure of Tourmaline. It is closed 3 months out of the year and is a result of pressure from the fishers and managers to keep it closed. The fishers are participating and leading the cause.

**Hurdles in Process**

Funding – more money needed for outreach to the public in the development and management processes.

- **Development**

  The steps taken in developing Tres Palmas were from the top-down approach, it was political instead of consulting the fishers and community. The initial boundaries affected the fishers' access to the ocean. There was no regard for socio-economic impacts.

  La Parguera is overdeveloped and is a boomtown filled with tourism, and therefore the local people do not support a reserve. It is very sad that La Parguera is a failure and hopefully the same will not happen in Rincón. There are not suitable marinas.

  In the initial stages of developing Bajo de Sico and Tourmaline, there was resistance from the fishers because of lack of knowledge. Fishers indicated the spawning areas and helped designate the closed areas.

- **Management**

  There is a lack of enforcement and outreach to the public. Marine reserves should be managed by stakeholders without the intervention of politicians. Politicians don't understand the importance of conserving the environment. Therefore, they create misinformation and mistrust to the stakeholders. The managers need to take into consideration of the history and way of life in the area. The government shouldn't spend more money on establishing new laws but spend it on enforcing the laws they have now. Currently, the status of the money for management is unknown. Coastguard and fishers are not aware or are unclear of the current regulated species. Example: Coastguard approaches a fisher and says the

fisher cannot fish in that area, but the fisher shows the coastguard the written regulations to prove that it is not a restricted area and that the coast guard was wrong.

Bajo de Sico consists of Federal and Commonwealth components. Areas in Federal waters are closed while areas in commonwealth waters are open during the 3 month seasonal closure.

**Participants and Roles**

Eugenio Piñiero – gives guidance and advice to stakeholders and decision makers.
Surfrider Foundation
Union of Commercial Fishermen
Town of Rincón
DNER

**Group Interactions**

The Environmental Defense Agency has been helpful to the fishers in their concerns with the conservation.

The local and federal governments that share jurisdiction of Bajo de Sico and Tourmaline work together. If there was no compliance with one another, the reserve would fall apart.

The politicians do not communicate well with the stakeholders.

Need to distinguish between government, middle managers, and enforcement.

The NGOs have failed in Puerto Rico. They bring people that do not speak Spanish to a Spanish speaking place and therefore cannot communicate well with the community. If they want to voice their opinions there should be knowledge and effort demonstrated from them. They should live and experience the life of the fisher community.

**MPA**

- **Management Plan**

Bajo de Sico and Tourmaline have management plans that are followed well – no one "cheats".

The status of the money for management in Tres Palmas is unknown. It may be a matter of months until the management plan is completed.

- **Co-Management**

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- **Enforcement**

Illegal immigration and drug trafficking boats come to the west coast of Puerto Rico from the Dominican Republic. The Coast Guard strictly enforces the waters for these illegal boats, but there is little enforcement of the reserve regulations. The fishers help enforce the reserves because they want to protect the area and it is unfair if people fish there if they cannot.

- **Biological Impact**

Tres Palmas is the only reserve dedicated to preserving elkhorn coral, and the coral there is healthy. Too early to determine biological impact being recently designated a marine reserve.

The Red Hind species are increasing in size and the stocks are replenishing at Bajo de Sico and Tourmaline sites.

La Parguera is a failure; no one knows what is there.

- **Public Participation**

There is door to door education. The community is very diligent about developing and demanding the measures for adverse impacts not only from water but also from land. The community is active and holds meetings whenever new developments occur.

Bajo de Sico and Tourmaline user education is low. There is mouth-to-mouth communication to clarify regulations.

**Social Implications**

Through awareness the community will develop a connection with their natural resources and give them a sense of pride.

**MPA Appropriate Tool?**

Tres Palmas has a positive impact on the nearby populations and resource users, it keeps the beach healthier.

It is a tool but there are better methods, such as: seasonal closures, gear and size limits

No-take areas are an easy way out because do not consider the social and economic impacts.

MPA benefits: soul, community, and economy.

**Future of MPA**

The fishers of Rincón are proposing a multiple-use MPA that will expand the present Tres Palmas Marine Reserve. Tres Palmas is a no-take zone but the fishers are willing to keep it closed because it does not affect them. The expansion of Tres Palmas is being proposed and analyzed by the fishers, and the fishers plan on being responsible for its enforcement.

There is a good outlook if done with the consent of the people and using the bottom to top development process. The number of MPA will hopefully increase if more measures are taken and if people stop assuming that the environment will preserve itself.

**Recommendations**

The best way to manage marine resources is through enforcement and education. Money and time needs to be put into education. Experts need to visit schools with photographs and information to educate the community. Users and stakeholders need to be educated too. Show that conserving the reefs protects their beauty and enhances the wealth of the community through good, clean tourism.

There should be an outreach program set that when fishers apply and get licensed they are also given a list of the laws and regulated species in their area.

Promote outreach to make the environment a high priority.

Put money into education and enforcement.

**Other**

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## *Section 6: Interview Summary – Ernesto Díaz*

**Date:** April 8, 2005
**Location:** DNER
**Conducted By:** Elliot Miller

**Name:** Ernesto Díaz
**Agency:** DNER
**Representative of (actor groups):** Policy Makers
**Sites familiar with:** All
**Sites experience with:** All
**Years experience working on marine reserves:** 20+
**Other background:** Former Coastal Zone Director

**The Process**

There is no designation for Marine Managed Area (MMA).

Marine Reserve – defined by legislature, clear management objective, used for protecting an area not managing it, maximum level of protection

Natural Reserve – They have three goals, to restore, to manage resources and to preserve. They are the most commonly utilized tool and are recognized by the planning board.

There are three methods of restoration: natural restoration (where nature recovers without human assistance), assisted restoration (where humans aid nature in returning to its original state), and enhancement (where humans aid nature in changing to a habitat that was not its original).

The Macro Approach is the concept of looking at Puerto Rico as a whole for planning.

The Regional Approach breaks Puerto Rico into either economic or administrative regions for planning.

Sectoral planning takes into account only one sector of the economy for planning, for instance economic, infrastructure, etc… sectors of the economy. This is bad because it does not take into consideration factors from other sectors

When looking at the different ways to establish an MPA, use case-by-case basis, if it works it does not matter which approach is used.

**Hurdles in Process**

- **Development**

  User concerns need to be integrated early on, or you will run into problems later for example when you have to repeatedly revise the management plan so that users are satisfied. Bringing everyone on board, collecting all the Traditional Ecological Knowledge (TEK) and concerns of users to successfully balance them is very important but also hard to do. Altruism,

getting users to place the needs of Puerto Rico and environment over their own, is something that is very hard to create.

If the MMA is completely in water it occupies only public lands, however in the case of Parguera land tenure is a big issue. In order to establish an MMA on land, the land must be purchased from its original owner.

A lack of economic resources and personnel hinders the development of the MMA.

Disagreements between neighbors are a common problem, not just within the community but also between reserves.

Gaining trust from users of the government and maintaining it is often hard, but showing that you are reliable

- **Management**

Altruism is necessary for management as well; resource users need to follow regulations even if it does not coincide with their own interests.

People are used to doing things a certain way, changing patterns of use and attitudes can be very hard, it can cause them to fear a loss of identity.

**Participants and Roles**

Fishers and Community – provide TEK which is often more reliable than scientific

information, if it agrees with science you can be almost 100% sure of what needs to be done, if it does not agree you need more evaluation of what to do.

Rangers – much of their purpose is for education and enforcement.

**Group Interactions**

Tour boat operators and fishers have to get registration for boats; the DNER uses this opportunity for education by giving them information.

Boy Scouts and other similar organizations help with outreach opportunities thereby broadening the range of people that can be educated.

**MPA**

- **Management Plan**

The management plan for Luis Peña and Tres Palmas is currently under development.

A management plan for Parguera has existed since 1995, but there is no management plan specifically for the reserve.

- **Co-Management**

Co-management is a very important tactic; recurrent users that are interested should be viewed as allies and integrated as much as they are able and willing to be.

In the Stratton report hourglass, finding the balance between community empowerment and government responsibilities

Opportunities for co-management are there but not yet fully exploited.

Bosque de Pueblo, though not an MMA, is a good example where some responsibilities are placed on the community, with DNER keeping responsibilities that cannot be distributed.

- **Enforcement**

Marine areas are harder to manage than terrestrial areas. Boundaries are not well designated and in order to enforce resources must be allocated for boats or helicopters for use in patrolling. Coordination with other agencies and private or government users is absolutely necessary.

- **Biological Impact**

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- **Public Participation**

Empowerment is crucial, the individual is the key component and by creating the opportunity for them to participate gives a connection to the reserve. Interaction with NGOs and community is necessary to collect the best management options and implement them.

Outreach to community is important and is most effective with direct contact. Fisher associations are relied on somewhat for statistics from fishers' everyday sampling. The relationship with government is very good in some places, though not always, but regardless the DNER recognizes the benefits of good relations.

**Social Implications**

Applying concerns and perceptions of resource users is the most important part to MPA development/management. New curriculum at schools is used for outreach.

**MPA Appropriate Tool?**

If you have a healthy resource base, with no conflicting uses, you do not need any management options. The most successful outcome is a system that requires the least amount of management while remaining sustainable. If user gets to the level where he respects the rights of his neighbor and the rules of nature, we can move towards a self-administered type of management.

If decreasing resources are identified, then management is required, and institutional arrangements need to be set, these institutional arrangements were basically derived from national and international views on sustainability.

**Future of MPA**

There is one major gap in knowledge that needs to be filled in the future. It is hard to judge the threshold for sustainability until after you pass it, there needs to be better ways to identify this threshold.

All sites will improve in consciousness and enforcement, growing slowly but surely. The number of successful MPA will hopefully increase.

Work needs to be done on knowledge transfer between managers, academia, users and the community at large.

**Recommendations**

If a larger management plan already exists, such as in the case of Parguera, instead of doing an extra management plan for a smaller area, zone the original management plan for use.

Use different types of MPA for different purposes, for habitat protection use natural or marine reserve, for fish stocks use seasonal closures, the important thing is to know what tools are there and what options are available.

If Diaz had a magic wand, it would be hard to pick one thing. He would change the attitude towards 'the golden goose', an increase in good neighbor practices and less reliance of the reserve on enforcement and more on good consciousness.

**Other:**

Talk to Cladimar Diaz, the Director of the Planning Division of DNER, he has a good outline of management plans.

## *Section 7: Interview Summary – Carlos Gaston*

**Date:** April 12, 2005
**Location:** Realtor's Office in Rincón
**Conducted by:** Jillian Yao

**Name:** Carlos Gaston
**Agency:** Realtor of Rincón
**Representative of (actor groups):** Local Business Owner, Biologist, Environmentalist
**Sites familiar with:** All, especially Tres Palmas
**Sites experience with:** Tres Palmas
**Years experience working on marine reserves:** Since the beginning
**Other background:** He has backgrounds in Biology and Real Estate Development, and
is against excessive development.

**The Process**

The greatest threats to the reefs are sedimentation and pollution from non-point sources, with overfishing a lesser risk. At first, the surfers that came to Rincón wanted to protect the area they use for surfing and recreation, but the coral reefs were used as the primary reason to push for the reserve because recreational reasons were not enough to convince the government. The original attempt at Tres Palmas was to declare the whole area, including the land, as a Natural Reserve. This would have to involve purchasing private land from the government and so the attempt fell through.

The purpose of Tres Palmas is to preserve the Elkhorn coral population that lives there and to permit the area to redevelop itself because it has not since been protected from destructive human activities. The marine reserve will help the coral and fish populations replenish. The main factors that were considered in planning Tres Palmas are the existence of the elkhorn reef and recreational surfing.

**Hurdles in Process**

- **Development**
  The steps taken in developing Tres Palmas were from the bottom-up approach. The original purpose was to protect the waves and the surfers' access to those waves, but just the recreational aspect of surfing would not

have been enough to declare the area protected, so the elkhorn coral was used as the primary reason.
The protection of the watershed area and special zoning were neglected in the development but are a major threat to the area.
The challenge is to get but, more importantly, to keep the public involved in the process. It's hard to get people to do more then they usually do.
The challenges in development were the special interest groups and the landowners because they felt it would put limits on the use of private property.

- **Management**
  Environmental Regulations are bypassed by money and government influence; there are "mafia-type" relations.
  The local communities defend their own backyard resources, but it takes a lot of money to challenge decisions in court; "it's a war".
  Sedimentation is not being controlled because of corrupt permitting process. Laws for land development permits need to be stricter about controlling sedimentation inland and around the whole island. The rivers throughout Puerto Rico are pumping much sedimentation out into the ocean.
  Need to understand the long-term, and need more education than a fisher has.
  Watershed area needs to be zoned for keeping sedimentation to a minimum. The DNER needs to establish sedimentation ponds throughout the whole island.
  Government needs to promote traditional agriculture because the current agricultural practices are increasing sedimentation.
  Politicians do not understand the coral reef problem because they have too many other issues to deal with. The only thing that motivates them to support conserving the reefs is votes.

**Participants and Roles**

Environmental Defense (Ken Lindeman)
Surfrider Foundation (Chad Nelson, Leon Richter)
Town of Rincón – Holds community outreach programs and meetings.
Politicians – Good idea for them to support the marine reserve because it is a paper
reserve and costs them nothing.
Carlos Gaston – He lives in Rincón and is very environmentally involved. His role with
Tres Palmas Marine Reserve is to propose ideas for the overall management plan with emphasis on watershed zoning areas.

**Group Interactions**

There are two associations of fishers in Rincón:

1. The human interest fishers are true and dedicated to preserving marine resources for future generations.

2. The special interest fishers are married to the guy that buys fish from them and to the politicians, and are only thinking about what is best for them now.

Gaston has a good relationship with the human interest fishers, but has many disagreements with the special interest fishers. The special interest fishers threatened the establishment of the reserve by not agreeing with the original coordinates because they were concerned that it was too close to the marina.

**MPA**

- **Management Plan**

Management plan has to include the whole watershed area in a special zoning regulation. It also needs to outline plans to study and monitor the area continuously to record progress.

The management plan will force watershed zoning and open the road for special zoning areas.

Gaston thinks that the management plan will be finished by the end of the year, and he will be in communication with Dr. Valdés-Pizzini about it.

- **Co-Management**

Co-management is important and useful in Tres Palmas because it involves the community. The input from the local people is used in the development of the official management plan for the area.

- **Enforcement**

Gaston is actively stopping development in the Tres Palmas area by discovering illegal permits.

- **Biological Impact**

Tres Palmas is the only reserve dedicated to preserving elkhorn coral, and the coral there is healthy. Too early to determine biological impact being recently designated a marine reserve.

The Zoning now is not detrimental to the ecology; the bad effect that can happen is runoff and sedimentation from the land.

To be able to see imminent habitat destruction it takes scientific knowledge.

- **Public Participation**

As people gain knowledge, they gain resources.

There has been public support since the start and there is much public desire for the marine reserve.

**Social Implications**

There are no MPA due to "traditional ecological knowledge", there needs to be scientific research. Scientific research can detect the destruction right away as it is occurring, TEK can only detect destruction after everything is destroyed – not as dependable.

**MPA Appropriate Tool?**

It's the only way.

**Future of MPA**

In order to have successful MPA, restoration efforts need to return the resources to their maximum potential. It is not a local issue; the efforts need to go

to the center of Puerto Rico to stop the sedimentation. Success does not depend solely on the inside of the reserve.

MPA are necessary and Gaston is in favor of them.

Hopeful for more, but in order for Puerto Rico to have more MPA the agencies would need a lot of force and convincing.

**Recommendations**

MPA should be implemented in an area where there is a resource in need and in an area where the variables can be controlled.

**Other**

If Gaston had a magic wand, he would take out all the politicians and replace them with teachers.

## *Section 8: Interview Summary – Ruperto Chaparro*

**Date:** April 12, 2005
**Location:** Sea Grant Office, UPR Mayaguez
**Conducted by:** Martin Driggs

**Name:** Ruperto Chaparro
**Agency:** Sea Grant
**Representative of (actor groups):** Researcher, Facilitator
**Sites familiar with:** All
**Sites experience with:** Tres Palmas, Luis Peña, and La Parguera
**Years experience working on marine reserves:** 15 years
**Other background:**

**The Process**

Tres Palmas – Sea Grant worked with Surfrider Foundation from the initial efforts and after an approximate 3 year process, Tres Palmas was declared a protected area in 2004.

In establishing an MPA there are many political factors, conflicts, and gaps that need to be filled. For the MPA to do well there needs to be conflict resolution and education of all parties involved.

**Hurdles in Process**

- **Development**

Luis Peña – There were 3 different written proposals for marine reserves because the location and area could not be agreed upon. After 3-4 years, the fishers' proposal was accepted and Luis Peña was established because the fishers did not fish in that area.

Parguera – This area is still not completed or declared as a marine reserve. Sea Grant joined the cause in the middle of negotiations with the fishers over their fishing area.

The main challenge in development of MPA is selecting an area for the benefit it can offer to fisheries. Need to establish MPA where a resource is in

need and can benefit from protection; it is pointless to establish an MPA just for the sake of having another MPA.

- **Management**

It is not the marine reserves that need to be managed, the people should be managed through education and enforcement of laws.

The challenge is to maintain credibility that has already been established

Tres Palmas – There is no management or enforcement, the area is a "paper reserve".

**Participants and Roles**

Sea Grant – Their role is to promote the benefits of MPA by offering information to stakeholders and by trying to facilitate the efforts. (Example: Surfrider is the primary agency in charge of Tres Palmas, but Sea Grant coordinates meetings, promotes outreach, and supplies information to the public.)

Fishers Association

Researchers

NGOs

- Surfrider Foundation: Tres Palmas
- Coralations: Luis Peña

DNER

National Marine Fisheries Service (NMFS)

Municipal Government

- The *resource management agencies* have a sincere intention of MPA. They understand the problems and want more for the health of the resources and coral reefs.
- The *politicians* are motivated to conserve the resources as a means of getting votes. They do not understand the problems but they understand that people support conservation and there will be votes if the politicians show support.

**Group Interactions**

The various actor groups know each other well. Each group knows who to talk to, what the other groups' views and opinions are, and who they will need to convince to support their cause. Managers and users do not communicate well and leads to gaps in knowledge.

Sea Grant deals mostly with fishers and recreational users, and sometimes with developers. Sea Grant cannot take sides on conservation issues; they have to offer their information to everyone that requests it. The agency tries to remain neutral but tends to lean a little towards conservation.

Sea Grant has been working with resource users for more than 25 years and has gained their trust. Most resource users have faith that when Sea Grant pushes for something it must be a good cause.

Fishers take priority in Sea Grant's efforts. Researchers know a lot of theory, but more practically fishers know what is going on in the area. Agents of Sea Grant visit fishers' meetings regularly. When fishers have a problem they call Sea Grant, and when it is time to do research, Sea Grant relays the fishers' concerns to the scientists and researchers. Traditional Ecological Knowledge

(TEK) is part of Sea Grant's method of applied research, or research directed to solve a problem. They gather the TEK and then transfer that knowledge to the researchers to come up with a more complete solution to the problem.

There is tension between the fishers and the other stakeholders because the fishers are the only ones getting restricted from extracting fish and making a living. If politicians see that the fishers are in opposition of the MPA, then the politicians will not support the initiative.

**MPA**

- **Management Plan**

The government (DNER) needs to approve it before it becomes official.

The challenges of developing and implementing a management plan are enforcing the laws and educating the public.

Tres Palmas – A management plan is presently being constructed. When it is written it has to be approved and implemented.

Culebra – The management plan is written and in the process of having DNER approve and establish it.

Bajo de Sico – The management plan is administered by NMFS.

- **Co-Management**

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- **Enforcement**

There is not enough money. DNER needs a bigger budget or else cannot manage the areas effectively. A budget needs to be established for each reserve and the rangers need to be educated.

The federal government is more effective than commonwealth at enforcing regulations.

- **Biological Impact**

Luis Peña – Researchers are reporting more fish and healthier corals in the area.

Tres Palmas – This reserve is too new to tell. There has not been enough time to witness progress and there has been no enforcement in the area.

- **Public Participation**

Educating the public will help the people to see the benefits of protecting the area, and will turn into the users doing the enforcing. If people do not know the benefits of the area or what is there, they will have no concern for protection.

**Social Implications**

The social aspects are more specifically related to fishers because other user groups are recreational users. They don't have as big a concern as the fishers with conserving and accessing the area because recreational actions are not extractive.

Fishing charters do not use the marine reserve areas so most of the concern is with artisanal or commercial fishers. Developers and marina operators worry about the reserves, but not a big concern to researchers and managers of the areas.

**MPA Appropriate Tool?**

MPA should include the surrounding land area as well as the coast and ocean.

Every conservation effort is good. Establishment of an MPA makes people see that there is something important and worth conserving in that area. Need to promote natural attractions.

MPA is a great educational tool.

**Future of MPA**

There will be more and hopefully they will increase in size. Hopefully there will be bigger and more plentiful fish so people will be convinced of the effectiveness of MPA.

**Recommendations**

Need to start with a small area to try to control because cannot get results as easily or as quickly with a bigger area. If it is shown that the smaller area is working and improving, then can start expanding it.

**Other**

If Chaparro had a magic wand he would change the politics of management because right now the management is controlled by politicians. He would change people so that they would want to do the right things.

## *Section 9: Interview Summary – Richard Appeldoorn*

**Date:** April 9, 2005
**Location:** Telephone Interview
**Conducted By:** Martin Driggs

**Name:** Richard Appeldoorn
**Agency:** UPRM
**Representative of (actor groups):** Researcher
**Sites familiar with:** All but Parguera
**Sites experience with:** -----
**Years experience working on marine reserves:** 13
**Other background:** Almost 25 working in Marine Science

**The Process**

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**Hurdles in Process**

- **Development**

The big problem is a lack of time and money to set up communications between stakeholders and legal authority. There is a lack of available personnel from the government that would be necessary to go community by community and talk to people. If the government focuses on doing this then other communities will be left out. The community needs to be educated about the benefits of reserves before they will develop an appreciation for it.

Spanish culture and government structure of Puerto Rico is different from the USA, so different approaches are needed. In the USA there exist very large industrial fleets and very large and powerful anti-MPA fishers. Most fishers here very supportive or neutral, leading to much less opposition. Due to fisher support, a smaller population, etc… there are fewer hurdles to overcome in Puerto Rico than in the USA.

- **Management**

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**Participants and Roles**

Government - They have a very strong interest in the reefs but problems such as a lack of

coordination between the legislature and the DNER and the lack of available funds hinders MPA development. They are getting money now specifically for coral reef conservation, so there is more motivation and enthusiasm in pursuit of this goal. They are only now reaching a level where they can start looking at an ecosystem approach.

NGOs like the Nature Conservancy in Puerto Rico - There is very little support from

these large-scale agencies, but a growing interest from them is making the MPA movement gain momentum.

**Group Interactions**

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**MPA**

- **Management Plan**

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- **Co-Management**

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- **Enforcement**

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- **Biological Impact**

The ecosystems approach is not employed at all, though it is starting to get some attention finally. There has been recent talk of critical habitats and linkages. If an ecosystem approach is going to work, people need to give up some aspects of single-species management, people are unwilling to start over from scratch, but that is what needs to be done in order to develop concepts and attitudes needed for the ecosystem approach.

The CFMC started to put together ecosystem plan in 80s**.** They wrote a background document for it but were told that Appeldoorn thinks the NMFS should go back to looking at single species fisheries management. For more information on this ask Miguel Rolón.

Tres Palmas is trying to protect the land through the marine reserve, rather than just protecting the land directly.

- **Public Participation**

The best way to manage marine resources is through participatory management.

**Social Implications**

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**MPA Appropriate Tool?**

There was little to no resource management before MPA. There was some fishery management but that did not work very well. The best way to manage resources is closures. Currently the question of purpose is largely unasked before MPA creation, which means it is hard to decide if it is the most appropriate way to accomplish the purpose.

**Future of MPA**

MPA have a pretty good future, there is a lot of interest.

The ecosystem approach will be much more integrated into management in the next 10 years. Marine reserves are necessary for an ecosystem approach because free from human interaction, it is the only way to measure effectiveness. Bottom-up and top-down movements both will cause the shift to an ecosystem approach. There are a number of gaps in knowledge that need to be filled. An awareness of what laws are available to be utilized and what holes they have is very important. Maps of areas gives an inventory of what resources we have, which is crucial, and locations of spawning aggregation sites need to better identified to better protect fish stocks.

As technology improves, things will have better coverage and be more cost effective.

**Recommendations**

If Appeldoorn had a magic wand, he thinks that we need to start to develop the process for community based management plan where the whole community manages the entire reserve.

All groups need to communicate and work together more efficiently.

**Other:**

Ask Manolo Valdés about a draft of Appeldoorn's ecosystem approach paper.

People to talk to: Reni García, Ken Lindeman, Jose Rivera – contract worker for NMFS involved in fisheries issues but gone for the month

Look for report by NGO, King Foundation(Appeldoorn not sure of the name) – developed by Ken Stumps, about 9-10 months old, contact Stumps directly for the report.

## *Section 10: Interview Summary – Lourdes Feliciano*

**Date:** April 15, 2005
**Location:** Hardware store in Culebra
**Conducted by:** Elliot Miller

**Name:** Lourdes Feliciano
**Agency:** Fisher Association
**Representative of (actor groups):** local business owner
**Sites familiar with:** Luis Peña Marine Reserve
**Sites experienced with:** Luis Peña Marine Reserve

**Years of experience working on marine reserves:** 25 years, since 1980
**Other background:** Secretary of the Fisher Association (1979), Director of the Tourism
Company for the Municipality of Culebra

**The Process**

The fisher association proposed the idea an MPA since the 1980's. They felt that if nothing were done then, the marine resources would deplete within decades. Most of the fish being caught are not by the native fishers but by the fishers from other islands such as, Dominican Republic, Rio Grande, Luquillo, and mostly from Vieques. The Fisher Association has been concerned that some of the fish caught in Culebra were being sold in San Juan for $35 a bucket and could possibly be sold in other parts of the main island. These concerns led the Fisher Association to make initiatives for a marine reserve in Culebra.

They planned meetings with the native fishers but they did not like to attend the meetings. Therefore, the director of the Fisher Association and Feliciano visited the bars, restaurants, and other places where the fishers would usually go. Dr. Vicente, who had information pertaining to the area of the marine reserve, was also invited to these occasions.

They designated the channel between Luis Peña and Culebra as the marine reserve because it contains many important resources such as, corals, sea grass, fish, conch, and turtles. Most fishers of Culebra do not fish in this area. This site was most appropriate and desirable because it did not affect the native fishers, it has many important resources, and it is protected from the hurricanes. The Fisher Association held a meeting with 132 people of Culebra, consisting of mostly fishers and some residents and they all agreed to have the proposed area protected.

Sometimes community needs to stern with the legal authorities in order to acknowledge their views and concerns. It took 20 years for the government to acknowledge their desire for a marine reserve. The community had turned to the newspapers and television to spread their concerns and ideas for a marine reserve. There has been no account of a fishing community that wanted to establish a no fishing area.

Currently, the Fisher Association is working with DNER, the mayor, and the Conservation and Development of Culebra to create the management plan for the Luis Peña Marine Reserve. They are contributing the pros and cons of the management plan.

The marine reserve is a start for the protection of its resources. They originally proposed to set up nine MPA. This is too much and they need to concentrate on one area before they can manage nine.

They worked with Teresa Talevez, the manager of the Fish and Wildlife Service to plant mangroves but the area they planted the mangroves is visited by a lot of big boats, jet skis, and other equipment that harm the resources. Even though they are not establishing more MPA now, they will regulate other marine

areas nearby. The resources are not just harmed by the boats and fishers but also harmed by construction.

People should know who they are and what they want. If they know these things, they will appreciate the island more and take care of it.

**Hurdles in Process**

- **Development**

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- **Management**

The DNR needs to define the maritime zone in order to complete the management plan.

People from the main island still come to the reserve to fish. There is no enforcement because there are no boats or motors for patrolling because they do not have money for equipment.

Conservation and Development was transferred to the municipality by the ex mayor. The new mayor says that Conservation and Development is not part of the municipality. The money was in the municipality and they ask for the money from the Conservation and Development. Now, this problem is settled and money is being transferred to Conservation and Development.

**Participants and Roles**

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**Group Interactions**

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**MPA**

- **Management Plan**

The management plan was supposed to be completed last December and now the projected deadline is this December. There are currently identifying the problems in the area. There are new committee members. The people who make the final decisions are the Fisher Association, Conservation and Development, DNR, NOAA, and the mayor.

They are not many buoys set up and there needs to be more of them for moorings. There also needs to be buoys for zoning out the area for different types of uses because some areas are so shallow that the people who snorkel harm the reefs more than they intend to. This will be part of the management plan.

- **Co-Management**

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- **Enforcement**

There is no enforcement because there are no boats or motors for patrolling. They rely on the community and visitors to abide by the restrictions.

The DNR creates more laws but are not enforcing their laws. They are concerned about different species but are not enforcing the regulations.

The court process is very slow for anyone who caught fishing in the reserve. Some of the legal cases from five or six years ago still exist. There should be a system similar to speeding tickets. Every boater would carry a license and would receive a fine for any violation within the reserve. There was a man

who was caught fishing in the reserve and no legal action taken upon him. Now, there are people from UPR who are researching the laws and finding faster route to settle cases.

- **Biological Impact**

Based on information from Mr. Feliciano and Edwin, they found white grouper that weighed approximately 50-70 lb, lobster, and more fish.
Threats:

A group of engineers will be coming in May to find explosives in the reserve left behind by the Navy. The reserve has problems of sedimentation and erosion. The U.S. Fish and Wildlife Service and Conservation and Development are looking into the deforestation nearby.

There is a dump from the septic tanks in the middle of the reserve. They are trying to work with the municipality to acquire machines that use the sewage water for irrigation instead of pumping this sewage into the ocean. This would enhance the quality of the water.

The municipality is establishing a new management plan that includes building new hotels near the reserve. This would harm the reserve that the community has worked hard for. The infrastructure of Culebra would never be able to hold such developments.

- **Public Participation**

Education:

They have been using flyers, pamphlets, and posters educating everyone about the development of the reserve. They try to use an approach that is not authoritative by asking them and educating them that if they respect the restrictions, then their actions will help restore the marine area.

Coralations is trying to teach the elders about the reserve but they find it difficult. This organization is also working with children whom they call marine explorers. They teach them about the ocean, its resources, and why it is important to protect the area. They want to teach the kids who will hopefully teach their parents.

**Social Implications**

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**MPA Appropriate Tool?**

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**Future of MPA**

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**Recommendations**

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**Other**

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## *Section 11: Interview Summary - Luz*

**Date:** April 15, 2005

**Location:** El Eden Liquor Store and Café
**Conducted by:** Martin Driggs

**Name:** Luz
**Agency:**
**Representative of (actor groups):** Dive shop owner
**Sites familiar with:** Luis Peña Marine Reserve
**Sites experience with:** Luis Peña Marine Reserve
**Years experience working on marine reserves:** None
**Other background:** She has been to Culebra for 20 years and has permanently lived on
the island for 7 years. She has a degree in Speech Pathology and Clinical Psychology for kids.

**The Process**

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**Hurdles in Process**

- **Development**

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- **Management**

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**Participants and Roles**

Coralations and the Fisher Association are involved with conservation.

**Group Interactions**

The ex-mayor still fishes in the marine reserve and refuses to stop fishing because his family has been fishing there for generations.

There is no motivation from the government to conserve the marine resources.

The management is missing a person like Edwin Hernández. Edwin is the type of person who gives his heart to his work.

**MPA**

- **Management Plan**

  The language and structure of the master plan is complex. It consists of three large books. If a speech pathologist finds it hard to read, it will be more difficult for the rest of the community to read it. If the community is unable to understand the material, it will be difficult for them to participate in its management. Also, the book is only in one language. They said it would be too much trouble to translate it.

- **Co-Management**

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- **Enforcement**

  Fishers from Vieques like to fish in Culebra because the fish near their island are not as big and populous as Culebra. They find plentiful fish in the reserve area and since there is not patrol, they fish in the reserve.

Culebra is a small town of approximately 2000 people and everyone knows each other. Seventy-five percent of the population is related to each other. If a local catches someone fishing inside the reserve, the person is not going to say anything. The community of Culebra will not enforce the regulations because it is not their custom. There should be people from outside the island to patrol the area and enforce the regulations.

- **Biological Impact**

It is surprising that with a little effort, the sea life has been growing beautifully.

- **Public Participation**

Education:

There needs to be a budget to educate the people. If they do not know an area is designated a marine reserve, people will violate the regulations.

Most people would accept the restrictions of a marine reserve if they know that there is one. However, most people do not know. When customers come to her dive shop, 95% percent of them do not know that there is a marine reserve near Luis Peña and directs them to where it is located.

There should be a sign about the reserve at the dock and airport since most of the visitors come on the island from these locations.

Found a full-page ad to "Protect Culebra." The pictures of coral and the island in the ad were not related to Culebra itself. The coral is actually found in the Pacific. They had a manatee in the ad but manatees do not live near Culebra. It would be more helpful if they advertised where the marine reserve is. She sent a friendly email to advertisers and gave them pictures they could use for their advertisement but she never got a response.

**Social Implications**

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**MPA Appropriate Tool?**

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**Future of MPA**

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**Recommendations**

There are fishers who fish just outside of the boundary. There should be a buffer boundary so that the fishers do not fish slightly outside the boundary but further away from it.

There should be a huge grant in the hands of person like Edwin that will start the program with politically goodwill.

They never seek to talk to the people and ask why they fish in the reserve. If they did this, then maybe they can convince them not to fish or it will give them ideas of how to stop them from fishing.

**Other**

When she was younger, she saw men who were taking the sand from the beach to their truck. She reported it to the DNER but they did not express any interest. She late found out from a friend that it was a policeman removing the sand and his son is a vigilante. No one felt that it was a major concern. In another instance, she went to collect sand to shield the overflowing septic tank but she was scolded for it. Even though her intention was to protect the children from the mosquitoes, she was told that it was wrong.

## *Section 12: Interview Summary – Mary Anne Lucking*

**Date:** April 15, 2005
**Location:** Culebra
**Conducted by:** Martin Driggs

**Name:** Mary Ann Lucking
**Agency:** Coralations
**Representative of:** Researcher, NGO
**Sites familiar with:** Luis Peña
**Sites experience with:** Luis Peña
**Years experience working with Marine Reserves:**
**Other Background:**

Bachelor of Zoology, Pharmacology, Forensic and Environmental Toxicology

Member of Coralations

**Process**

When they came to Culebra, they recognized failures in the fishery management, which was duplicating the U.S. schemes, and failing. There are problems with traditional fisheries management, when a single species is focused on, or with seasonal closures. She doubts the validity of data collected to create such regulations. Further, the top-down nature of the efforts are self-defeating. Balances fishery management involves too much education and too much enforcement. There is a greater chance in maintaining an area as a whole.

Coralations learned that the fishermen proposed a No-Take Zone to the DNER in 1981, and have been fighting to get it approved. Coralations helped get things going. In 1998, the DNER wanted more public education, so Coralations arranged for the construction of habitat touch tanks. The tanks allowed all to be reached, even those scared of the underwater environment. The tanks were donated to Vieques.

Coralations has a history of lawsuits against illegal development. In one case hey found inconsistencies in document numbers that revealed the fact that some building permits did not go though the Planning Board. These developments were in pristine areas, near habitats of 3 endangered species. They successfully sued to stop the development, and are now suing for reparations (for sedimentation), which would be a precedent-setting event.

In 1995/6 Coralations was looking for mooring buoys as a means of protecting the reefs. They found that the DNER had a mooring buoy program for 10 years. They had been diverting funds to a mooring buoy program and produced no mooring buoys by 1995. Coralations offered to establish the buoys, but the DNER claimed exclusive rights to give mooring buoy permits. They finally reached an agreement whereas the DNER would have the buoys installed while Coralations worked with public education. The bombs had to be cleared before the buoys could be installed. At first the Navy was going to charge to remove the bombs, but are now in an agreement with DNER to remove them.

In 1999, the Luis Peña Reserve was finally declared. When it was finally established, demarcation buoys had to be set up. Coralations produced the educational materials and signage to supplement the "No" signs. Restrictions in the name of nature conservation have a sordid past here. Areas contaminated with unexploded ordinance have been declared the strictest of wilderness reserves in order to avoid the problems with locating and removing the munitions. Vieques was split up so that half of it was a wilderness reserve, and half was bomb-testing grounds. Conservation has always meant "restriction, no, restriction, no." Coralations is trying to shift that connotation to "Mi orgullo, yes, mi orgullo, yes." – translated: "This is my pride, this is my heritage, I want to protect it."

**Hurdles in Process**

- **Development**

  She was working on educational posters, which included a map of the reserve. The DNER ended up installing the buoys way outside the agreed line, making the reserve larger. This was the FIRST VIOLATION OF TRUST. When asked about the error, the DNER said, "We kinda drifted." They did not understand that the point of the reserve is to have it with the community.

  They learned from Sea Grant, from Parguera, that you have to involve everyone. In Parguera, one of four Fishing Associations was left out, and they halted the establishment of the reserve.

- **Management**

  They realized that they needed a management plan and Edwin proposed one through ACDeC. There were political ramifications to this action, of attempting to establish the plan through this local and controversial satellite of the DNER and not the main agency. When Edwin the DNER that the demarcation buoys had been torn out by storms, and that the DNER had been sitting on buoys for 6 months, they were offended and fired him. Edwin had 10 years experience in Culebra and had gained the trust of the people. He was replaced by hired researchers, Estudios Tecnicos. Edwin had completed most of the significant technical work for the reserve.

  In a SECOND VIOLATION OF TRUST a DNR vigilante was caught fishing inside the reserve. He was subsequently moved to the port authority. The DNR Secretary released the story to the press, reinforcing everyone's views that "this reserve is never going to work."

Respect for the reserve is declining.
There is a rift between Coralations and the DNER.
A lesson: a regulating agency has to have a local community standing.

**Participants and Roles**

Coralations – This non-profit, non-government organization was started by Mary Anne in San Juan in 1995. Its primary purpose is public education. They are also attempting to bridge the gap between the DNER and the Fishing Association. They defeated the construction of a primary waste treatment plant proposed 30 years after the Clean Water Act, "just by asking questions.

NOAA – They are committed to getting the management plan done, but are still not listening to the community.

DNR – The same is true. They view the fishers as enemies, liars. There needs to be a true collaboration with the people. In addition, even without this, there is still no adequate enforcement. The purpose if the DNR is to protect the resources, but they are set up to sell the resources. They are set up for development. The regional DNR office gives permits to clear land before it goes through the planning board, in preparation for construction. This is done without scientific review or community notice. In addition to fast-tracking, the process favors development over protection. The system is not set up to evaluate the ecological impact of land use. Land is cleared before it is approved. The evaluations are made once the whole project is known, after the initial work. The damage is already done (sedimentation, deforestation). If the environmental violations are exposed, permits and extensions are still quickly obtained. The "permisos simples" is completely separate of everything else.

Sea Grant – has helped, realizing that the process is sociological before it is biological.

The Fishing Association – they got things going and make up the working group. They aid in education and putting out materials endorsing them with their logo, giving the materials local standing.

ACDeC – having problems functioning as envisioned, and still does not have autonomy.

Municipal Government

**Group Interactions**

The Fisher Association was somewhat feared, and known as an important group that Coralations had to have on their side. She started to talk to them and formed a relationship. They had similar ideas about conservation.

There is a conflict between ACDeC and the municipal government, over who will be the regulating body.

DNR does not appreciate or use the knowledge of the fishermen.

**MPA**

The purpose of Luis Peña is to replenish fish stocks and to protect and restore the corals. It still has a chance, but has a chance of loosing its funding because of a lack of management plan by a deadline. It may not matter because of the water quality degradation caused by sedimentation.

- **Management Plan**

The proposed plan went through ACDeC. There have been conflicts and politics, and the process is currently being stalled. NOAA is concerned and focused on the deadline rather than the quality of the product.

- **Co-management**

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- **Enforcement**

No boat. There is a problem with local Vigilantes. They live in the community where they have to enforce. (Familiarity breeds contempt.) The community must demand that these people start doing their jobs. They have an arbitrary method of enforcement, favoring those with power and money. Further, they are not totally educated as to their jurisdiction.

- **Biological impact**

Biological systems are continually being fragmented, especially by deforestation and effects on watershed. The ecosystem approach must be taken into consideration in all management efforts.

There are more fish since the reserve. However, continued water quality degradation is adversely affecting the area. Without a management plan in place that will encompass water quality problems, the reserve is not going to work. Rather than just monitoring water quality and effects, real time regulations are needed.

- **Public Participation**

At a community meeting, NOAA did not recognize the importance of sincere community contribution. They did not listen to the people, only instructed them. The people should help in identifying problems and potential solutions. The importance of a community-based management plan must be realized and implemented.

The population is very complicated (Culebrensis, Gringos, Off-island Puerto Ricans, and many divisions within them). There are many different fractions within the community that believe different things. The groups must be identified and representative contacts must be made. All the groups need to be identified and engaged based on their objectives, above all else.

As the resources go, the people of the island will go. The ecosystems are being systematically fractioned, and some of the people are being employed in the process. The MPA is important to the people, but not all of them realize it yet.

**Social Implications**

The social demographics of an area might be more important than the biological aspects.

**Is MPA Appropriate Tool?**

Yes, but it must include solutions to land-based effects.

**Future of MPA**

DNR just produced a proposal without any community input. If they can get funding to conduct more interviews with the community, with Edwin, when the final product is produced, they can present what the community says. If DNRR accepts it, the people will have a plan they feel ownership over.

The violations in trust are destroying the reserve, and the press coverage of the vigilante incident just compounded things. At first the people we enthusiastic and happy about the reserve, but now they seem to be letting go of it.

As for the future of MPA in Puerto Rico in general, it might not matter. Water quality is continuing to decline and reef degradation is at "Jamaica levels." In Culebra, with the new mayor, development is back on the rise. Everyone wants a piece of the pie.

**Recommendations**

They need a reasonable extension on the grant for Luis Peña.

NOAA needs to understand what meaningful communication with the community means, and that someone trusted by the community needs to solicit that information.

There needs to be a holistic approach. She suggests a "series of small no-take areas connected by current."

The management must have funding sources that realize the political sensitivity of the project, that conflicts may occur that will hold up the process.

**Other**

Documents Received:

None, but hoping to receive documents related to her lawsuits, the 6 DNER violations of trust, a summary of lessons learned in Culebra, and information the fast-tracking process.

People to see:

Sequito at the Empanadilla Shop and Jess Rodrigues from Inter-American University, on Sedimentation (check with Manolo)

## *Section 13: Interview Summary – Ramon Feliciano and Taso Soto*

**Date:** April 16, 2005
**Location:** Fisher Association in Culebra
**Conducted By:** Elliot Miller

**Names:** Ramon Feliciano and Taso Soto
**Agency:** Fish Association
**Representative of (actor groups):** Fishers
**Sites familiar with:** Luis Peña
**Sites experience with:** Luis Peña
**Years experience working on marine reserves:**
**Other background:** Feliciano – Mayor 1950-1980, Soto – President of Fisher Association

**The Process**

Fishers wanted to protect fish stocks because they saw a drastic decline due to off- island fishers so the idea of creating a marine reserve was proposed. Fishers wanted to protect 10 different areas, but decided to focus on just one to start. Luis Peña was chosen because it was deemed the area that was the most important and the most at risk. It used to be rich in marine life, but was extremely overfished. It was no longer profitable to fish there, so no one would object to the reserve.

Stocks of fish all around Culebra are depleted so most fishers have switched to construction and government jobs because fishing is no longer profitable. Only about 50-60 fishers are left including those from off-island.

**Hurdles in Process**

The government changes every 4 years, which means that they have to be reeducated and essentially start over every 4 years, which makes the process take a lot longer.

- **Development**

  Information needs to be put in terms that normal people understand, not using a lot of complex language and technical data.

  Commonwealth agencies were not very interested in creating a reserve in Culebra; they had to be convinced of the benefit and the public support that existed for it.

  Politics need to be kept out of marine reserve development. The last mayor of Culebra wanted control over everything and because of this he frustrated people.

- **Management**

  Gaining funding for the development of the management plan and maintenance and enforcement of the area was, and still is, difficult.

**Participants and Roles**

DNER

Fisher Association – considered the 'working group' on the reserve. They keep an eye

on the reserve and help follow boat movements within to see where boats entering the reserve are coming from and what they do there and report violations to the proper authorities. The Fish Association is involved with the Coralations coral farming program.

Coralations – has a coral farming program and promotes outreach to the public.

**Group Interactions**

The DNER is not working very well with the community at this point at all. Soto and Feliciano feel that TEK *is* taken into account by DNER in development of MPA and its management plan when they are forced to.

There used to be two groups, one that was interested in reserve and one that was not. Now for the most part, they are unified behind the support of the reserve.

**MPA**

Purpose: to protect and revitalize marine life

- **Management Plan**

For the near future the management plan is in the hands of the DNER. Soto and Feliciano would like to have more community involvement with the management plan.

- **Co-Management**

Fishermen convinced the Fish and Wildlife Service to allow the bay to be used as a reserve. The Fisher Association wants to try to hold the coast free from development so it can remain public lands and thus make it easier to continue to expand and establish future MPA.

- **Enforcement**

There is no enforcement at all right now; more funding is needed for boats, equipment, personnel, etc…

- **Biological Impact**

Sedimentation and erosion are one of the biggest threats, especially with permit process being so indifferent to environmental concerns. Soto and Feliciano are not sure of how successful the biological goals are as they cannot fish there so cannot sample, this is the job of biologists.

The fish are coming back. It is rumored that Grouper have been spotted, which have not been seen there in a very long time.

- **Public Participation**

There is currently a lot of public support, because no benefits are gained from the channel not being a reserve and a lot of value is gained when it is.

**Social Implications**

Though not significant in the case of Luis Peña reserve, when establishing MPA, it is important to remember that fishers need to feed their families and opportunities need to be provided for displaced fishers.

Overall the reserve increases happiness through a tourism boom, coral reef restoration, etc… This is enhanced by the fact that the area is not used for fishing so there is no displeasure due to displaced fishers

There was no benefit from the area before, because the reef was already seriously degraded from the navy bombing, with the reserve, people benefit from a boost in tourism.

Fishers benefit from fishing on the borders of the reserve

**MPA Appropriate Tool?**

The biggest threat is from off-island fishers, people traveling from other islands to fish in Culebra are causing most of the damage from overfishing. Strict enforcement is needed in the reserve to protect from this threat and an MPA is a good tool to use for this purpose

**Future of MPA**

It is the intent of the Culebran community, especially the Fisher Association, that reserves be created all around the island to protect the coasts and save what is left of the reefs. Culebra needs to make itself ready to encourage tourism so that this industry can flourish unhindered. Tourist services such as lodging, transportation, etc… need to be evolved without Culebra losing its attraction as a small, undeveloped island. Off-island wildlife should be brought in, creating more interest in the island for tourists.

There are not many gaps in knowledge that need to be filled. The lack of communication with federal agencies and their tendency to leave fishers outside of the process of MPA development and management should be dealt with in the near future though. If everyone works together the reserve should be a permanent success.

In the future the hope is to continue farming coral. It is important for Culebrans to know what they want.

**Recommendations**

School curriculums should not just educate about the biology of the reef, but also encourage ecological awareness.

Magic Wand Question: Both Soto and Feliciano agree that it is important that Culebrans adopt an altruistic attitude, an understanding of what is best for Culebra.

Politics need to be kept out of marine reserve development.

**Other**

Battle with the Navy

- Press and television was utilized to make Americans aware of the bombing.
- Taso Soto was president of the Rescue Committee on Culebra, which pushed for the cessation of bombing on the island.
- The navy left Culebra in 1975 and went to Vieques. They left Vieques in 1999 or 2000
- There are over 10,000 pieces of live ammunition left around Culebra, but much of it has coral and other sea life growing on or around it, so there is no way to remove the ordinance without destroying the coral.

Edwin and Coralations started coral farming using funding from the community, Toyota, the legislature and NOAA

Fish farming for Snapper was created with contracts in Florida and New York to help take fishing pressures off the coast.

A new law requiring children over 13 to have fishing license will soon come into effect and fishers on Culebra are very supportive.

## *Section 14: Interview Summary – Fernando Silva*

**Date:** April 20, 2005
**Location:** Conservation Trust
**Conducted by:** Elliot Miller

**Name:** Fernando Silva
**Agency:** Conservation Trust
**Representative of (actor groups):** NGO
**Sites familiar with:** Hacienda La Esperanza
**Sites experience with** Hacienda La Esperanza
**Years experience working on <u>nature</u> reserves:**

**Other background:**

His first formal experience with conservation was in high school. With the help of some scientists, he founded a group called Auxiliary Scientist Corp. It was a voluntary group that had no knowledge or background in environmental science. This group would assist the researchers of DNER in their projects that had conservation implications. This type of project is called citizen science. His interest is to build a bridge between social science and environmental science.

**His experience with conservation and social interactions:**

In the time of famous case of Rodney King, an African American man who was beaten by a group of police officers, much of the African American community of Los Angeles was frustrated with the not guilty verdict. In order to make amends, the Forest Service received money from the government to organize an environmental project that would include social and economic objectives. Through reforestation, different gangs would plant trees for the ones who died and this project was a means of creating a truce between the gangs.

Another project involved creating a community garden. This garden was created by people from different ethnic backgrounds that never had the chance or had a reason to interact with people other than their own race. This project allowed these people to collaborate with other races and share their knowledge.

He later worked for the DNER in their Forest Stewardship Program. He assisted private landowners with resource management plans for conservation. Then, he worked at the Conservation Trust as a property manager. He coordinated research, conservational activities, educational activities, and interpretation programs.

**Best way to manage natural resources:**

Managers need to understand the needs of the resource to exist and the needs of those who will benefit from the resource. All resources are managed to benefit people.

**Conservation Trust sites**

Conservation Trust owns 17 sites. Each site is meant to preserve its own valuable features. Some of them are known for their unique landscape. Others are valuable for its ecosystems and history. For example, La Parguera is unique because of its bioluminescent bays and La Esperanza is known for its historical sugarcane fields.

The public can visit any of the Conservation Trust sites but three of them have formal visitor centers. For all the other sites, they have requests for research and organize natural encounters for the members of Amigos.

One project that is in development is in La Parguera. There are remains of a salt operation and they want restore it for interpretation and education of the ecosystems in the area. There will be a visitor center where the public will learn about the site's history, salt-producing operator, bioluminescent bays, and other

ecosystems that are present. They are currently developing a conceptual plan for the project.

- **Money**

Originally, the Trust received money from a rule that involves a complex calculation from the Department of Interior. From this money, they established an endowment fund with the Financial Institution of Commission in Puerto Rico. They take out loans and invest it into the financial markets with the help of market advisors. They keep these profits for their projects or invest more money. They also receive a percentage of the taxes that the U.S. pays for rum.

**Participants and Roles**

Generally, Conservation Trust manages itself. Sometimes the Trust collaborates with DNER but DNER has limited capabilities to actively participate with the Trust.

**Public Participation**

The Trust always tries to get the public involved in their projects at some point in its development and management. They have a membership program called Amigos in which members participate in conservation activities. These activities are called natural encounters and are a means of educating the people. They also try to find different opportunities of educating the public about conservation other than having them hear about it.

They try to establish respectable relationships with the people affected by their projects. Usually, the land is an important connection in establishing these relationships. The Trust tries to solve whatever causes a threat to the people and their resources.

**Hurdles in Process**

- **Development & Management**

Conservation is costly. The Trust spends a great deal of money for legal cases. There is supposed to be a buffer zone for protected areas but sometimes there are intensive uses next to the protected area that harm their resources. Anything that would affect their protected areas negatively, they bring to court. They have to protect the area against intentional fires, users, hunting, and land development.

In the DNER, the biologists and ecologists generally do not have proper backgrounds in managing people. For example, there is a law for state forests in which they needs to provide recreational areas and there are people who rely on the resources there. There needs to be experts that understand the needs of the people and the resources.

**Co-Management**

It is not necessary to have co-management. Co-management depends on the needs and interests of the community. Improved relationships with the community will make conservation efforts more effective.

**Ecosystems Approach**

They cannot employ an ecosystems approach without clearly defining the critical ecosystems and dominant functions within the natural area. For example, the lagoons are providing the most valuable natural benefits of the area and are well known for being critical to waterfalls. Therefore, they try to allow the lagoon to receive more water and remove the grass that will increase the forest cover.

**Magic wand wish:**

He wants decision-making entities ranging from the government to the citizens to understand the great concern that Puerto Rico is an island. The size and population requires Puerto Ricans to rethink and develop a new way of consuming our resources. If they do not do this soon and if they continue using their resources and populating at the same rate, Puerto Rico will not be a viable society in a hundred years from now. They need to understand that Puerto Rico is not a continent and that the island will not be growing.

## *Section 15: Interview Summary – Damaris Delgado López*

**Date:** August 21, 2005
**Location:** DNER
**Conducted by:** Martin Driggs

**Name:** Damaris Delgado López
**Agency:** DNER
**Representative of:** Policy Maker
**Sites familiar with:** All except Bajo de Sico
**Sites experienced with:** Luis Peña, La Parguera, and Tres Palmas
**Years experienced working on marine reserves:** 7.5 years as Director of Bureau of
Coastal Reserves
**Other background:** She is involved with the management of the reserves, and is quite
familiar with Luis Peña. She has been involved in designating reserves; she took part in the development of Tres Palmas.

**The Process**

The main way that a proposed reserve gets approved is by the CZM board first preparing a designation document in support of the ecological value for the area. This document is written in English and is submitted to NOAA for approval. If NOAA approves, then the document is translated into Spanish, made more comprehensive, and then submitted to the planning board of Puerto Rico. The planning board holds a public meeting, either decides to approve or reject the proposal, and then notifies NOAA of its decision.

The document for Culebra was approved quickly because the area was all water, no private lands, and the Planning Board was involved from the start.

**Hurdles in Process**

The marine resources are subjected to a lot of sedimentation from construction and the DNER has no control over upland activities. There are efforts to try and control land development to lessen the impact of sedimentation.

In the conservation efforts in Puerto Rico - a very small budget is provided to perform a big task.

- **Development**

  People working on the La Parguera site need to establish priorities. Reni García gathered information on the status of the coral reefs and the marine resources in the area and performed a study that focused on what was there in the area. The present management officer of Parguera has until April 29th to develop priorities from Garcia's report in order to establish working plans for the next six months.

  There are limitations on private lands and the planning board will not designate an area a reserve if it affects private lands. Private lands that will be developed are a risk to the reserve.

  There is some distrust between the communities and the DNER that needs to get resolved. The DNER needs to strengthen the reserves that they already have before proceeding with establishing a new reserve, but they do not have all the necessary resources to strengthen the established areas. If they designate reserves without having all the resources to manage them, then the DNER is not doing their job.

- **Management**

  Trying to zone and order the uses within our marine and nature reserves. There were three zoning studies recently conducted: La Parguera, Luis Peña, and Cordillera. These zoning reports help to manage the resources.

  DNER is planning to put maps of the reserves that show reserve limits, coral reefs, sea grasses, and mangrove locations. They also want to put information centers at the offices of the reserves and try to set up meetings with the local community and stakeholders on what is there. The reserves presently have limited staff due to lack of funds so regular meetings are hard to set up.

  Not all permitting gets submitted to the Bureau of Coastal Reserves department of the DNER before being approved, and so that department has little control over land development.

  The DNER provides guidelines for preparing a management plan, but there is no official procedure.

**Participants and Roles**

DNER – Has jurisdiction over marine reserves, but not always in control of the surrounding land, coast, mountains, etc. Their focus is to promote the development of management plans and to promote the rational use of our marine resources.

Coastal Zone Management (CZM) – Has a committee that deals with the issue of

sedimentation. The committee consists of people from different agencies. They hold meetings and workshops to educate people on what activities affect the coastal zone from the perspective of non-point sources of pollution. They developed, with the help of Dr. Manuel Valdés-Pizzini, a Coastal Training Program to inform decision makers on problems and help them to do their best.

Planning Board – Has authority to zone the land and the water. They are the agency in charge of planning, zoning, and controlling the use of Puerto Rican land. They do not have to report to NOAA before making decisions.

Fisher Associations – They are important because they are the direct users of the resources that are being protected. They are an important player in terms of management. They are very knowledgeable and we can learn a lot from them. From their efforts and initiatives for Luis Peña, it is apparent that they are trying to help.

NOAA

**Group Interactions**

The DNER is trying to develop relationships and work with other agencies to slow land development. They are in the process of trying to get funds to hold and promote public forums, workshops, and meetings where all stakeholders can attend and be updated on new developments, efforts, and recommendations. The secretary of community relations has offered support to the DNER in their conservation efforts.

Special communities are areas that are behind economically, socially, and in need of basic services. The DNER has opened a big door for these special community issues and is helping the committee of special communities. They have problems with squatters in the maritime zones, especially in Parguera. One instance a manager from the DNER went to the area and a squatter showed the manager his gun, and the squatters are known to threaten rangers and staff members.

The DNER gathers the concerns of the local communities through public workshops and meetings, through staff members being accessible at reserve sites, and they accept letters. They try to educate the community and gather support through many types of media publicity, for example the newspapers. Every three years the DNER gets a federal evaluation on its Coastal Zone Management program, and the staff members hold public meetings where everyone can share their concerns.

The Fisher Associations do not like the DNER. There is distrust and reluctance to work together. The fishers do not like to have things imposed on them and they may feel that the DNER is attempting to regulate them. Hopefully someday the DNER can recover their trust because the Fisher Associations are not an enemy of the DNER; they are another stakeholder with valuable input.

Surfrider and the DNER agreed on the designation of Tres Palmas Marine Reserve. Surfrider was the driving force and DNER gave advice and direction.

**MPA**

- **Management Plan**

The procedure is unclear, and there has not been consensus on one method. Management plans provide policy, goals, restrictions on activities and uses, patrolling, and funding. They are a very powerful tool and are useful to the management of reserves, but the planning areas do not have enough people to work on and complete the management plan.

Hobos Bay – After a long, hard process, the planning board approved the management plan proposed by the DNER and the governor of Puerto Rico signed it. Now no one challenges the authority of the reserve because it is supported by the government.

Mona – It is required that a consultant gathers the public's opinions and views for the management plan.

- **Co-Management**

Delicate question and subject with conflicting views.

- **Enforcement**

Vigilantes have limitations due to lack of personnel, pay, vehicles, and knowledge. There can be more patrolling and better enforcement with the help of conservationists, NGOs, and local citizens. Technical staff needs to get the legal authority to patrol and intervene when violations occur.

- **Biological Impact**

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- **Public Participation**

The DNER is trying to promote awareness throughout the community that they have a treasure, the reserve area. Active community involvement is necessary and effective. Public responsibilities should be made clear from the beginning. They can help with patrolling.

**Social Implications**

An important element for conservation is the involvement of the NGOs, stakeholders, and local community. The DNER is moving in this direction of involving all parties; they are trying to improve their relationships and dialogue.

The DNER has not had the resources or personnel to monitor the social effects of MPA. It would be ideal to know the social effects before establishing a reserve, but it is also useful to know in the management.

**MPA Appropriate Tool?**

Marine Resources need to be managed as a whole ecosystem; they cannot be separated from the land. We will never be effective in managing marine resources unless we manage the land as well.

MPA is just a part of conserving marine resources; just designating an area is not enough.

**Future of MPA**

Things will improve and MPA will be more effective. The NGOs and local citizens are promoting outreach and the information is getting to where it needs to be – to the decision makers. It is the pressure from the community and NGOs that will influence the government's decisions. In the long run, people will

be more aware of the importance of MPA and will make better decisions. Hopefully there will be bigger budgets and tools to protect the resources.

It would be great to have more reserves, but that would be increasing responsibility without having adequate power and resources. The help of the public is essential to the prosperity of reserves.

**Recommendations**

There should be a committee comprised of members of the local community at each of the reserve sites that can give insight and recommendations to managers of the area. Community members should volunteer to work with the reserve and even help enforce the regulations.

There should be an administrative order for each reserve site stating that any action affecting or dealing with that particular reserve area must go through the Bureau of Coastal Reserves first so that they can control and manage the area.

All management plans should go through the same process, and if not federally funded then they should be written in Spanish. A brochure or pamphlet should be prepared that summarizes the management plan and be provided to the people, along with a local consultant available for any questions or concerns.

Decision makers need to be knowledgeable of the marine environment and realize the consequences of their actions. They need to make connections between their decisions and the impacts of their decisions on the resources.

All people and groups need to realize that everyone has common goals, and there needs to be commitment from all in order to get the right messages across.

If Damaris had a magic wand, she would make everyone aware of the importance of the environment. If everyone loved their natural resources there would not be a need for MPA because everyone would do their own part to protect the resources.

**Other**

Hobos Bay is being used as a pioneer project; the strategy is copied for other reserves.

## APPENDIX C: Raw Data on Hurdles and Lessons

Throughout the interview sessions, stories, examples and explanations of challenges in MPA development, many ideals, tactics and suggestions were revealed. Here we present an ordered list of these packets of knowledge we received, sorted by the major aspects of resource management.

**Enforcement:**

- The regulating agency (or its representatives) must have local community standing.
- Enforcement must be consistent and uniform.
- The familiarity of enforcers with the users leads to partiality. Rangers must be foreign to the local community and must maintain distance.
- Find out why people are breaking the rules.
- Processing in enforcement must be swift.
- Enforcement should be coordinated with other agencies and the users.
- Increase enforcement of current laws before establishing new ones.
- Make it clear that the regulations are in place not to tell them how to live, but to help them preserve their heritage.
- Enforcers and managers must recover/maintain trust and credibility with the community.

**Education:**

- Demonstrate the benefits of resource management and the reserve.
- People must realize that Puerto Rico is an island.
- Altruism must be promoted.
- Bring common goals to light.
- Enforcers as well as users must be educated.
- Help people realize who they are and what they want
- Empower the users by helping them realize that respecting the restrictions will give them the power to restore the marine resources.
- Teach the children in order to reach the parents.
- Rangers should be educators as well, instructing through personal contact.
- Increase the knowledge transfer between managers, academia, users, and the community.
- Make the environment a high priority.
- Instill trust with the users in order to take advantage of their knowledge, which is great and only fully accessible through trust.
- Once the baseline is discovered, it must be made known so that the people can decide what they are willing to give up to get it back.
- Prove the value of the resource by proving injury.
- Educators and managers must be media savvy.

- Use role models, leaders, and celebrities to reach the population.
- Education is needed for all ages.
- Efforts must exist with realization of differential educational backgrounds.

**Politics:**
- Keep politics out. Marine reserves can not be a power tool. This causes negative feelings to be associated with the effort.
- MPA should not be established as a "cool" thing to do.
- The people must demonstrate the importance of conservation to politicians (through pressure). Managers must facilitate this demonstration.
- Funding sources must realize the political sensitivity involved with establishing a reserve.
- Politicians do not understand the importance of conserving the environment.
- Reserves should be managed by stakeholders, without the intervention of politicians.
- There needs to be a political will to protect marine resources.

**Monitoring:**
- Must learn the background status (baseline), the impact of activities, and the social and economic indicators of reserve effects.
- Must be continuous and long-term. Success is relative to the scale of time.
- The movement of water and species must be monitored.

**Public Participation:**
- The public can bring about changes by asking questions.
- Managers must realize the value of community contribution, not only in the identification of problems and solutions, but also in promoting compliance.
- The individual is the key. Provide opportunities to him/her to participate and form a personal connection with the reserve.
- Get people involved with meetings, conferences, symposiums.
- Good news is needed to prompt support (a cyclic challenge).

**Management:**
- The necessity for co-management depends on the needs and interest of the community.
- Users should be included in planning if they are willing and able. (The DNER must maintain the responsibilities that can not be distributed by law.) The people must be made to see the importance of maintaining those rights and know that it is in their best interest. Both parties should work together, not against each other.
- Management details must be presented in an easily accessible format.

- Managing the whole is simpler, conceptually than managing the parts (ecosystem vs. balanced fishery management), and is more easily understood.
- The management team should include experts with their heart in the cause.
- Move away from single species, towards the systems approach. Identify critical habitats and linkages.
- Establish open communication between parties, between managers and users.
- Should start with a small area and demonstrate the operation and value. Then expand the area with support.
- Address the concerns of private property owners near the managed area.
- Must include watershed areas.
- There are many tools (reserve and regulation types) to use when conserving resources, all of which may be appropriate in different situations.
- Integrate user concerns early on in the process in order to avoid problems later on.
- Interact with NGOs and the community to find and select the best management options.
- New initiatives concerning MPA must be made introduced and made clear; the holistic, ecosystem approach to preservation.
- For fisheries management, the use of an MPA must be combined with traditional techniques in order to protect outside the confines of the reserve and multiple life stages.

**Non-point Damage:**
- Ecological considerations must be made in the land-use permitting process.
- Those with the awareness must change the process.
- Water quality problems must be addressed and measures must be taken.
- Establish sedimentation ponds and other preventative measures.
- Sedimentation is not only a local issue, it is island-wide.

**Social Considerations:**
- Biologists, Ecologists, and other researchers involved in management must also understand the needs of the users. This is imperative and intrinsic to the purpose of resource management.
- Opportunities must be provided for displaced users.
- Resource management is sociological before it is biological
- Social demographics may be a heavier deciding factor than biological
- The divisions within the target populations must be identified and representative contacts must be made.
- Focus management on conflict resolution.

**Miscellaneous:**

- Establish reserves only where the resource and the people will benefit from protection.
- MPA should be established in areas with greatest control over the variables (impacts).